

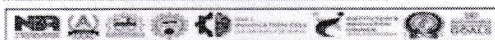


NPR **College of Engineering and Technology**

(AN AUTONOMOUS INSTITUTION)

NBA Accredited (B.E., CSE, ECE, EEE & Mechanical Engg.) | Accredited by NAAC with 'A' Grade
Recognized by UGC under 2 (f) | ISO 9001:2015 Certified | Approved by All India Council for Technical Education, New Delhi
Affiliated to Anna University, Chennai

Natham, Dindigul (Dist.) - 624 401, Tamil Nadu.

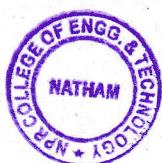


B.E. - MECHANICAL ENGINEERING

REGULATIONS - 2023

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM AND SYLLABUS




Chairperson - Board of Studies,
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I - Department Vision

To develop qualified mechanical engineers to compete with evolving industrial challenges

II - Department Mission

DM1: To impart quality education by best teaching techniques.

DM2: To enhance employability skills through training programs

DM3: To develop alliances with global industries to cognize prevailing technologies

DM4: To provide direction on lifelong learning for constructive career.

III - Program Name: B.E. MECHANICAL ENGINEERING

IV - Program Educational Objectives

Bachelor of Mechanical Engineering curriculum is designed to impart knowledge, skill and attitude on the graduates to

PEO1: Have a successful career in Mechanical Engineering and allied industries.

PEO2: Have expertise in the areas of Design, Thermal, Materials and Manufacturing.

PEO3: Contribute towards technological development through academic research and industrial practices.

PEO4: Practice their profession with good communication, leadership, ethics and social responsibility.

PEO5: Adapt evolving technologies through life-long learning.




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V - Program Outcomes

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design / development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.




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PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

VI - Program Specific Outcomes

At the end of the program students will be able to

PSO1: Apply engineering knowledge in design & analysis tools to solve the real time problems in the areas of structural, thermal and fluid mechanics.

PSO2: Acquire knowledge and undertake or execute projects in the area of modern materials and automobiles.

VII - Mapping of PEOs, POs, and PSO

POs PEOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
PEO1	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√		√					√	√	√
PEO3	√	√	√	√	√	√		√				√	√	√
PEO4						√	√	√	√	√	√			
PEO5	√	√	√	√	√							√	√	√

VIII - Program Scope

- The scope for a B.E (Bachelor of Engineering) in Mechanical Engineering (MECH) program in broad and offers diverse career opportunities.
- Graduates can pursue careers in industries such as manufacturing, automotive, aerospace, energy, robotics, and consulting. They can work in areas such as product design, manufacturing processes, thermodynamics, fluid mechanics, solid mechanics, and control systems.



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- The program equips students with necessary technical skills and knowledge to design and analyze mechanical systems, solve complex engineering problems, and contribute to innovations in various sectors.

IX - Program Specific Criteria

Lead Society: **American Society of Mechanical Engineers**

These program criteria will apply to all engineering programs that include "mechanical" or similar modifiers in their titles.

1. Curriculum

In preparation for professional practice, the curriculum must include:

- a) principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations);
- b) applications of these topics to modeling, analysis, design, and realization of physical systems, components or processes;
- c) coverage of both thermal and mechanical systems; and
- d) in-depth coverage of either thermal or mechanical systems.

2. Faculty

The program must demonstrate that faculty members responsible for the upper-level professional courses maintain currency in their specialty area (s).




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X - Curriculum I Semester to VIII Semester

Semester – I

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23IP100	Induction Programme	-	-	-	-	-	0
THEORY								
2	23HS101	Professional English-I	HSMC	3	0	0	3	3
3	23MA101	Matrices and Calculus	BSC	3	1	0	4	4
4	23PH101	Engineering Physics	BSC	3	0	0	3	3
5	23CY101	Engineering Chemistry	BSC	3	0	0	3	3
6	23GE102	Problem Solving and Python Programming	ESC	3	0	0	3	3
7	23GE103	தமிழர்மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
8	23GE111	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9	23BS111	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10	23GE112	English Laboratory - I	EEC	0	0	2	2	1
Total				16	1	10	27	22



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Semester – II

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23HS201	Professional English-II	HSMC	2	0	0	2	2
2	23MA201	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	23PH204	Materials Science and Technology	BSC	3	0	0	3	3
4	23BE201	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
5	23ME201	Engineering Mechanics	ESC	3	0	0	3	3
6	23GE202	Engineering Graphics	ESC	2	0	4	6	4
7	23GE201	தமிழரும் தொழில்நுட்பமும் /Tamil and Technology	HSMC	1	0	0	1	1
8		NCC Credit Course Level 1 [#]	-	2	0	0	2	2 [#]
PRACTICALS								
9	23GE211	Engineering Practices Laboratory	ESC	0	0	3	3	1.5
10	23BE212	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	3	3	1.5
11	23GE212	English Laboratory - II	EEC	0	0	2	2	1
Total				17	1	12	30	24

[#] NCC Credit Course level 1 is offered for NCC students only, the grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.



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Semester – III

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA301	Transforms and Applications of Partial Differential Equations	BSC	3	1	0	4	4
2	23ME301	Engineering Thermodynamics	PCC	3	1	0	4	4
3	23ME303	Manufacturing Processes	PCC	3	0	0	3	3
4	23GE902	Human Values and Ethics	HSMC	2	0	0	2	2
5		Mandatory Course – I*	MC	3	0	0	3	0*
6		Value-added Course – I [§]	EEC	1	0	0	1	1 [§]
7		NCC Credit Course Level 1 [#]	-	2	0	0	2	2 [#]
THEORY CUM PRACTICAL								
7	23ME302	Strength of Materials	PCC	3	0	2	5	4
PRACTICALS								
8	23ME311	Computer Aided Machine Drawing	ESC	0	0	4	4	2
Total				20	2	6	28	19

* Mandatory Course-I is a Non-credit Course

[§]For Value-added courses, the grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

[#]NCC Credit Course level 1 is offered for NCC students only, the grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.




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Semester – IV

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23ME401	Thermal Engineering	PCC	3	1	0	4	4
2	23ME402	Manufacturing Technology	PCC	3	0	0	3	3
3	23GE901	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
4		Mandatory Course – II*	MC	3	0	0	3	0*
5		Value-added Course – II [§]	EEC	1	0	0	1	1 [§]
6		NCC Credit Course Level 2 [#]	-	2	0	0	2	2 [#]
THEORY CUM PRACTICAL								
7	23ME403	Theory of Machines	PCC	3	0	2	5	4
8	23ME404	Fluid Mechanics and Machinery	PCC	3	0	2	5	4
PRACTICALS								
9	23ME411	Thermal Engineering Laboratory	PCC	0	0	4	4	2
10	23ME412	Manufacturing Technology Laboratory	PCC	0	0	4	4	2
Total				20	1	12	33	21

* Mandatory Course-I is a Non-credit Course

[§] For Value-added courses, the grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

[#] NCC Credit Course level 2 is offered for NCC students only, the grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.




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Semester – V

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23ME501	Design of Machine Elements	PCC	4	0	0	4	4
2	23ME502	Metrology and Measurements	PCC	3	0	0	3	3
3	23ME503	Computer Aided Design and Manufacturing	PCC	3	0	0	3	3
4		Professional Elective-I	PEC	3	0	0	3	3
5		Professional Elective-II	PEC	3	0	0	3	3
6		Open Elective-I~	OEC	3	0	0	3	3~
PRACTICALS								
7	23ME511	Summer Internship	EEC	0	0	0	0	1
8	23ME512	Metrology Laboratory	PCC	0	0	4	4	2
9	23ME513	CAD/CAM Laboratory	PCC	0	0	4	4	2
Total				19	0	8	27	24




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Semester – VI

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23ME601	Heat and Mass Transfer	PCC	3	1	0	4	4
2	23ME602	Design of Transmission System	PCC	3	0	0	3	3
3	23ME603	Hydraulics and Pneumatics	PCC	3	0	0	3	3
4		Professional Elective-III	PEC	3	0	0	3	3
5		Professional Elective-IV	PEC	3	0	0	3	3
6		Open Elective-II~	OEC	3	0	0	3	3~
PRACTICALS								
7	23ME611	Heat Transfer Laboratory	PCC	0	0	4	4	2
8	23ME612	Product Design and Fabrication Projects	EEC	0	0	4	4	2
Total				18	1	8	27	23



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Semester – VII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23ME701	Mechatronics	PCC	3	0	0	3	3
2	23ME702	Computer Integrated Manufacturing	PCC	3	0	0	3	3
3	23GE706	Industrial Management	HSMC	3	0	0	3	3
4		Professional Elective-V	PEC	3	0	0	3	3
5		Open Elective –III~	OEC	3	0	0	3	3~
THEORY CUM PRACTICAL								
6	23ME703	Finite Element Analysis	PCC	3	0	2	5	4
PRACTICALS								
7	23ME711	Summer internship	EEC	0	0	0	0	1
8	23ME712	Mechatronics Laboratory	RCC	0	0	4	4	2
Total				18	0	6	24	22

Semester –VIII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1	23ME811	Project Work	EEC	0	0	20	20	10
Total				0	0	20	20	10



TOTAL Credits 165


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XI - Mandatory Courses I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23MC902	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	23MC903	Disaster Risk Reduction and Management	MC	3	0	0	3	0
3.	23MC910	Elements of Literature	MC	3	0	0	3	0
4.	23MC911	Film Appreciation	MC	3	0	0	3	0

Mandatory Courses II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23MC904	History of Science and Technology in India	MC	3	0	0	3	0
2.	23MC905	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
3.	23MC906	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
4.	23MC907	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	23MC908	Industrial Safety	MC	3	0	0	3	0




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XII - Professional Elective Courses: Verticals

Vertical - I Modern Mobility Systems	Vertical - II Product and Process Development	Vertical - III Robotics and Automation	Vertical - IV Digital and Green Manufacturing	Vertical V Process Equipment and Piping Design	Vertical - VI Clean and Green Energy Technologies	Vertical - VII Computational Engineering	Vertical - VIII Diversified courses Group 1	Vertical - IX Diversified courses Group 2	Vertical - X Diversified courses Group 3
Automotive Materials, Components, Design and Testing	Value Engineering	Sensors and Instrumentation	Digital Manufacturing and IoT	Design of Pressure Vessels	Bioenergy Conversion Technologies	Computational Solid Mechanics	Automobile Engineering	Turbo Machines	Advanced Vehicle Engineering
Conventional and Futuristic Vehicle Technology	Additive Manufacturing	Electrical Drives and Actuators	Lean Manufacturing	Failure Analysis and NDT Techniques	Carbon Footprint Estimation and Reduction Techniques	Computational Fluid Dynamics and Heat transfer	Measurements and Controls	Non-traditional Machining Processes	Advanced Internal Combustion Engineering
Renewable Powered Off Highway Vehicles and Emission Control Technology	Design For X	Embedded Systems and Programming	Modern Robotics	Material Handling and Solid Processing Equipment	Energy Conservation in Industries	Theory on Computation and Visualization	Design Concepts in Engineering	Thermal Power Engineering	Casting and Welding Processes
Vehicle Health Monitoring, Maintenance and Safety	Ergonomics in Design	Robotics	Green Manufacturing Design and Practices	Rotating Machinery Design	Energy Efficient Buildings	Computational Bio-Mechanics	Composite Materials and Mechanics	Design for Manufacturing	Process Planning and Cost Estimation
CAE and CFD Approach in Future Mobility	New Product Development	Smart Mobility and Intelligent Vehicles	Environment Sustainability and Impact Assessment	Thermal and Fired Equipment Design	Energy Storage Devices	Advanced Statistics and Data Analytics	Electrical Drives and Control	Power Generation Equipment Design	Surface Engineering



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Hybrid and Electric Vehicle Technology	Product Life Cycle Management	Haptics and Immersive Technologies	Energy Saving Machinery and Components	Industrial Layout Design and Safety	Renewable Energy Technologies	CAD and CAE	Power Plant Engineering	Dynamics of Ground Vehicles	Precision Manufacturing
Thermal Management of Batteries and Fuel Cells		Drone Technologies	Green Supply Chain Management	Design Codes and Standards	Equipment for Pollution Control	Machine Learning for Intelligent Systems	Refrigeration and Air Conditioning	Operational Research	Gas Dynamics and Jet Propulsion



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Professional Elective Courses**Vertical - I: MODERN MOBILITY SYSTEMS**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME11	Automotive Materials, Components, Design and Testing	PEC	2	0	2	4	3
2.	23PME12	Conventional and Futuristic Vehicle Technology	PEC	3	0	0	3	3
3.	23PME13	Renewable Powered Off Highway Vehicles and Emission Control Technology	PEC	3	0	0	3	3
4.	23PME14	Vehicle Health Monitoring, Maintenance and Safety	PEC	3	0	0	3	3
5.	23PME15	CAE and CFD Approach in Future Mobility	PEC	2	0	2	4	3
6.	23PME16	Hybrid and Electric Vehicle Technology	PEC	3	0	0	3	3
7.	23PME17	Thermal Management of Batteries and Fuel Cells	PEC	3	0	0	3	3

Vertical 2: PRODUCT AND PROCESS DEVELOPMENT

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME18	Value Engineering	PEC	3	0	0	3	3
2.	23PME19	Additive Manufacturing	PEC	2	0	2	4	3
3.	23PME20	Design For X	PEC	3	0	0	3	3
4.	23PME21	Ergonomics in Design	PEC	3	0	0	3	3
5.	23PME22	New Product Development	PEC	3	0	0	3	3
6.	23PME23	Product Life Cycle Management	PEC	3	0	0	3	3



Vertical 3: ROBOTICS AND AUTOMATION

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME24	Sensors and Instrumentation	PEC	3	0	0	3	3
2.	23PME25	Electrical Drives and Actuators	PEC	3	0	0	3	3
3.	23PME26	Embedded Systems and Programming	PEC	2	0	2	4	3
4.	23PME27	Robotics	PEC	3	0	0	3	3
5.	23PME28	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
6.	23PME29	Haptics and Immersive Technologies	PEC	3	0	0	3	3
7.	23PME30	Drone Technologies	PEC	3	0	0	3	3

Vertical 4: DIGITAL AND GREEN MANUFACTURING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME31	Digital Manufacturing and IoT	PEC	2	0	2	4	3
2.	23PME32	Lean Manufacturing	PEC	3	0	0	3	3
3.	23PME33	Modern Robotics	PEC	2	0	2	4	3
4.	23PME34	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
5.	23PME35	Environment Sustainability and Impact Assessment	PEC	3	0	0	3	3
6.	23PME36	Energy Saving Machinery and Components	PEC	3	0	0	3	3
7.	23PME37	Green Supply Chain Management	PEC	3	0	0	3	3



Vertical 5: PROCESS EQUIPMENT AND PIPING DESIGN

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME38	Design of Pressure Vessels	PEC	3	0	0	3	3
2.	23PME39	Failure Analysis and NDT Techniques	PEC	2	0	2	4	3
3.	23PME40	Material Handling and Solid Processing Equipment	PEC	3	0	0	3	3
4.	23PME41	Rotating Machinery Design	PEC	3	0	0	3	3
5.	23PME42	Thermal and Fired Equipment Design	PEC	3	0	0	3	3
6.	23PME43	Industrial Layout Design and Safety	PEC	2	0	2	4	3
7.	23PME44	Design Codes and Standards	PEC	3	0	0	3	3

Vertical 6: CLEAN AND GREEN ENERGY TECHNOLOGIES

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME45	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2.	23PME46	Carbon Footprint Estimation and Reduction Techniques	PEC	3	0	0	3	3
3.	23PME47	Energy Conservation in Industries	PEC	3	0	0	3	3
4.	23PME48	Energy Efficient Buildings	PEC	3	0	0	3	3
5.	23PME49	Energy Storage Devices	PEC	3	0	0	3	3
6.	23PME50	Renewable Energy Technologies	PEC	3	0	0	3	3
7.	23PME51	Equipment for Pollution Control	PEC	3	0	0	3	3



Vertical 7: COMPUTATIONAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME52	Computational Solid Mechanics	PEC	3	0	0	3	3
2.	23PME53	Computational Fluid Dynamics and Heat transfer	PEC	3	0	0	3	3
3.	23PME54	Theory on Computation and Visualization	PEC	3	0	0	3	3
4.	23PME55	Computational Bio-Mechanics	PEC	3	0	0	3	3
5.	23PME56	Advanced Statistics and Data Analytics	PEC	3	0	0	3	3
6.	23PME57	CAD and CAE	PEC	2	0	2	4	3
7.	23PME58	Machine Learning for Intelligent Systems	PEC	3	0	0	3	3

Vertical 8: DIVERSIFIED COURSES GROUP 1

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME59	Automobile Engineering	PEC	3	0	0	3	3
2.	23PME60	Measurements and Controls	PEC	3	0	0	3	3
3.	23PME61	Design Concepts in Engineering	PEC	3	0	0	3	3
4.	23PME62	Composite Materials and Mechanics	PEC	3	0	0	3	3
5.	23PME63	Electrical Drives and Control	PEC	3	0	0	3	3
6.	23PME64	Power Plant Engineering	PEC	3	0	0	3	3
7.	23PME65	Refrigeration and Air Conditioning	PEC	3	0	0	3	3



Vertical 9: DIVERSIFIED COURSES GROUP 2

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME66	Turbo Machines	PEC	3	0	0	3	3
2.	23PME67	Non-traditional Machining Processes	PEC	3	0	0	3	3
3.	23PME68	Thermal Power Engineering	PEC	3	0	0	3	3
4.	23PME69	Design for Manufacturing	PEC	3	0	0	3	3
5.	23PME70	Power Generation Equipment Design	PEC	3	0	0	3	3
6.	23PME71	Dynamics of Ground Vehicles	PEC	3	0	0	3	3
7.	23PME72	Operational Research	PEC	3	0	0	3	3

Vertical 10: DIVERSIFIED COURSES GROUP 3

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PME73	Advanced Vehicle Engineering	PEC	3	0	0	3	3
2.	23PME74	Advanced Internal Combustion Engineering	PEC	3	0	0	3	3
3.	23PME75	Casting and Welding Processes	PEC	3	0	0	3	3
4.	23PME76	Process Planning and Cost Estimation	PEC	3	0	0	3	3
5.	23PME77	Surface Engineering	PEC	3	0	0	3	3
6.	23PME78	Precision Manufacturing	PEC	3	0	0	3	3
7.	23PME79	Gas Dynamics and Jet Propulsion	PEC	3	0	0	3	3



XIII - Open Electives

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23OCS01	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
2.	23OCS02	Augmented Reality /Virtual Reality	OEC	3	0	0	3	3
3.	23OCS03	Data Science Fundamentals	OEC	3	0	0	3	3
4.	23OCS04	Data Structures	OEC	3	0	0	3	3
5.	23OCS05	IoT Concepts and Applications	OEC	3	0	0	3	3
6.	23OCE01	Cartography & GIS	OEC	3	0	0	3	3
7.	23OCE02	Environment, Health & Safety	OEC	3	0	0	3	3
8.	23OCE03	Environment Impact Assessment	OEC	3	0	0	3	3
9.	23OCE04	Industrial waste water management	OEC	3	0	0	3	3
10.	23OCE05	Remote sensing concepts	OEC	3	0	0	3	3
11.	23OEC01	Antenna Fundamentals	OEC	3	0	0	3	3
12.	23OEC02	Consumer Electronics	OEC	3	0	0	3	3
13.	23OEC03	Display Devices Fundamentals	OEC	3	0	0	3	3
14.	23OEC04	Embedded Systems	OEC	3	0	0	3	3
15.	23OEC05	Fundamentals of Nano Electronics	OEC	3	0	0	3	3
16.	23OEC06	Fundamentals of Image Processing	OEC	3	0	0	3	3
17.	23OEC07	Internet of Things	OEC	3	0	0	3	3
18.	23OEC08	Sensors and Actuators	OEC	3	0	0	3	3
19.	23OEC09	Wearable Devices	OEC	3	0	0	3	3
20.	23OEC10	Wireless Sensor Networks	OEC	3	0	0	3	3



21.	23OEE01	AI with Mat lab	OEC	3	0	0	3	3
22.	23OEE02	Applied Soft Computing	OEC	3	0	0	3	3
23.	23OEE03	Electric Vehicle Technology	OEC	3	0	0	3	3
24.	23OEE04	Electrical Safety	OEC	3	0	0	3	3
25.	23OEE05	E-waste Management	OEC	3	0	0	3	3
26.	23OEE06	Industrial Automation	OEC	3	0	0	3	3
27.	23OEE07	Power Plant Instrumentation	OEC	3	0	0	3	3
28.	23OEE08	Principles of Robotics	OEC	3	0	0	3	3
29.	23OEE09	Sensors and Transducers	OEC	3	0	0	3	3
30.	23OEE10	Solar and Wind Energy Resources	OEC	3	0	0	3	3
31.	23OMA01	Graph Theory	OEC	3	0	0	3	3
32.	23OMA02	Resource Management Techniques	OEC	3	0	0	3	3
33.	23OMA03	Operations Research	OEC	3	0	0	3	3
34.	23OMA04	Algebra and Number Theory	OEC	3	0	0	3	3
35.	23OMA05	Linear Algebra	OEC	3	0	0	3	3
36.	23OMA06	Queuing and Reliability Modelling	OEC	3	0	0	3	3
37.	23OHS01	English for Competitive Examinations	OEC	3	0	0	3	3
38.	23OHS02	Project Report Writing	OEC	3	0	0	3	3



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XIV Summary of Curriculum Components with Credits

S. No.	Curricular Components	Semester wise								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	4	3	2	-	-	-	3	-	12
2.	BSC	12	7	4	2	-	-	-	-	25
3.	ESC	5	13	2	-	-	-	-	-	20
4.	PCC	-	-	11	19	14	12	12	-	68
5.	PEC	-	-	-	-	6	6	3	-	15
6.	OEC	-	-	-	-	3	3	3	-	9
7.	EEC	1	1	1 ^{\$}	1 ^{\$}	1	2	1	10	16
8.	MC	-	-	-	-	0	-	-	-	0
9.	Total	22	24	19	21	24	23	22	10	165

^{\$} Not included for CGPA calculation


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MECHANICAL ENGINEERING - SYLLABUS R2023**SEMESTER – I****I – Course Code & Name: 23HS101 Professional English-I**

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	HSMC	3	0	0	3

II - Course Objectives

1.	To improve the communicative competence of learners.
2.	To learn to use basic grammatic structures in suitable contexts.
3.	To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
4.	To help learners use language effectively in professional contexts.
5.	To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

III - Course Content

Preamble: This course is designed to impart required levels of Communication Skills in Reading and Writing and Proficiency in English language in writing necessary for different professional contexts.		
Unit – I	Introduction to Effective Communication & Fundamentals of Communication	9 Periods
Communication- effective communication- seven C's of effective communication Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar – Simple Tenses (Present / Past /Future); Question types: Wh/ Yes or No/- Question Tags. Vocabulary – Synonyms (word -meaning- sentence making); (One word substitution; Abbreviations & Acronyms (as used in technical contexts) –Silent letters.		
Unit – II	Narration and Summation	9 Periods
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Progressive tenses (Present / Past /Future); Subject-Verb Agreement; Prepositions. Vocabulary - Wordforms (prefixes& suffixes); Phrasal verbs – Words often confused.		
Unit – III	Description of a Process / Product	9 Periods
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Perfect Tenses (Present / Past /Future); Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).		
Unit – IV	Classification and Recommendations	9 Periods



Writing – Note-making / Note-taking; Writing recommendations; Transferring information from non-verbal (chart, graph etc, to verbal mode), Transcoding, Grammar – Perfect continuous tenses (Present / Past /Future);. Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions – Idioms and Phrases.		
Unit – V	Expression	9 Periods
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar –Mixed Tenses - Punctuation; Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Functionwords – British & American vocabulary (spelling and word changes)		

Text Books:	1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition) 2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Jovani, Department of English, Anna University.
Reference Books:	1. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017. 2. A Course Book on Technical English by Lakshminarayanan, Scitech Publications (India) Pvt. Ltd. 3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244. 4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House 5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc23_hs115/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To use appropriate words in a professional context and communicate in a professional context.	Applying (BL 3)
CO2	To gain understanding of basic grammatic structures and use them in right context.	Understanding (BL 2)
CO3	To read and infer the denotative and connotative meanings of technical texts and use technical words in describing products with appropriate definitions.	Applying (BL 3)
CO4	To write definitions, descriptions, narrations and essays on various topics.	Creating (BL 6)
CO5	To express their opinions effectively in both oral and written medium of communication.	Creating (BL 6)



(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-3	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-4	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√		√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MA101 Matrices and Calculus

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	BSC	3	1	0	4

II - Course Objectives

1.	To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2.	To familiarize the student with functions of several variables. This is needed in many branches of engineering.
3.	To familiarize the students with integral calculus and various techniques of integration.
4.	To make the students understand the concepts of vector calculus and applications.
5.	To acquaint the student with mathematical tools needed in evaluating ordinary differential equations and their applications.

III - Course Content

Preamble: This course introduces basic concepts and techniques of multivariable calculus, matrices, and ordinary differential equations and highlights their applications in various field of engineering such as Design Engineering, Electric Circuit Theory, Cryptography, Resistor conversion, Robotics etc.		
Unit – I	Matrices	12 Periods
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley – Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.		
Unit – II	Functions of Several Variables	12 Periods
Partial differentiation – Homogeneous functions and Euler’s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange’s method of undetermined multipliers.		
Unit – III	Integral Calculus and Multiple Integrals	12 Periods
Definite integrals – Properties – Problems- Double and Triple integrals – Cartesian, polar coordinates – change of order of integration – Applications: Area between curves, Volume of integrals.		
Unit – IV	Vector Calculus	12 Periods
Gradients - Divergence - Curl – Directional derivative - Irrotational and Solenoidal vector fields– Vector Integration (Line integral, Surface integral, Volume integral, Simple Problems only) – Green’s theorem in plane, Gauss divergence theorem and Stoke’s Theorem (excluding proof) – Simple applications involving cubes and rectangular parallelopipeds.		
Unit – V	Ordinary Differential Equations	12 Periods



Higher order linear differential equations with constant coefficients – Method of variation of parameters. Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.	
Text Books:	1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016. 2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018. 3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].
Reference Books:	1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016. 2. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009. 3. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016. 4. Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009. 5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016. 6. Srimantha Pal and Bhunia. S.C, "Engineering Mathematics " Oxford University Press, 2015. 7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/122104018 2. https://archive.nptel.ac.in/courses/111/106/111106146/ 3. https://onlinecourses.nptel.ac.in/noc21_ma16/preview 4. https://digimat.in/nptel/courses/video/111105122/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Use the matrix algebra methods for solving practical problems.	Applying (BL 3)
CO2	Able to use differential calculus ideas on several variable functions.	Applying (BL 3)
CO3	Apply integral calculus and multiple integral tools in solving various application problems.	Applying (BL 3)
CO4	Understand the concepts of Gradient, divergence and curl of a vector point function and related applications.	Understanding (BL 2)
CO5	Apply various techniques in solving ordinary differential equations.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO-2	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO-3	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO-4	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO-5	3	3	-	-	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√	√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23PH101 Engineering Physics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	BSC	3	0	0	3

II - Course Objectives

1.	To instill the essentials of properties of matter.
2.	To gain knowledge of electromagnetic waves and its applications.
3.	To amplify the information on optical fiber for communication purposes.
4.	To describe the principles of quantum mechanics and their various applications.
5.	To provide the fundamental understanding of crystals and their numerous crystal formations.

III - Course Content**Preamble:**

The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes.

Unit – I	Properties of Matter	9 Periods
Elasticity – stress - strain -Hooke’s law- S-S diagram -factors affecting elastic modulus and tensile strength–Torsion pendulum-moment of inertia of a body - young’s modulus – cantilever method, uniform and non-uniform bending – I-shaped girders -Poisson’s ratio.		
Unit – II	Electromagnetic Field and Waves	9 Periods
The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure – Smart phone reception.		
Unit – III	Laser and Fiber Optics	9 Periods
LASER- interaction of light radiation with materials - Einstein’s coefficients- Nd:YAG, CO ₂ , Quantum dot laser – LIDAR. Fiber optics: modes of propagation of light – numerical aperture and acceptance angle — fiber optical communication system - Fiber optic displacement sensors.		
Unit – IV	Quantum Physics	9 Periods
Comparison between Classical and Quantum Theory –Compton scattering: experimental description-uncertainty principle – physical significance of wave function-Schrödinger’s wave equation – time dependent and time independent equations – particle in a box- Quantum confinement.		
Unit – V	Crystal Physics	9 Periods
Crystallography–unit cell, primitive cell-crystal systems, Bravais lattices, Miller indices – inter-planar distances - Coordination number and packing factor for SC, BCC, FCC, HCP structures- Diamond &		



NaCl Crystal structure - Crystal defect and dislocation. Crystal growth techniques: Bridgman method.

Text & Reference Books	1. Tipler Mosca, Physics For Scientists and Engineers 6th Edition, 2015. 2. Gaur R.K. and Gupta S.L, Engineering Physics, Dhanpat Rai Publications, 2013. 3. Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, 2015. 4. S. O. Pillai, Solid State Physics, New Age International Private Limited, 10th edition, 2022 5. Marikani A, Engineering Physics, PHI, New Delhi, 2013.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc20_mm13/preview 2. https://www.noaa.gov/jetstream/satellites/electromagnetic-waves 3. https://fractory.com/fibre-lasers-explained/ 4. https://www.livescience.com/33816-quantum-mechanics-explanation.html 5. https://archive.nptel.ac.in/courses/115/104/115104109/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Choose the correct materials based on their qualities for any intended applications and learn the basics of elasticity and its engineering-related applications.	Applying (BL 3)
CO2	Express their knowledge in electromagnetic waves.	Understanding (BL 2)
CO3	Infer the characteristics of laser for various Engineering applications and expand the understanding of optical fibers use in communications.	Understanding (BL 2)
CO4	Apply quantum theory's sophisticated physics notions to the matter's characterization.	Applying (BL 3)
CO5	Know the fundamentals of crystal formations and growth methods.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	3	3	-	-	2	-	-	-	-	3	-	-
CO-2	3	2	3	2	-	-	2	-	-	-	-	3	-	-
CO-3	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO-4	3	3	3	2	-	-	3	-	-	-	-	2	-	-
CO-5	3	2	3	3	-	-	-	-	-	-	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓						✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23CY101 Engineering Chemistry

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	BSC	3	0	0	3

II - Course Objectives

1.	To inculcate sound understanding of water quality parameters and water treatment techniques.
2.	To impart knowledge on the basic principles and preparatory methods of nanomaterials.
3.	To introduce the basic concepts and applications of polymers and composites.
4.	To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5.	To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

III - Course Content**Preamble:**

The objective of this course is to bestow the better understanding of basic concepts of chemistry and its applications in Engineering and Technology. This course provides exposure on properties of water and its treatment methods. It also imparts knowledge on properties and application of nano-materials in data storage devices. This course also highlights preparation, properties and applications of polymers and composite materials. It also imparts knowledge on fuel types and applications of energy conversion and storage devices.

Unit – I	Water and Its Treatment	9 Periods
Water: Sources and impurities, Water quality parameters: Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and Sludge, Boiler corrosion, Caustic embrittlement, Priming & Foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment: Ion exchange demineralisation and zeolite process.		
Unit – II	Nano Chemistry	9 Periods
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
Unit – III	Polymers and Composites	9 Periods
Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Preparation properties and uses of PVC, Teflon, Nylon 6,6 and Epoxy resins. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials		



(Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.		
Unit – IV	Fuels and Combustion	9 Periods
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: Spontaneous Ignition Temperature, Explosive range; Flue gas analysis - ORSAT Method. CO₂ emission and carbon foot print.		
Unit – V	Energy Storage Devices	9 Periods
Nuclear energy: Light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery – dry cell, Secondary battery -lead acid storage battery and lithium-ion-battery; Electric vehicles-working principles; Fuel cells: H₂-O₂ fuel cell, Super capacitors		

Text Books:	1. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 17th Edition, 2018. 2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 6th Edition 2012. 3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
Reference Books:	1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018. 2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017. 3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2nd Edition, 2017. 4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2nd Edition, 2019. 5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013. 6. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,) Chennai, 4th Edition , 2021.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses



IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Summarize the water related problems in boilers and their treatment techniques.	Remembering (BL 1)
CO2	Discuss the applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.	Understanding (BL 2)
CO3	Discuss the types, properties and applications of polymers and composites.	Applying (BL 3)
CO4	Summarize the fuels used for engineering processes and applications of fuels.	Understanding (BL 2)
CO5	Summarize the principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	-	-	-	3	-	-	-	-	2	-	-
CO-2	2	1	1	-	-	-	3	-	-	-	-	2	-	-
CO-3	2	1	1	-	-	-	3	-	-	-	-	2	-	-
CO-4	2	1	1	-	-	-	1	-	-	-	-	2	-	-
CO-5	3	2	2	-	-	-	3	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓						✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23GE102 Problem Solving and Python Programming

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	BSC	3	0	0	3

II - Course Objectives

1.	To understand the basics of algorithmic problem solving.
2.	To learn to solve problems using Python conditionals and loops.
3.	To define Python functions and use function calls to solve problems.
4.	To use Python data structures - lists, tuples, dictionaries to represent complex data.
5.	To do input/output with files in Python.

III - Course Content

Preamble: Python is an open-sourced programming language that combines the features of C and Java. It has exceptional procedural as well as object-oriented capabilities. Having said this, always remember that everything in Python is an **object**.

UNIT 1	Computational Thinking and Problem Solving	9 Periods
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi		
UNIT 2	Data Types, Expressions, Statements	9 Periods
Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.		
UNIT 3	Control Flow, Functions, Strings	9 Periods
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search		
UNIT 4	Lists, Tuples, Dictionaries	9 Periods
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT 5	Files, Modules, Packages	9 Periods



Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

Text Books:	1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016. 2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.
Reference Books:	1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021. 2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021 3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press 4. Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019. 5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.
MOOC/Web Platforms:	1. https://www.python.org 2. Introduction to C (w3schools.com)

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the concepts of computational thinking and algorithmic problem-solving techniques.	Understand (BL 2)
CO2	Develop simple python programs for applying the concepts of datatypes, expressions, and python statements.	Applying (BL 3)
CO3	Develop Python programs for solving real-time computational problems by using conditionals, looping, functions, and strings.	Applying (BL 3)
CO4	Understand the concepts of compound data using Python lists, tuples, and dictionaries.	Understand (BL 2)
CO5	Develop python programs for solving computational problems by using modules, files, and python packages.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)




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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	-	-	-	-	-	-	-	2	-	-	-
CO-2	3	3	3	2	2	-	-	-	-	-	2	3	-	-
CO-3	3	3	3	2	2	-	-	-	-	-	2	3	-	-
CO-4	3	2	2	-	-	-	-	-	-	-	2	-	-	-
CO-5	3	3	3	2	3	-	-	-	-	-	2	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√					√		√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23GE103 தமிழர்மரபு /Heritage of Tamils

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	ESC	1	0	0	1

III - Course Content

UNIT 1	Language and Literature	3 Periods
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.		
UNIT 2	Heritage - Rock Art Paintings to Modern Art – Sculpture	3 Periods
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.		
UNIT 3	Folk and Martial Arts	3 Periods
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
UNIT 4	Thinai Concept of Tamils	3 Periods
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
UNIT 5	Contribution of Tamils to Indian National Movement and Indian Culture	3 Periods
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		

Text Books & Reference Books:	1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). 2. கணினித்தமிழ் – முனைவர் - இல. சுந்தரம். (விகடன் பிரசுரம்). 3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு) 4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு). 5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) 6. Social Life of the Tamils - The Classical Periods (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
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	7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies). 8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.) 9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) 10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author) 11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) 12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.
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VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓					✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23GE111 Problem Solving and Python Programming Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	ESC	0	0	4	2

II - Course Objectives

1.	To understand the problem-solving approaches
2.	To learn the basic programming constructs in Python.
3.	To practice various computing strategies for Python-based solutions to real world problems
4.	To use Python data structures - lists, tuples, dictionaries
5.	To do input/output with files in Python.

III - Course Content

Experiments
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.
Total Periods - 60



Text Books:	1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016. 2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
Reference Books:	1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021. 2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021. 3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021. 4. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021. 5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.
MOOC/Web Platforms:	1. https://www.python.org/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Develop simple python programs for applying the concepts of datatypes, expressions, and python statements.	Applying (BL 3)
CO2	Develop Python programs using conditionals, looping, functions, and strings for solving real-time computational problems.	Applying (BL 3)
CO3	Understand the concepts of compound data using Python lists, tuples, and dictionaries.	Understand (BL 2)
CO4	Develop python programs for solving problems by using modules, files, and python packages.	Applying (BL 3)
CO5	Utilize Python packages for developing real-world software applications.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	-	2	-	-	2	-	3	2	2	-	-	-
CO-2	3	3	3	2	2	-	-	2	-	3	2	3	-	-	-



CO-3	3	2	1	2	-	-	-	2	-	3	2	3	-	-	-
CO-4	3	2	2	2	2	-	-	-	2	-	2	3	-	-	-
CO-5	3	3	3	2	2	-	-	-	2	-	2	3	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	√	√				√		√		

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I - Course Name: 23BS111 Physics and Chemistry Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	BSc	0	0	4	2

Preamble:

This course aims to provide practical training in the estimation of physical parameters like band gap, ultrasound velocity, liquid compressibility, thin wire thickness, Young's modulus, and knowledge of the operation of the photoelectric effect, Michelson interferometer, laser, and fibre optics as well as to provide project-based skills development.

Physics Laboratory: (Any seven experiments to be conducted)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc.
2. Uniform bending (or) Non-uniform Bending– Determination of young's modulus.
3. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
4. Laser- Determination of the wave length of the laser using grating.
5. (a) Optical fibre -Determination of Numerical Aperture and acceptance angle
(b) Compact disc- Determination of width of the groove using laser.
6. Air wedge – Determination of thickness of a thin sheet/wire.
7. Determination of Band gap of a semiconductor.
8. Particle size determination using LASER.
9. Simple harmonic oscillations of cantilever.
10. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

IV - Course Outcome (Physics Laboratory)

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apprehend the concepts of interference, diffraction of light and recognize the resonance concept of waves.	Understanding (BL 2)
CO2	Apply the principles of operations of optical fibers, semiconductor using simple circuits and interaction of electromagnetic waves and crystalline solids.	Applying (BL 3)
CO3	Measure the elastic moduli and moment of inertia of given materials with the help of suggested procedures.	Applying (BL 3)
CO4	Experiment the relationship between the light and matter & properties of liquids.	Analyzing (BL 4)
CO5	Estimate the thermal properties and thermal behavior of the material.	Understanding (BL 2)



II - Course Objectives (Chemistry Laboratory)

1.	To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
2.	To induce the students to familiarize with electroanalytical techniques such as, PH metry and potentiometry
3.	To make the student to acquire practical skills conductometry in the determination of impurities in aqueous solutions.
4.	To demonstrate the analysis of metals and alloys.
5.	To demonstrate the synthesis of nanoparticles

III - Course Content**Preamble:**

This course aims to provide the students, a basic practical knowledge in chemistry. The objective of this course is to develop intellectual and psychomotor skills of the students by providing hands on experience in quantitative, electrochemical and photo-chemical analysis.

Chemistry Laboratory: (Any seven experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer.
10. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
11. Pseudo first order kinetics-ester hydrolysis.
12. Corrosion experiment-weight loss method.
13. Phase change in a solid.
14. Conductometric titration of strong acid vs strong base.

Reference Books:	1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).
MOOC/Web Platforms:	-



IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.	Analyzing (BL 4)
CO2	Determine the amount of metal ions through volumetric and spectroscopic techniques.	Applying (BL 3)
CO3	Analyse and determine the composition of alloys.	Analyzing (BL 4)
CO4	Learn simple method of synthesis of nanoparticles	Understanding (BL 2)
CO5	Quantitatively analyse the impurities in solution by electroanalytical methods.	Analyzing (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	1	-	-	-	-	-	1	3	2	-	-	-	-
CO-2	3	1	-	-	-	-	-	1	2	1	-	-	-	-
CO-3	3	3	-	-	-	-	-	2	2	1	-	-	-	-
CO-4	3	2	-	-	-	-	-	1	3	2	-	-	-	-
CO-5	3	2	-	-	-	-	-	2	1	2	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	✓	✓				✓		✓		

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



[Signature]
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I – Course Code & Name: 23GE112 English Laboratory – I

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	I	EEC	0	0	2	1

II - Course Objectives

1.	To improve the communicative competence of learners
2.	To help learners use language effectively in academic /work contexts
3.	To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
4.	To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
5.	To use language efficiently in expressing their opinions via various media.

III - Course Content**Preamble:**

This course is designed to equip students with the necessary skills to listen and speak so as to develop their linguistic and communicative competencies.

Unit – I	Introduction To Fundamentals of Communication	6 Periods
Listening for general information-specific details- conversation: Introduction to classmates - Audio /video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; -politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).		
Unit – II	Narration and Summation	6 Periods
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations - describing experiences and feelings-engaging in small talk- describing requirements and abilities.		
Unit – III	Description of a Process / Product	6 Periods
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities (large & small)-talking about precautions.		
Unit – IV	Classification and Recommendations	6 Periods
Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation.		
Unit – V	Expression	6 Periods



Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website-describing processes.

Recommended Software:	1. Globarena Software 2. Open Source Software and YouTube Videos in Career Lab.
Manual	1. English Laboratory Manual, Department of English, NPR College of Engineering & Technology College, Dindigul.
MOOC/Web Platforms:	1. https://www.digitalteacher.in/english-language-lab

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To listen to and comprehend general as well as complex academic information.	Understanding (BL 2)
CO2	To listen to and understand different points of view in a discussion.	Understanding (BL 2)
CO3	To speak fluently and accurately in formal and informal communicative contexts.	Applying (BL 3)
CO4	To describe products and processes and explain their uses and purposes clearly and accurately.	Creating (BL 6)
CO5	To express their opinions effectively in both formal and informal discussions.	Creating (BL 6)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-3	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-4	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



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VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓					✓			✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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SEMESTER– II**I – Course Code & Name: 23HS201 Professional English-II**

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to All Branches	II	HSMC	2	0	0	2

II - Course Objectives

1.	To engage learners in meaningful language activities to improve their reading and writing skills.
2.	To learn various reading strategies and apply in comprehending documents in professional context.
3.	To help learners understand the purpose, audience, contexts of different types of writing.
4.	To develop analytical thinking skills for problem solving in communicative contexts.
5.	To demonstrate an understanding of job applications and interviews for internship and placements.

III - Course Content

Preamble: This course is designed to impart required levels of Communication Skills in Reading and Writing and Proficiency in English language in writing necessary for different professional contexts.		
Unit – I	Making Comparisons	6 Periods
Reading - Reading advertisements, user manuals, brochures; Writing – Agenda & Minutes of the meeting-Compare and Contrast Essay; Grammar– Parts of speech (Conversion of one form into another form) – Kinds of sentences		
Unit – II	Expressing Causal Relations in Speaking and Writing	6 Periods
Reading – Reading longer technical texts– Cause and Effect Essays, and Formal Letters/emails of complaint, Writing-Writing responses to complaints – Jumbled sentences. Grammar – Active & Passive Voice-Infinite and Gerunds.		
Unit – III	Problem Solving	6 Periods
Reading- Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Circular drafting -Problem solution essay/ Argumentative Essay. Grammar – Error correction; If conditional sentences.		
Unit – IV	Reporting of Events and Research	6 Periods
Reading –Newspaper articles; Writing – Accident Report with Recommendations, Survey Report; Grammar–Reported Speech, Modals –Conjunctions- Sentence pattern		
Unit – V	The Ability to Put Ideas or Information Cogently	6 Periods
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing– Job/ Internship application– Cover letter &Resume; Grammar–Numerical adjectives, Relative Clauses.		



Text Books:	1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University. 2. English for Science&TechnologyCambridgeUniversityPress2021. 3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
Reference Books:	1. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017 2. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. NewDelhi. 3. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi. 4. Learning to Communicate –Dr. V.Chellammal. AlliedPublishers, NewDelhi,2003. 5. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, TataMcGrawHill & Co.Ltd.,2001, NewDelhi.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc23_hs115/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To compare and contrast products and ideas in technical texts and write analytical essays.	Applying (BL 2)
CO2	To identify and report cause and effects in events, industrial processes through technical texts and draft a report with suggestions.	Creating (BL 6)
CO3	To analyze problems in order to arrive at feasible solutions and communicate them in the written format.	Analyzing (BL 4)
CO4	To present their ideas and opinions in a planned and logical manner in industrial nature.	Creating (BL 6)
CO5	To draft effective resumes in the context of job application.	Creating (BL 6)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-3	-	-	-	-	-	-	-	-	3	3	-	2	-	-

CO-4	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√		√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MA201 Statistics and Numerical Methods

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	Common to B. E (Civil, EEE, Mechanical Engineering) & B. Tech (AI & DS)	II	BSC	3	1	0	4

II - Course Objectives

1.	This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
2.	To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
3.	To introduce the basic concepts of solving algebraic and transcendental equations.
4.	To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5.	To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

III - Course Content

Preamble: This course is applied to analyse the ground water, pollutants in civil engineering, automatic control systems, fluid mechanics, gas dynamics, heat and mass transfer, thermodynamics, vibrations, data communication, data computing, etc.		
Unit – I	Testing of Hypothesis	12 Periods
Statistical hypothesis – Small sample Tests based on t for single mean and difference of means - F-distributions for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes - large sample tests based on Normal distribution for single mean and difference of means- proportion.		
Unit – II	Design of Experiments	12 Periods
One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design.		
Unit – III	Solution of Equations	12 Periods
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations –direct method (Gauss elimination method, Gauss Jordan method) – Iterative methods (Gauss Jacobi and Gauss Seidel methods).		
Unit – IV	Interpolation, Numerical Differentiation and Numerical Integration	12 Periods
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
Unit – V	Numerical Solution of Ordinary Differential Equations	12 Periods



Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

Text Books:	1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015. 2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
Reference Books:	1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016 2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007. 4. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020. 5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012. 6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_ma74/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.	Applying (BL 3)
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.	Applying (BL 3)
CO3	Apply the basic concepts and Techniques of solving algebraic and transcendental equations.	Applying (BL 3)
CO4	Understand the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.	Understanding (BL 2)
CO5	Solve the ordinary differential equations with initial conditions by using certain techniques with engineering applications.	Analysing (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)




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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	1	1	1	-	-	-	2	-	2	3	-	-
CO-2	3	3	1	1	1	-	-	-	2	-	2	3	-	-
CO-3	3	3	1	1	1	-	-	-	2	-	2	3	-	-
CO-4	2	3	1	1	1	-	-	-	2	-	2	3	-	-
CO-5	3	3	1	1	1	-	-	-	2	-	2	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√						√	√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23PH204 Materials Science and Technology

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E.– Mechanical Engineering	II	BSC	3	0	0	3

II - Course Objectives

1.	To recognize the phases involved in the materials and phase diagrams.
2.	To become knowledgeable about ferrous alloys and their applications.
3.	To describe the mechanical properties and methods to measure.
4.	To describe the properties and uses of dielectric, and superconducting materials.
5.	To explicate the properties and applications of advanced materials.

III - Course Content**Preamble:**

Students who successfully complete this course will have a better grasp of phase diagrams, ferrous alloys mechanical properties of materials, dielectric, superconducting and nanomaterials as well as the relationships across other scientific disciplines.

Unit – I	Phase Diagrams	9 Periods
Solid solutions - Hume Rothery's rules – the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.		
Unit – II	Ferrous Alloys	9 Periods
The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel – pearlitic, bainitic and martensitic transformations - tempering of martensite – steels – stainless steels – cast irons.		
Unit – III	Mechanical Properties	9 Periods
Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination – fatigue - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.		
Unit – IV	Dielectric And Superconducting Materials	9 Periods
Dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials and their properties.		
Unit – V	Special Materials	9 Periods



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Metallic glasses - shape memory alloys: phases, pseudoelastic effect, applications – nanomaterials: preparation (bottom up and top-down approaches), properties and applications – actuators and sensors

Text & Reference Books:	1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015. 2. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd., 2014. 3. A. Marikani, Materials Science, PHI Learning Pvt Ltd, 2017. 4. Raghavan, V. "Physical Metallurgy: Principles and Practice". PHI Learning, 2015 5. Rogers, B., Adams, J. & Pennathur, S., "Nanotechnology: Understanding Small Systems", CRC Press, 2014.
MOOC/Web Platforms:	1. https://pressbooks.bccampus.ca/thermo1/chapter/phase-diagrams/ 2. https://archive.nptel.ac.in/courses/113/105/113105024/ 3. https://www.electrical4u.com/dielectric-materials/ 4. https://nptel.ac.in/courses/115103108 5. https://onlinecourses.nptel.ac.in/noc22_ee47/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To inferring the fundamental knowledge in phase diagrams and explain its application in the field of materials science and engineering.	Understand (BL 2)
CO2	To interpret the fundamentals of the Fe-Fe ₃ C phase diagram, diverse microstructures, and alloys for engineering designs.	Apply (BL 3)
CO3	To understand the fundamental mechanical properties of materials and their methods of measurement.	Understand (BL 2)
CO4	To gain knowledge on dielectric, super conducting and their properties.	Understand (BL 2)
CO5	To apply the suitable nanomaterials and shape memory alloys for specific engineering applications.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	-	-	-	-	-	-	-	-	-	3	-	3
CO-2	3	2	-	-	-	-	-	-	-	-	-	3	-	3
CO-3	3	2	-	-	2	-	-	-	-	-	-	3	-	3



CO-4	3	3	2	-	1	-	-	-	-	-	-	1	-	-
CO-5	3	3	2	-	3	-	2	-	-	-	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓						✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23BE201 Basic Electrical and Electronics Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E.– Mechanical Engineering	II	ESC	3	0	0	3

II - Course Objectives

1.	To introduce the basics of electric circuits and analysis
2.	To impart knowledge in the basics of working principles and application of electrical Machines
3.	To introduce analog devices and their characteristics
4.	To educate on the fundamental concepts of digital electronics
5.	To introduce the functional elements and working of measuring instruments

III - Course Content

Preamble: It is an introductory course which emphasize the fundamental concepts and overview of Electrical Engineering. The concepts discussed herein are intended to provide clarification on basic electrical engineering for beginners of all engineering graduates.		
Unit – I	Electrical Circuits	9 Periods
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor (Simple problems only)		
Unit – II	Electrical Machines (Qualitative Analysis)	9 Periods
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, working principle and Applications of Transformer, Single phase Induction Motor, Working types and Applications		
Unit – III	Analog Electronics (Qualitative Analysis)	9 Periods
Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode – Characteristics Applications – Bipolar Junction Transistor-Biasing (CB Characteristics only) JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications		
Unit – IV	Digital Electronics	9 Periods
Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only).		
Unit – V	Measurements and Instrumentation	9 Periods
Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, DSO-Block diagram- Data acquisition.		



Text Books:	1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020 2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
Reference Books:	1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019. 2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017. 3. H.S. Kalsi, 'Electronic Instrumentation and Measurements', Tata McGraw-Hill, New Delhi, 2019.
MOOC/Web Platforms:	1. https://www.classcentral.com/course/swayam-fundamentals-of-electrical-engineering-14074

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Compute the electric circuit parameters for simple problems	Applying (BL 3)
CO2	Examine the working principle and applications of electrical machines	Understanding (BL 2)
CO3	Illustrate the characteristics of analog electronic devices	Understanding (BL 2)
CO4	Examine the basic concepts of digital electronics	Analyzing (BL 4)
CO5	Apply the concepts of principles of measuring instruments for real time applications	Applying (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	2	1	-	-	-	1	-	-	-	2	2	-	-
CO-2	2	2	1	-	-	-	1	-	-	-	2	2	-	-
CO-3	2	1	1	-	-	-	1	-	-	-	2	2	-	-
CO-4	2	2	1	-	-	-	1	-	-	-	2	2	-	-
CO-5	2	2	1	-	-	-	1	-	-	-	2	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓						✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23ME201 Engineering Mechanics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Common to Mechanical & Civil Engineering	II	ESC	3	0	0	3

II - Course Objectives

1.	To expose various laws of forces for the equilibrium of rigid bodies.
2.	To introduce the concept of properties of surfaces and solids.
3.	To impart knowledge on the fundamental of dynamics of particles and rigid bodies.

III - Course Content**Preamble:**

The engineering Mechanics course is designed to provide a comprehensive understanding of the fundamental principles that govern the behavior of bodies under the influence of forces and moments. Through this course, students will gain insights into the mechanics of how structures and machines interact with their environments and how these principles form the basis of engineering analysis and design.

Unit – I	Equilibrium of Forces	9 Periods
Types of force system- Coplanar concurrent force – Resultant - Moment of force and its applications – couples and resultant of a force system equation of equilibrium of coplanar concurrent and non-concurrent force system Lami's theorem- Resolution of a force into a force and a couple-polygon law of forces for resultant.		
Unit – II	Equilibrium of Rigid Bodies	9 Periods
Free body diagram – Types of supports –Support reaction – Moments and Couples – Moment of a force about a point and about an axis – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions.		
Unit – III	Properties of Surfaces and Solids	9 Periods
Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic and cylindrical solids.		
Unit – IV	Dynamics of Particles	9 Periods
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.		
Unit – V	Friction and Rigid Body Dynamics	9 Periods
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding		



friction – wedge friction- Rolling resistance - Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

Text Books:	1. Vela Murali, "Engineering Mechanics", Oxford University Press (2018) 2. Bhavikatti, S.S, "Engineering Mechanics", MULTI COLOUR EDITION, New Age International (P) Limited Publishers, 2021.
Reference Books:	1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 9th Edition, Tata McGraw-Hill Publishing company, New Delhi (2009). 2. S. Timoshenko, D.H young, J.V. Rao, Sukumar pati, "Engineering Mechanics" 4th edition TMH Education 2016. 3. Sanjay Bansal R. K. Bansal A Text book of Engineering Mechanics 8th edition Lakshmi Publication 2011.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112106286

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify various force system in a plane.	Understanding (BL 2)
CO2	Solve equilibrium of rigid bodies in two dimensions.	Applying (BL 3)
CO3	Calculate the centroid, areas and mass moment of inertia for surface and solids.	Applying (BL 3)
CO4	Apply the concept of dynamics for particle motions.	Applying (BL 3)
CO5	Determine the friction of elements and dynamics of rigid bodies.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO-2	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO-3	3	3	2	1	-	-	-	-	-	-	-	2	3	-



CO-4	3	3	2	1	-	-	-	-	-	-	-	2	3	-
CO-5	3	3	2	1	-	-	-	-	-	-	-	2	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓					✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23GE202 Engineering Graphics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Common to (Civil, EEE Mechanical Engineering)	II	ESC	2	0	4	4

II - Course Objectives

1.	Drawing engineering curves.
2.	Drawing freehand sketch of simple objects.
3.	Drawing orthographic projection of solids and section of solids.
4.	Drawing development of solids.
5.	Drawing isometric and perspective projections of simple solids.

III - Course Content**Preamble:**

Engineering graphics serves as a foundation for your journey into the world of engineering design and visualization. Through this course, you will acquire essential skills and knowledge that are crucial for effective communication and representation of engineering concepts. This course bridges the gap between ideas and reality by transforming abstract concepts into visual representations.

Unit – I	Plane Curves	18 Periods
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.		
Unit – II	Projection of Points, Lines and Plane Surface	18 Periods
Orthographic projection – principles - Principal Planes - First angle projection - projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
Unit – III	Projection of Solids and Freehand Sketching	18 Periods
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles Representation of Three-Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination).		
Unit – IV	Section of Solids and Development of Surfaces	18 Periods
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination).		



examination).		
Unit – V	Isometric and Perspective Projections	18 Periods
Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three-dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination).		

Text Books:	1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019. 2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
Reference Books:	1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008. 2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015. 3. T.Jeyapoovan, "Engineering Graphics Using AutoCAD", 7th Edition, Vikas Publishing Houses Pvt Ltd, 2015. 4. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019. 5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112103019 2. https://archive.nptel.ac.in/courses/112/102/112102304/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Construct the conic curves, involutes and cycloid.	Applying (BL 3)
CO2	Solve practical problems involving projection of lines, points and plane surfaces	Applying (BL 3)
CO3	Draw orthographic projection of solids and freehand sketch of simple objects.	Applying (BL 3)
CO4	Draw the sectioning and development of simple solids.	Applying (BL 3)
CO5	Draw isometric and perspective projections of simple solids.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)




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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	1	1	-	-	-	-		-	-	3	-	2	-	-
CO-2	3	1	1	-	-	-	-		-	-	3	-	2	-	-
CO-3	3	1	1	-	-	-	-		-	-	3	-	2	-	-
CO-4	3	1	1	-	-	-	-		-	-	3	-	2	-	-
CO-5	3	1	1	-	-	-	-		-	-	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√		√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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**I – Course Code & Name: 23GE201 தமிழரும் தொழில்நுட்பமும் /
Tamils and Technology**

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to All Branches	II	HSMC	1	0	0	1

III - Course Content

UNIT 1	Weaving and Ceramic Technology	3 Periods
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT 2	Design and Construction Technology	3 Periods
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.		
UNIT 3	Manufacturing Technology	3 Periods
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.		
UNIT 4	Agriculture and Irrigation Technology	3 Periods
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoempu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society		
UNIT 5	Scientific Tamil & Tamil Computing	3 Periods
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		

Text Books & Reference Books:	1. தமிழக வரலாறு மக்களும் பண்பாடும் = கே. கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்) 2. கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்). 3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு) 4. பொருளை = ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு) 5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) 6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:
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	International Institute of Tamil Studies.
	7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
	8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
	9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
	10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
	11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
	12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓					✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23GE211 Engineering Practices Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to AIDS, CSE, Civil, IT, Mechanical & EEE	II	ESC	0	0	3	1.5

II - Course Objectives

1.	Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2.	Wiring various electrical joints in common household electrical wire work.
3.	Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.
4.	Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

III - Course Content**Preamble:**

Engineering Practices Laboratory – a hands-on learning experience that complements your theoretical knowledge with practical skills essential for success in the field of engineering. This laboratory course is designed to bridge the gap between classroom learning and real-world application, providing a platform to develop crucial engineering skills and gain confidence in working with tools, equipment, and techniques commonly used in engineering practice.

Group – A (Civil & Mechanical)

PART 1	Civil Engineering Practices Plumbing Work	12 Periods
Plumbing Work: a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows, and other components which are commonly used in households. b) Preparing plumbing line sketches. c) Laying pipe connection to the suction side of a pump. d) Laying pipe connection to the delivery side of a pump. e) Connecting pipes of different materials: Metal, plastic, and flexible pipes used in household appliances. Wood Work: a) Sawing, b) Planing and c) Making joints like T-Joint, Mortise joint and Tenon joint, and Dovetail joint. Wood Work Study: a) Studying joints in door panels and wooden furniture. b) Studying common industrial trusses using models.		
PART 2	Mechanical Engineering Practices	12 Periods



Welding Work:

- a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- b) Practicing gas welding.

Basic Machining Work:

- a) (simple) Turning.
- b) (simple) Drilling.
- c) (simple) Tapping.

Assembly Work:

- a) Assembling a centrifugal pump.
- b) Assembling a household mixer.
- c) Assembling an airconditioner.

SHEET METAL WORK:

- a) Making of a square tray

Group – B (Electrical and Electronics)

PART 3	Electrical Engineering Practices	11 Periods
a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets b) Staircase wiring c) Fluorescent Lamp wiring with introduction to CFL and LED types. d) Energy meter wiring and related calculations/calibration e) Study of Iron Box wiring and assembly f) Study of Fan Regulator (Resistor type and electronic type using Diac/Triac/quadrac) g) Study of emergency lamp wiring/Water heater		
PART 4	Electronic Engineering Practices	10 Periods
SOLDERING WORK: a) Soldering simple electronic circuits and checking continuity. ELECTRONIC ASSEMBLY AND TESTING WORK: a) assembling and testing electronic components on a small PCB. ELECTRONIC EQUIPMENT STUDY: a) Study an element of smart phone. b) Assembly and dismantle of LED TV. c) Assembly and dismantle of computer/laptop		

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.	Applying (BL 3)
CO2	Wire various electrical joints in common household electrical wire work.	Applying (BL 3)

CO3	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.	Applying (BL 3)
CO4	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.	Applying (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	-	-	1	1	1	-	-	-	-	2	1	1
CO-2	3	2	-	-	1	1	1	-	-	-	-	2	1	1
CO-3	3	2	-	-	1	1	1	-	-	-	-	2	1	1
CO-4	3	2	-	-	1	1	1	-	-	-	-	2	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	✓	✓				✓		✓		

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23BE212 Basic Electrical and Electronics Engineering Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E.–Mechanical Engineering	II	ESC	0	0	3	1.5

II - Course Objectives

1.	To train the students in conducting load tests on electrical machines
2.	To gain practical experience in characterizing electronic devices
3.	To train the students to use DSO for measurements.

III - Course Content

List of Experiments
1. Verification of ohms and Kirchhoff's Laws. 2. Load test on DC Shunt Motor. 3. Load test on Self Excited DC Generator 4. Load test on Single phase Transformer 5. Load Test on single phase Induction Motor 6. Characteristics of PN and Zener Diodes 7. Characteristics of BJT and SCR 8. Implementation of Binary Adder and Subtractor 9. Study of Logic Gates 10. Study of DSO

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Perform the Verification of Ohm's and Kirchhoff's Laws for DC circuits.	Applying (BL 3)
CO2	Analyze experimentally the load characteristics of electrical machines	Analyzing (BL 4)
CO3	Analyze the characteristics of basic electronic devices	Analyzing (BL 4)
CO4	Demonstrate use of DSO to measure the various parameters	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)




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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	2	1	1	-	-	1	2	-	-	-	-	-
CO-2	3	3	2	1	1	-	-	1	2	-	-	-	-	-
CO-3	3	3	2	1	1	-	-	1	2	-	-	-	-	-
CO-4	3	3	2	1	1	-	-	1	2	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	✓	✓				✓		✓		

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23GE212 & English Laboratory – II

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to All Branches	II	EEC	0	0	2	1

II - Course Objectives

1.	To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
2.	To analyze concepts and problems and make effective presentations explaining them clearly and precisely.
3.	To enhance the Employability and Career Skills of students and acquire professional skills required for workplace / higher education.
4.	To develop their confidence and help them attend interviews successfully.
5.	To make them Employable Graduates and use English language skills effectively in various situations.

III - Course Content

Preamble: This course is designed to impart necessary skills to listen, speak, read and write in order to obtain better professional communication skills.		
Unit – I	Role Play	6 Periods
Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences-talking about events in life-discussing past events.		
Unit – II	Travelogue	6 Periods
Speaking: Discussing news stories – talking about frequency – talking about travel problems-discussing travel procedures -talking about travel problems-making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms.		
Unit – III	Professional Speaking	6 Periods
Speaking: Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5minute presentations.		
Unit – IV	Group Discussion	6 Periods
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic — questioning and clarifying –GD strategies- activities to improve GD skills.		
Unit – V	Interview	6 Periods
Interview etiquette – dress code – body language – attending job interviews– telephone/skype		



interview -one to one interview & panel interview – FAQs related to job interviews.

Text Books:	1. Globarena Software. 2. Open-Source Software and YouTube Videos in Career Lab.
Reference Books:	1. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015. 2. Interact English Lab Manual for Undergraduate Students, Orient Blackswan: Hyderabad, 2016 3. English For Technica ICommunication (WithCD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN :0070264244. 4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House 5. Learning to Communicate–Dr. V. Chellammal, Allied Publishing House, NewDelhi,2003.
MOOC/Web Platforms:	1. https://www.digitalteacher.in/english-language-lab

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Speak effectively in group discussions held in a–formal/semi formal contexts.	Creating (BL 6)
CO2	Discuss, analyze and present concepts and problems from various perspectives to arrive at suitable solutions.	Analyzing (BL 4)
CO3	Make effective presentations in an attractive way using appropriate vocabulary.	Applying (BL 3)
CO4	Attend job interviews and be successful in them.	Creating (BL 6)
CO5	Develop adequate Soft Skills required for the workplace.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO-2	-	-	-	-	-	-	-	-	3	3	-	3	-	-



CO-3	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO-4	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO-5	-	-	-	-	-	-	-	-	3	3	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓					✓			✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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SEMESTER – III**I – Course Code & Name: 23MA301 & Transforms and Applications of Partial Differential Equations**

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. Common to Mechanical & Civil Engineering	III	BSC	3	1	0	4

II - Course Objectives

1.	To introduce the Fourier series analysis which is central to many applications in engineering a part from its use in solving boundary value problems.
2.	To study the application of transform techniques using Fourier Transforms.
3.	To provide the basic concepts of Z-Transform techniques for discrete time systems.
4.	To introduce the basic concepts of PDE for solving standard Partial Differential Equations.
5.	To familiarize the student with Fourier series techniques in solving heat flow problems used in various situations.

III - Course Content**Preamble:**

Fourier analysis allows modelling periodic phenomena which appears frequently in engineering, alternating electric currents or the motion of planets. The idea of Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines.

Unit – I	Fourier Series	12 Periods
Dirichlet's conditions – General Fourier series –Half range sine and cosine series – Parseval's identity – Harmonic analysis.		
Unit – II	Fourier Transforms	12 Periods
Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem (excluding proof) – Parseval's identity.		
Unit – III	Z - Transforms and Difference Equations	12 Periods
Z-transforms- Elementary properties–Inverse Z-transform (using partial fraction and residues) - Convolution theorem - Formation of difference equations – Solution of difference equations using Z -transform.		
Unit – IV	Partial Differential Equations	12 Periods
Formation of partial differential equations - Elimination of arbitrary constants and functions – Solutions of five standard types of first order partial differential equations - Lagrange's linear equation - Homogenous type of Second order Linear differential equations with constant coefficients.		



Unit – V	Applications Of Partial Differential Equations	12 Periods
Classification of PDE – Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (excluding insulated edges).		

Text Books:	1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018. 2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2018.
Reference Books:	1. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021. 2. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016. 3. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018. 4. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/111/103/111103021/ 2. https://archive.nptel.ac.in/courses/111/106/111106139/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design general periodic functions and apply in problems of Fourier series, which are sums of sines and cosines.	Apply (BL 3)
CO2	Use the Fourier transform as the tool to connect the time domain and frequency domain in signal processing.	Apply (BL 3)
CO3	Use the effective mathematical tools for the solutions of partial differential equations by using Z - Transform techniques for discrete time systems.	Apply (BL 3)
CO4	Understand how to solve the given standard partial differential equations.	Understand (BL 2)
CO5	Describe real time engineering problems using PDE in 1-D wave vibrating membrane and heat passing through rod two-dimensional heat conduction problems.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO-2	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO-3	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO-4	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO-5	3	3	1	1	-	-	-	-	2	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√	√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23ME301 & Engineering Thermodynamics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	III	PCC	3	1	0	4

II - Course Objectives

1.	To gain a foundational understanding of thermodynamics.
2.	To apply the principles of the first law of thermodynamics.
3.	To study the thermodynamic properties of pure substances and their phase change processes.
4.	To understand and analyze the second law of thermodynamics, focusing on its application in evaluating thermal device performance.
5.	To calculate changes in the properties of atmospheric air during psychrometric processes using equations and charts.

III - Course Content

Preamble: This course explores the laws behind energy changes, from basic states to complex processes. Uncover ideal gas behavior, key laws, and practical applications in clear, engaging units.		
Unit – I	Basic Concepts of Thermodynamics	12 Periods
Basic concepts - concept of continuum - Path and point functions. Intensive and extensive - System and their types - Thermodynamic Equilibrium State, path and process - Heat and work transfer - Definition and comparison, sign convention. Displacement work and other modes of work - P-V diagram - Zeroth law of thermodynamics – Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor - Generalized Compressibility Chart and its use.		
Unit – II	First Law of Thermodynamics	12 Periods
Introduction of First law of thermodynamics. Applications of First of Law of Thermodynamics - applied to Non-flow Systems – Ideal gas processes. Flow Systems – Mass balance - Continuity equation - Energy balance - Steady Flow Energy Equation.		
Unit – III	Properties of Pure Substance	12 Periods
Pure substances - Phase change - Property diagrams - thermodynamic properties of steam - Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.		
Unit – IV	Second Law of Thermodynamics	12 Periods
Thermal energy reservoir-heat engines and heat pumps - Kelvin and Clausius statements. - Reversible and irreversible processes - Carnot cycle and theorem - Clausius inequality - Concept of Entropy - Increase of entropy principle – Availability and applications.		
Unit – V	Thermodynamic Relations and Psychrometry	12 Periods
Maxwell relations – TdS Equations - heat capacities relations - Energy equation, Joule Thomson experiment - Clausius-Clapeyron equation. Psychrometry and psychrometric charts - property calculations of air vapour mixtures – Simple Psychrometric processes - Evaporative cooling.		



Text Books:	1. Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2018), NewDelhi. 2. Rajput RK, A Textbook of Engineering Thermodynamics, 4thEdition, Laxmi PublicationsPrivate Limited, 2015.
Reference Books:	1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGrawHill,9th Edition, 2019. 2. J.P Holman, Thermodynamics, Tata McGraw Hill Publishing company Pvt Ltd., New Delhi,2016. 3. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/106/112106310/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explore the fundamental concepts of thermodynamics.	Understanding (BL 2)
CO2	Apply the first law of thermodynamics to both closed and open systems.	Applying (BL 3)
CO3	Determine the thermodynamic properties of pure substances and analyze their phase change processes.	Applying (BL 3)
CO4	Solve problems related to thermodynamics devices by employing the second law of thermodynamics.	Applying (BL 3)
CO5	Evaluate thermodynamic relations and quantify changes in properties of atmospheric air undergoing psychrometric processes using equations and charts.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	-	-	2	-	-	-	-	2	3	2
CO-2	3	3	2	1	-	-	2	-	-	-	-	2	3	2
CO-3	3	3	2	1	-	-	2	-	-	-	-	2	3	2
CO-4	3	3	2	1	-	-	2	-	-	-	-	2	3	2
CO-5	3	3	2	1	-	-	2	-	-	-	-	2	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23ME302 & Strength of Materials

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	III	PCC	3	0	2	4

II - Course Objectives

1.	To understand the concepts of stress, strain, principal stresses and principal planes. To study the mechanical properties of metals by testing in laboratory.
2.	To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
3.	To determine the stresses and deformation in circular shafts and helical springs due to torsion, and study the torsion test in shafts and the stiffness of the springs.
4.	To compute the slopes and deflections in determinate beams using various methods, and perform a deflection test on the beam.
5.	To study the stresses and deformations induced in thin and thick shells.

III - Course Content

Preamble: The study of strength of materials delves into the behavior of various materials under the influence of external forces, providing insights into their mechanical properties, deformation characteristics, and structural integrity essential for engineering design and analysis.		
Unit – I	Stress, Strain and Deformation of Solids	9 Periods
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.		
Unit – II	Transverse Loading on Beams and Stresses in Beam	9 Periods
Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.		
Unit – III	Torsion	9 Periods
Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.		
Unit – IV	Deflection of Beams	9 Periods
Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.		
Unit – V	Thin Cylinders, Spheres and Thick Cylinders	9 Periods
Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lamé's theory.		



LIST OF EXPERIMENTS**(15 Periods)**

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on given metal specimen in Rockwell hardness testing Machine
4. Hardness test on given metal specimen in Brinell Hardness testing Machine
5. Compression test on helical spring
6. Deflection test on beam
7. Impact test on metal specimen - Izod test
8. Impact test on metal specimen - Charpy test
9. Effect of hardening- Improvement in hardness of steels

List of Equipment for a Batch Of 30 Students

S.No.	NAME OF THE EQUIPMENT	Quantity
1.	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity 1	1
2.	Torsion Testing Machine (60 NM Capacity)	1
3.	Impact Testing Machine (300 J Capacity)	1
4.	Brinell Hardness Testing Machine	1
5.	Rockwell Hardness Testing Machine 1	1
6.	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7.	Test beam with supports and a dial gauge	1

Text Books:	1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S. Chand & company Ltd., New Delhi, 7th edition, 2019. 2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2018. 3. Dr. R.K. Bansal "Strength of Materials, Seventh Edition, Laxmi Publications Pvt Ltd, New Delhi, 2023.
Reference Books:	1. Singh. D.K., "Strength of Materials", Ane Books Pvt Ltd., New Delhi, 2021. 2. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015. 3. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi 2019. 4. Vazirani. V.N, Ratwani. M.M, Duggal. S.K "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.
MOOC/Web Platforms:	1. https://www.nptelvideos.com/video.php?id=841&c=7




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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic principles of stress and strain to both simple and composite bars, explore various techniques for assessing mechanical properties, and grasp the importance of principal stresses and principal planes	Understanding (BL 2)
CO2	To plot the variation of shear force and bending moments over the beams under different types of loads.	Applying (BL 3)
CO3	Use the fundamental torsion equations to determine torsional shear stress and stiffness when designing shafts and helical springs.	Applying (BL 3)
CO4	Determine the slope and deflection of beams using different methods, and then perform a practical test to measure the actual deflection of the beam.	Applying (BL 3)
CO5	To analyze the cylindrical shells under circumferential and radial loading	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	3	3	-	2	1	2	2	3	1	2	3	2
CO-2	3	3	3	3	-	2	1	2	2	3	1	2	3	2
CO-3	3	3	3	3	-	2	1	2	2	3	1	2	3	2
CO-4	3	3	3	3	-	2	1	2	2	3	1	2	3	2
CO-5	3	3	3	3	-	2	1	2	2	3	1	2	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23ME303 - Manufacturing Processes

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	III	PCC	3	0	0	3

II - Course Objectives

1.	To illustrate the working principles of various metal casting processes.
2.	To learn and apply the working principles of various metal joining processes.
3.	To analyse the working principles of bulk deformation of metals.
4.	To learn the working principles of sheet metal forming process.
5.	To study and practice the working principles of plastics molding.

III - Course Content

Preamble: Metal manufacturing processes form the backbone of modern industrial production, enabling the creation of intricate components vital for various applications. From traditional casting and joining methods to cutting-edge additive manufacturing techniques, each process contributes uniquely to the fabrication landscape, balancing efficiency, precision, and material innovation.		
Unit – I	Metal Casting Processes	9 Periods
Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications – Molding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – low pressure, gravity- Tilt pouring, high pressure die casting- Centrifugal Casting – CO ₂ casting – Defects in Sand casting process-remedies.		
Unit – II	Metal Joining Processes	9 Periods
Fusion welding processes – Oxy fuel welding – Filler and Flux materials–Arc welding, Welding specifications – Gas Tungsten arc welding –Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding — Resistance welding Processes -Electron beam welding –Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects – inspection & remedies – Brazing - soldering – Adhesive bonding.		
Unit – III	Bulk Deformation Processes	9 Periods
Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.		
Unit – IV	Sheet Metal Processes	9 Periods
Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming.		
Unit – V	Manufacture of Plastic Components	9 Periods



Types and characteristics of plastics – Molding of thermoplastics & Thermosetting polymers– working principles and typical applications – injection molding – Plunger and screw machines – Compression molding, Transfer Molding – Typical industrial applications – introduction to blow molding – Rotational molding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics- duff moulding.

Text Books:	1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 4th Edition, 2013. 2. P.N.Rao Manufacturing Technology Volume 1 Mc Graw hill Education 5th edition, 2018. 3. R.K.Rajput Manufacturing Technology, Laxmi publication (P) Limited, New Delhi, Third edition, 2023.
Reference Books:	1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006. 2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008. 3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eighth Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 1997. 4. Hajra Choudhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997 5. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004 6. "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" by Ian Gibson, David W. Rosen, and Brent Stucker. 7. "Metal Additive Manufacturing: A Review" by Paolo D. Cozzolino, Nima Shamsaei, Bahman Zohuri, and Lorna Gibson.
MOOC/Web Platforms:	NPTEL Videos: https://nptel/courses/video/112105126/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the principle of different metal casting processes.	Understanding (BL 2)
CO2	Describe the various metal joining processes.	Applying (BL 3)
CO3	Illustrate the different bulk deformation processes.	Applying (BL 3)
CO4	Apply the various sheet metal forming process.	Applying (BL 3)



CO5	Apply suitable moulding technique for manufacturing of plastics components	Applying (BL 3)
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(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	1	1	-	-	2	1	1	1	-	-	1	1	2
CO-2	3	1	1	-	-	2	1	1	1	-	-	1	1	2
CO-3	3	1	1	-	-	2	1	1	1	-	-	1	1	2
CO-4	3	1	1	-	-	2	1	1	1	-	-	1	1	2
CO-5	3	1	1	-	-	2	1	1	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√							√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23GE902 - Human Values and Ethics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	III	HSMC	2	0	0	2

II - Course Objectives

1.	To understand core democratic values and their role in citizen participation.
2.	To understand secular values and their importance in promoting acceptance and non-discrimination in a diverse society.
3.	To understand the concept of secularism in the Indian context and its role in promoting acceptance of all faiths and non-discriminatory practices.
4.	To apply ethical reasoning to social issues like gender bias, violence, and discrimination, while understanding constitutional protections and promoting inclusive practices.
5.	To understand and apply professional ethics, including integrity, respect for authority, confidentiality, and the rights of employees and employers, in the workplace.

III - Course Content

Preamble: This course aims to provide a broad understanding of the modern values and ethical principles that have evolved and are enshrined in the Constitution of India concerning the democratic, secular, and scientific aspects. The course is designed for undergraduate students so that they can study, understand, and apply these values in their day-to-day lives.

Unit – I	Democratic Values	6 Periods
Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in the Governance-Indian Freedom Movement.		
Unit – II	Secular Values	6 Periods
Understanding Secular values – Interpretation of secularism in the Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.		
Unit – III	Scientific Values And Ethics	6 Periods
Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, validating facts using an evidence-based approach. Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions.		
Unit – IV	Social Ethics	6 Periods
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.		
Unit – V	Professional Ethics	6 Periods
Plagiarism - Dishonesty - Stealing - Respect for Authority – Collective Bargaining - Confidentiality – Conflicts of Interest – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination. Values, and standards that both employees and employers - Code of ethics in the workplace.		



Text Books:	1. Reading Text: Excerpts from John Stuart Mills on Liberty. 2. Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani. 3. Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R. 4. Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari.
Reference Books:	1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016. 2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016. 3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017. 4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press, 5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022
MOOC/Web Platforms:	1. www.onlineethics.org 2. www.nspe.org 3. www.globalethics.org 4. www.ethics.org

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain how democratic values like equality, liberty, and justice enhance governance and citizen participation.	Understand (BL 2)
CO2	Apply secular values to ensure acceptance of all faiths and non-discrimination.	Apply (BL 3)
CO3	Apply scientific thinking and methods to assess and promote transparency, fairness, and ethical use of scientific inventions for societal benefit.	Apply (BL 3)
CO4	Explain how ethical reasoning applies to social issues and constitutional protections.	Understand (BL 2)
CO5	Apply professional ethics to address issues such as honesty, confidentiality, and conflicts of interest in the workplace.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	1	2	3	1	2	-	2	-	-
CO-2	-	-	-	-	-	1	2	3	1	2	-	2	-	-



CO-3	-	-	-	-	-	1	2	3	1	2	-	2	-	-
CO-4	-	-	-	-	-	1	2	3	1	2	-	2	-	-
CO-5	-	-	-	-	-	1	2	3	1	2	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓					✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23ME311 - Computer Aided Machine Drawing

Prerequisites	Program Name	Sem	Category	L	T	P	C
23GE202 Engineering Graphics	B.E. – Mechanical Engineering	III	ESC	0	0	4	2

II - Course Objectives

1.	To impart fundamental knowledge and basic skills to the students in drafting and modelling techniques
2.	To make the students understand and interpret drawings of machine components.
3.	To develop skills on creating 2D and 3D models using modelling packages.

III - Course Content

Preamble: This course explores fundamental principles of engineering graphics, focusing on projection, geometric construction, dimensioning, and tolerancing. It develops skills to create and interpret precise drawings essential for translating ideas into functional machinery and give the technical communication through detailed and accurate engineering drawings.

Part I	Drawing Standards & Fits and Tolerances	12 Periods
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Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits - tagging and international standards – Tolerancing of individual dimensions IS919- Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning & Tolerancing.

Part II	2D Drafting	30 Periods
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Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.

1. Bearings – Bush Bearing
2. Valves – Safety and Non-return Valves
3. Couplings – Flange
4. Joints – Universal, Knuckle
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, multi-plate clutch.
6. Machine Components – Screw Jack, Machine Vice, Lathe Tail Stock, Lathe Chuck, Plummer Block

Total: 20% of classes for theory classes and 80% of classes for practice

Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software.

Part III	3D Modelling	18 Periods
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1. Construct a three-dimensional modelling and assembly of coupling.
2. Create a three-dimensional modelling and assembly of tailstock of lathe.



Text Books:	1. Gopalakrishna K.R., "Machine Drawing", 17th Edition, Subhas Stores Books Corner, Bangalore, 2003 2. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 51st Edition, Charator Publishers, 2022
Reference Books:	1. K. L Narayana, P. Kannaiah, K. Venkata Reddy, Machine Drawing, 15 Edition, New Age International Publication 2. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata McGrawHill, 2006 3. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112102101 2. https://onlinecourses.nptel.ac.in/noc21_me125/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To draw orthographic projections of simple components using geometric modeling software.	Understanding (BL 2)
CO2	To create three-dimensional assembly models of automotive and machine components using CAD software.	Applying (BL 3)
CO3	To generate 3D assembly models of machine elements using CAD software.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	3	2	3	-	-	2	3	2	-	3	3	2
CO-2	3	2	3	2	3	-	-	2	3	2	-	3	2	2
CO-3	3	2	3	2	3	-	-	2	3	2	-	3	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI –Pedagogies (Select appropriate Teaching pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√							√		

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)

SEMESTER – IV**I – Course Code & Name: 23ME401 Thermal Engineering**

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME301 – Engineering Thermodynamics	B.E. – Mechanical Engineering	IV	PCC	3	1	0	4

II - Course Objectives

1.	To apply thermodynamics laws to predict the operation of gas power cycles.
2.	To analyze the performance of vapor power cycles and steam nozzles.
3.	To analyze the performance of steam turbines using velocity triangles and to investigate performance enhancement techniques in gas turbines.
4.	To analyze the operation of internal combustion engines and their auxiliary systems, and to evaluate various performance parameters of IC engines.
5.	To provide a thorough understanding of the operational principles, performance of refrigeration and air conditioning systems.

III - Course Content

Preamble: This course provides a comprehensive understanding of thermodynamic cycles and systems including gas and vapour power cycles, steam and turbines, internal combustion engines, and refrigeration systems. Students will develop expertise in performance analysis, efficiency evaluation, and the optimization of energy systems in various engineering applications.		
Unit – I	Gas Power Cycles	12 Periods
Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison. Applications of air standard cycles in advanced automotive systems.		
Unit – II	Vapour Power Cycle & Steam Nozzles	12 Periods
Vapour Power Cycle: Basic Rankine Cycle, modified, reheat and regenerative cycles. Cogeneration systems Steam Nozzles: Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.		
Unit – III	Steam and Gas Turbines	12 Periods
Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Industrial applications: Impulse and Reaction Turbines - Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.		
Unit – IV	IC Engines – Features and Performance	12 Periods



IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Combustion in SI & CI Engines – Knocking – phenomena and control. Ignition systems – Magneto, Battery and Electronic. Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests.

Unit – V	Refrigeration and Air Conditioning	12 Periods
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Refrigeration-Principles, COP, power calculations, refrigerants, Vapour absorption Refrigeration Systems. Refrigeration Devices - Expansion devices- Evaporators - condenser and cooling towers-capacity-system balancing- types of refrigerating compressors.

Air Conditioning- Effective temperature, comfort conditions - Psychrometry, Psychrometer, Psychrometric processes - Modern techniques in food preservation.

Text Books:	1. Domkundwar, Kothandaraman, & Domkundwar, "A Course in Thermal Engineering", 6th Edition, Dhanpat Rai& Sons, 2011. 2. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2017
Reference Books:	1. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012. 2. Arora C P, "Refrigeration and Air Conditioning", 4th Edition Tata McGraw-Hill, New Delhi,2003, 2020. 3. Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi,2003 4. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/103/112103316/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply thermodynamic concepts to analyze various gas power cycles and solve related engineering problems.	Applying (BL 3)
CO2	Solve problems in vapor power cycles and steam nozzles, including calculation of critical pressure ratios.	Applying (BL 3)
CO3	Analyze the flow characteristics in steam turbines, construct velocity diagrams to understand turbine performance, and evaluate gas turbines through cycle analysis to solve performance-related problems.	Applying (BL 3)
CO4	Explain the functioning and features of IC engines, including their components and auxiliary systems, and evaluate various performance parameters.	Applying (BL 3)
CO5	Analyze the performance of refrigeration and air conditioning systems in various applications.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	2	3	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	2	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



Chairperson - Board of Studies,
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I – Course Code & Name: 23ME402 Manufacturing Technology

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME302 - Manufacturing Processes	B.E. – Mechanical Engineering	IV	PCC	3	0	0	3

II - Course Objectives

1.	To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
2.	To learn working of basic and advanced turning machines
3.	To impart knowledge and practical skills in the operation of reciprocating, drilling, boring, slotting, and grinding machines, along with fine finishing processes.
4.	To understand the basic concepts, constructional features, and operational principles of CNC machine tools and to learn CNC programming for developing part programs for machining centers.
5.	To explore the evolution, technologies, and key drivers of modern manufacturing, focusing on automation, AI, IoT, additive manufacturing, robotics, and digital integration.

III - Course Content

Preamble: Manufacturing Technology delves into the core principles of metal cutting, encompassing turning and reciprocating machines. To equip students with knowledge on advanced manufacturing environments, it integrates CNC programming and explores contemporary manufacturing advancements, including additive manufacturing, robotics, and Industry 4.0 concepts.		
UNIT - 1	Mechanics of Metal Cutting	9 Periods
Introduction - Mechanics of chip formation, forces in machining, Types of chip, cutting tools – Single point cutting tool nomenclature, orthogonal and oblique metal cutting, Thermal aspects. cutting tool materials, tool wear, tool life, surface finish, cutting fluids -properties, and Machinability.		
UNIT - 2	Turning Machines	9 Periods
Introduction - Types- Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Special lathes – Capstan and turret lathes – Introduction and turret indexing mechanism – tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type		
UNIT - 3	Special Machines	9 Periods



Reciprocating machine tools: shaper, planer, slotter: Types of operations making, crank, and slotted link quick return mechanisms: Drilling, types of drills and nomenclature of twist drill, reaming, boring, tapping, type of milling operations—attachments—types of milling cutters—machining time calculation – Gear cutting, gear hobbing and gear– gear finishing methods. Grinding, types of grinding process, Fine finishing processes - Honing, lapping, buffing and super finishing.		
UNIT - 4	Programming of CNC Machines And Machine Tools	9 Periods
Computer Numerical Control (CNC) machine tools, constructional details, special features – tool changers; CNC Control systems – Open/closed, point-to-point/continuous – Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features. Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes.		
UNIT - 5	Modern Manufacturing	9 Periods
Evolution of modern manufacturing, Importance of technology, Key drivers: Automation, Industry 4.0, AI, and IoT, Challenges and opportunities in modern manufacturing - Additive Manufacturing, Advantages and Challenges - Smart Manufacturing and Industry 4.0, Introduction to Industry 4.0, Key concepts, Applications, Challenges – Automation – Future Trends in Manufacturing Automation.		

Text Books:	1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 7th Edition, 2018 2. Michael Fitzpatrick. Machining and CNC Technology, McGraw–Hill Education; 4th edition, 2018. 3. D. P. T. DeGroot and R. C. D. Myers, Additive Manufacturing: Materials, Processes, and Applications", Springer, 1st edition 2018.
Reference Books:	1. Roy. A. Lindberg, Processes and materials of manufacture, PHI/ Pearson education, 2006. 2. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984. 3. Rao. P.N "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw – Hill, New Delhi, 2009. 4. A.B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017. 5. Peter Smid, CNC Programming Handbook, Industrial Press Inc; Third edition, 2007. 6. Paul G. Ranky, Smart Manufacturing: Concepts and Methods", Springer, 2nd edition, 2017.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/105/112105126/




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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the mechanism of metal removal process and to identify the factors involved in improving machinability	Apply (BL 3)
CO2	Describe the constructional and operational features of centre lathe and other special purpose lathes.	Understand (BL 2)
CO3	Describes the construction and operational features of reciprocating machine tools, grinding and fine finishing processes, and develops practical skills in grinding machine operations.	Understand (BL 2)
CO4	Apply the constructional features and working principles of CNC machine tools to plan, write codes, and set up CNC machines, demonstrating the ability to manufacture a given component effectively.	Apply (BL 3)
CO5	Understand the impact of modern technologies on manufacturing, including automation, robotics, and smart manufacturing trends.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	3	1	1	1	3	-	-	3	-	2	-	1
CO-2	3	3	3	1	1	1	3	-	-	3	-	2	-	1
CO-3	3	3	3	1	1	1	3	-	-	3	-	2	-	1
CO-4	3	3	3	1	1	1	3	-	-	3	-	2	-	1
CO-5	3	1	1	-	1	1	3	-	-	1	-	2	-	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓				✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



Buy
Chairperson - Board of Studies,
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I - Course Name: 23GE901 Environmental Sciences and Sustainability

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. /B.TECH. Common for EEE, Civil, Mech and AI & DS	IV	BSC	2	0	0	2

II - Course Objectives

1.	To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
2.	To impart knowledge on the causes, effects and control or prevention measures of environmental pollution.
3.	To study the dynamic processes and understand the features of the earth's interior and surface.
4.	To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
5.	To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

III - Course Content**Preamble:**

The objective of this course is intended to make the students to understand the basic concepts of environment, ecology and pollution of the current environmental issues and to participate in various activities on conserving and protecting the environment.

Unit – I	Environment and Biodiversity	6 Periods
Definition, scope and importance of environment – need for public awareness. Eco-system and energy flow – ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: in-situ and ex-situ.		
Unit – II	Environmental Pollution	6 Periods
Causes, effects and preventive measures of water, soil, air and noise pollutions. Solid, hazardous and e-waste management. case studies on occupational health and safety management system (OHSMS). Environmental protection - environmental protection acts.		
Unit – III	Social Issues and the Environment	6 Periods
Water conservation, rain water harvesting, watershed management – Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.		
Unit – IV	Renewable Sources of Energy	6 Periods



Energy management and conservation, new energy sources: need of new sources. Different types of new energy sources. Applications of - hydrogen energy, ocean energy resources, tidal energy conversion. Concept, origin and power plants of geothermal energy.

Unit – V	Sustainability Practices	6 Periods
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Zero waste and R concept, circular economy, ISO 14000 series, material life cycle assessment, environmental impact assessment. Sustainable habitat: green buildings, green materials, energy efficiency, Sustainable transports. Sustainable energy: non-conventional sources, energy cycles carbon cycle, emission and sequestration, green engineering: sustainable urbanization - socio economical and technological change.

Text Books:	1. Anubha Kaushik and C. P. Kaushik's 'Perspectives in Environmental Studies', 6th Edition, New Age International Publishers, 2018. 2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2017. 3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004. 4. Allen, D. T. and Shonnard, D. R., 'Sustainability Engineering: Concepts, Design and Case Studies', Prentice Hall. 5. Bradley. A.S; Adebayo, A.O., Maria, P. 'Engineering applications in sustainable design and development', Cengage learning. 6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
Reference Books:	1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media, 2010. 2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015. 3. Erach Bharucha 'Textbook of Environmental Studies for Under graduate Courses' Orient Blackswan Pvt. Ltd. 2021.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation	Remember (BL 1)
CO2	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.	Understand (BL 2)
CO3	To identify the causes, effects of natural disasters and contribute to the preventive measures in the society.	Apply (BL 3)



CO4	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.	Understand (BL 2)
CO5	To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	-	-	-	2	3	-	1	-	-	2	1	1
CO-2	3	2	-	-	-	3	3	-	1	-	-	2	1	1
CO-3	3	1	1	-	-	2	2	-	-	-	-	2	1	1
CO-4	3	1	1	1	-	2	2	-	1	-	-	2	1	1
CO-5	3	2	1	-	-	2	2	-	1	-	-	1	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√			√				√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



B. My

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I – Course Code & Name: 23ME403 Theory of Machines

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME201 - Engineering Mechanics	B.E. – Mechanical Engineering	IV	PCC	3	0	2	4

II - Course Objectives

1.	To study the basic components of mechanisms, analyze their assembly in terms of displacement, velocity, and acceleration at any point in a link.
2.	To study the basic concepts of toothed gearing and kinematics of gear trains.
3.	To analyze mechanical systems through static and dynamic force analysis.
4.	To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
5.	To analyze the effect of dynamics of undesirable vibrations.

III - Course Content

Preamble: Theory of Machines focuses on the principles and methodologies essential for understanding, designing, and analyzing mechanical systems. It covers topics such as kinematics of mechanism, cams, gears, force analysis, gyroscopes, and vibration principles to provide a comprehensive understanding of mechanical behavior and system dynamics.

Unit – I	Kinematics of Mechanisms	9 Periods
Mechanisms – Concept and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – kinematics inversions of four bar and slide crank chain Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms.		
Unit – II	Gears and Gear Trains	9 Periods
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.		
Unit – III	Force Analysis	9 Periods
Dynamic force analysis – Inertia force and Inertia torque– D'Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses.		
Unit – IV	Balancing of Mass	9 Periods
Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.		
Unit – V	Free and Forced Vibration	9 Periods



Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration – Torsional vibration of shaft – Critical speeds of shafts – Two and three rotor torsional systems.

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion – transmissibility – Vibration isolation vibration measurement.

List of Experiments**(15 Periods)**

1. Study of Four Bar, Slider Crank and Crank Rocker Mechanisms
2. Determine the speed at which cam jump occur for various spring loading condition.
3. Study of simple, compound and epicyclic gear trains.
4. Determination of moment of inertia of flywheel and axle system.
5. Determination of mass moment of inertia of a body about its axis of symmetry.
6. Dynamic Balancing of Rotating Masses
7. To determine the gyroscopic effect of rotating masses
8. Determine natural frequency of Undamped free vibrations of a single degree freedom spring-mass system.
9. Determine natural frequency of Torsional Vibration (Undamped) of single rotor shaft system.
10. Determine Natural frequency of Transverse Vibration (Cantilever Beam)
11. Determination of Critical Speed of a Shaft using Whirling Apparatus.

List of Equipment for a Batch of 30 Students

S. No.	NAME OF THE EQUIPMENT	Quantity
1.	Kinematic Models to study various mechanisms.	1
2.	CAM Jump Setup	1
3.	Gear Models.	1
4.	Flywheel and axle system	1
5.	Turn table apparatus.	1
6.	Dynamic balancing machine	1
7.	Motorized gyroscope	1
8.	Spring mass vibration system	1
9.	Torsional Vibration of single rotor system setup.	1
10.	Transverse Vibration Setup	1
11.	Whirling of shaft apparatus.	1

Text Books:	1. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019. 2. Khurmi R.S., "Theory of Machines" 14th edition S. Chand Publication, 2017 3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
Reference Books:	1. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2nd edition, 2014. 2. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008. 3. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019.



	4. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112/104/112104121/ 2. https://nptel.ac.in/courses/112105268/ 3. https://nptel.ac.in/courses/112101096/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design and analyze mechanisms, including kinematic inversions and apply these concepts to mechanical systems.	Analyze (BL 4)
CO2	Examine and design spur gears and gear train systems, including parallel axis and epicyclic types, for automotive applications.	Applying (BL 3)
CO3	To analyze dynamic forces, apply D'Alembert's principle, study engine dynamics, interpret torque diagrams, and design flywheels.	Applying (BL 3)
CO4	To analyze and apply balancing techniques for rotating masses, single and multi-cylinder engines, linkages, and rotors using balancing machines and field balancing methods.	Applying (BL 3)
CO5	To analyze vibratory systems, free and damped vibrations, torsional vibrations, forced vibrations, and apply vibration isolation and measurement techniques.	Analyze (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-2	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-3	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-4	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-5	3	3	2	-	1	-	-	-	1	1	-	1	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓	✓			✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



**Chairperson - Board of Studies,
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I – Course Code & Name: 23ME404 Fluid Mechanics and Machinery

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	IV	PCC	3	0	2	4

II - Course Objectives

1.	To develop an understanding of fluid properties and their behavior under static and dynamic conditions, and how these are applied in real-world applications
2.	To investigate the differences between laminar and turbulent flow in circular conduits, including the losses associated with pipe flow
3.	To gain an understanding of dimensional analysis and model testing
4.	To understand the performance calculations of turbine and their associated velocity triangles
5.	To understand the performance calculations of pumps and the corresponding velocity triangles

III - Course Content

Preamble: Fluid Mechanics and Machinery offers a comprehensive understanding of fluid properties, flow behavior, and fluid machinery operation. It covers fluid dynamics, pipe flow, dimensional analysis, and turbine performance, focusing on both theoretical concepts and practical engineering applications.		
Unit – I	Fluid Properties and Flow Characteristics	10 Periods
Introduction and Basic concepts of Fluid Mechanics. Continuum assumption - Fluid properties - Absolute, gauge and vacuum pressures, Static pressure measurement, Manometry -Eulerian and Lagrangian description of fluids, local and convective acceleration - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.		
Unit – II	Flow Through Pipes	8 Periods
Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel.		
Unit – III	Dimensional Analysis and Model Studies	9 Periods
Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.		
Unit – IV	Turbines	9 Periods
Rotodynamic machines - Classification of turbines – Working principles - Pelton wheel - Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines - theoretical perspective of smart turbines		
Unit – V	Pumps	9 Periods



Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies- Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps - theoretical perspective of smart pumps

Text Books:	1. Modi P.N. and Seth, S.M. Hydraulics & Fluid Mechanics including Hydraulic Machines, Standard Book House, New Delhi, 22nd edition 2019. 2. Yunus A. Cengel; John M. Cimbala, Fluid Mechanics Fundamental and Application, McGraw Hill Education Pvt. Ltd., 4th Edition, 2019. 3. R. K. Bansal, Textbook of Fluid Mechanics & Hydraulic Machines, Laxmi Publications Pvt Ltd, 9th Edition, 2017.
Reference Books:	1. Fox W.R., McDonald A.T. and Mitchell J.W., Introduction to Fluid Mechanics, John-Wiley & Sons, Singapore, 2020. 2. S. K. Som, Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 3rd edition, 2021. 3. Subramanya, K. Fluid Mechanics and Hydraulic Machines (Problems and Solutions), Tata McGraw- Hill Pub. Co., New Delhi, 2nd edition, 2018. 4. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014. 5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 9th edition, 2017.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112104117 2. https://nptel.ac.in/courses/112105182 3. https://nptel.ac.in/courses/105101082

LIST OF EXPERIMENTS**(15 Periods)**

1. Verification of energy equation.
2. Calculation the rate of flow using the Rota meter.
3. Determination of the Coefficient of discharge of the given Orifice meter.
4. Determination of the Coefficient of discharge of the given Venturi meter.
5. Determination of friction factor for a given set of pipes.
6. Conducting experiments and drawing the characteristic curves of the Pelton wheel.
7. Conducting experiments and drawing the characteristics curves of the Francis turbine.
8. Conducting experiments and drawing the characteristics curves of the Kaplan turbine.
9. Conducting experiments and drawing the characteristic curves of the centrifugal pump.
10. Conducting experiments and drawing the characteristic curves of the reciprocating and gear pump.

List of Equipment for a Batch of 30 Students

S. No.	NAME OF THE EQUIPMENT	Quantity
1.	Bernoulli apparatus	1
2.	Orifice meter	1
3.	Venturi meter	1
4.	Rota meter	1



5.	Set of pipes	1
6.	Pelton wheel	1
7.	Francis turbine	1
8.	Kaplan turbine	1
9.	Centrifugal pump	1
10.	Reciprocating pump	1
11.	Gear pump.	1

Text Books:	1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, (2017). 2. Yunus A. Cengel; John M. Cimbala, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
Reference Books:	1. R K Bansal, Fluid mechanics and Hydraulic machines, Laxmi Publications Pvt Ltd, Ninth Edition 2012. 2. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012. 3. Subramanya, K. Fluid Mechanics and Hydraulic Machines, Tata McGraw- Hill Pub. Co., New Delhi, 2011. 4. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014. 5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co. (2010).
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112104117 2. https://nptel.ac.in/courses/112105182 3. https://nptel.ac.in/courses/105101082

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand fluid properties, distinguish them from solids, and examine their behavior under both static and dynamic conditions.	Understanding (BL 2)
CO2	Calculate pipeline losses under laminar and turbulent flow conditions, analyze pipes in series and parallel, and determine the associated losses in circular conduits	Applying (BL 3)
CO3	Apply dimensional analysis and model testing techniques to establish relationships among parameters and assess prototype performance through model studies	Applying (BL 3)
CO4	Apply performance calculations to turbines and analyze the associated velocity triangles	Applying (BL 3)
CO5	Perform calculations to evaluate performance of pumps, analyze their characteristics, and interpret the associated velocity triangles.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	2	2	-	-	1	-	1	-	-	1	2	-
CO-2	3	3	3	2	-	-	1	-	1	-	-	1	2	-
CO-3	3	3	3	3	-	-	1	-	1	-	-	1	2	-
CO-4	3	3	3	3	-	-	1	-	1	-	-	2	2	-
CO-5	3	3	3	3	-	-	1	-	1	-	-	2	2	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO) 2

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	√	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23ME411 Thermal Engineering Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME301 & Engineering Thermodynamics	B.E. – Mechanical Engineering	IV	PCC	0	0	4	2

II - Course Objectives

1.	To study the valve and port timing diagram and performance characteristics of IC engines
2.	To study the Performance of Air conditioning and refrigeration cycle / components
3.	To study the Performance and Energy Balance Test on a Steam Generator.

III - Course Content**Preamble:**

The primary objective of the laboratory is to teach students experimental methods related to thermal energy and various engines. It also demonstrates the operational procedures of these engines. The experimental data obtained can be used to determine additional fuel properties. To ensure students grasp the theoretical concepts, classroom lectures are scheduled before the laboratory sessions. Students are encouraged to focus during lectures to enhance their performance in the lab.

List of Experiments**List of Experiments:**

1. Valve Timing and Port Timing diagrams.
2. Performance Test on four – stroke Diesel Engine
3. Heat Balance Test on 4 – stroke Diesel Engine.
4. Morse Test on Multi-Cylinder Petrol Engine.
5. Retardation Test on a Diesel Engine.
6. Determination of Flash Point and Fire Point of various fuels / lubricants
7. Determination of viscosity of various fuels / lubricants
8. Performance test on a two stage Reciprocating Air compressor
9. Determination of COP of a Refrigeration system
10. Determination of COP Air- Conditioning of a system
11. Study of Steam Generators and Turbines.
12. Performance and Energy Balance Test on a Steam Generator.
13. Performance and Energy Balance Test on Steam Turbine.

60 Periods

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List of Equipment for a Batch of 30 Students

S. No.	Description of Equipment	Quantity
1	I.C Engine – 2 stroke and 4 stroke cut section model.	1
2	Apparatus for Flash and Fire Point	1
3	Viscometers	1
4	4-stroke Diesel Engine with mechanical loading	1
5	4-stroke Diesel Engine with hydraulic loading.	1
6	4-stroke Diesel Engine with electrical loading.	1
7	Multi-cylinder Petrol Engine	1
8	Single cylinder Petrol Engine	1
9	Data Acquisition system with petrol engine	1
10	Two stage reciprocating air compressors	1
11	Refrigeration test rig	1
12	Air-conditioning test rig	1
13	Steam Boiler with turbine setup	1

Text Books:	1. Tamilselvan Rathinasamy, Benjamin Franklin, Thermal Engineering Laboratory -I, Scholars Press 2. Patrick Gallagher, Hand Book Of Thermal Analysis and Calorimetry - Principles and Practices, Elsevier
Reference Books:	1. RS Khurmi JK Gupta , A text book of Thermal Engineering SI Unit, S.Chand Publications 2. Yunus A Cengal, Fundamental of Thermal – Fluid Sciences, Tata Mcgraw Hill 3. S.C Garg , R.M.Bansal, C.K.Ghosh, Thermal Physics – Kinetic Theory, Thermodynamics and Statistical Mechanics. Mc Graw Hill. 4. Er.R.K.Rajput, Thermal Engineering 3rd Edition, Laxmi Publications.
MOOC/Web Platforms:	-

IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Conduct tests to evaluate performance characteristics of IC engines	Applying (BL 3)
CO2	Conduct tests to evaluate the performance of refrigeration cycle	Applying (BL 3)
CO3	Conduct tests to evaluate Performance and Energy Balance on a Steam Generator	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	3	2	2	-	-	2	3	2	-	3	3	2
CO-2	3	2	3	2	2	-	-	2	3	2	-	3	2	2
CO-3	3	2	3	2	2	-	-	2	3	2	-	3	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI –Pedagogies (Select appropriate Teaching pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	√					√		√

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23ME412 Manufacturing Technology Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME303 & Manufacturing Process	B.E. – Mechanical Engineering	IV	PCC	0	0	4	2

II - Course Objectives

1.	To Selecting appropriate tools, equipment's and machines to complete a given job.
2.	To Performing various welding process using GMAW and fabricating gears using gear making machines
3.	To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analysing the defects in the cast and machined components

III - Course Content

Preamble: The Manufacturing Technology Laboratory provides hands-on training in basic manufacturing processes such as machining, welding, casting, and forming. It helps students understand the working of machine tools and develop practical skills in material removal and fabrication techniques. The lab bridges theoretical knowledge with real-world applications, preparing students for industrial practices and problem-solving in manufacturing engineering.

List of Experiments**List of Experiments**

- 1 Fabricating simple structural shapes using Gas Metal Arc Welding machine
- 2 Preparing green sand moulds with cast patterns
- 3 Taper Turning and Eccentric Turning on circular parts using lathe machine
- 4 Knurling, external and internal thread cutting on circular parts using lathe machine
- 5 Shaping – Square and Hexagonal Heads on circular parts using shaper machine
- 6 Drilling and Reaming using vertical drilling machine
- 7 Milling contours on plates using vertical milling machine
- 8 Cutting spur and helical gear using milling machine
- 9 Generating gears using gear hobbing machine
- 10 Generating gears using gear shaping machine
- 11 Grinding components using cylindrical and centerless grinding machine
- 12 Grinding components using surface grinding machine
- 13 Cutting force calculation using dynamometer in milling machine
- 14 Cutting force calculation using dynamometer in lathe machine

60 Periods**List of Equipment for a Batch of 30 Students**

S. NO.	Name of the Equipment	Quantity
1	Centre Lathes	7
2	Shaper	1
3	Horizontal Milling Machine	1
4	Vertical Milling Machine	1



5	Surface Grinding Machine	1
6	Cylindrical Grinding Machine	1
7	Radial Drilling Machine	1
8	lathe Tool Dynamometer	1
9	Milling Tool Dynamometer	1
10	Gear Hobbing Machine	1
11	Gear Shaping machine	1
12	Arc welding transformer with cables and holders	2
13	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	1
14	Moulding table, Moulding equipments	2
Text Books:		1. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, Workshop Technology Vol. I & II, Media Promoters & Publishers Pvt. Ltd.
Reference Books:		1. P. N. Rao, Manufacturing Technology – Vol. I & II, Tata McGraw-Hill 2. R. K. Jain, Production Technology, Khanna Publishers. 3. S. K. Hajra Choudhury, Elements of Workshop Technology Vol. I & II, Media Promoters & Publishers Pvt. Ltd. 4. H. N. Gupta, R.C. Gupta, Arun Mittal. Manufacturing Processes, New Age International
MOOC/Web Platforms:		-

IV – Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW.	Applying (BL 3)
CO2	The students able to make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.	Applying (BL 3)
CO3	The students become make the gears using gear making machines and analyze the defects in the cast and machined components	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
CO-2	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2



CO-3	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
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Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI –Pedagogies (Select appropriate Teaching pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓					✓		✓

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



SEMESTER – V**I – Course Code & Name: 23ME501 Design of Machine Elements**

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME303 – Strength of Materials	B.E. – Mechanical Engineering	V	PCC	3	1	0	4

II - Course Objectives

1.	To learn the various steps involved in the Design Process.
2.	To Learn designing shafts and couplings for various applications.
3.	To Learn the design of temporary and permanent Joints.
4.	To Learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for various applications.
5.	To Learn designing and select sliding and rolling contact bearings, seals and gaskets.

III - Course Content

Preamble: Design of Machine Elements covers the fundamental principles for designing mechanical components to withstand diverse loads. It focuses on stress analysis, material selection, and failure prevention to ensure safety and reliability. The course combines theory and practical methods for creating durable, efficient machine parts. Emphasis is placed on real-world applications and engineering standards.

Unit – I	Fundamental Concepts in Design	12 Periods
Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and ‘C’ frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards.		
Unit – II	Design of Shafts and Couplings	12 Periods
Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.		
Unit – III	Design Of Temporary and Permanent Joints	12 Periods
Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads- theory of bonded joints.		
Unit – IV	Design of Energy Storing Elements and Engine Components	12 Periods



Types of springs, design of helical and concentric springs—surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines— Solid and Rimmed flywheels- connecting rods and crank shafts— Development of transmission systems for electric vehicle applications.

Unit – V	Design of Bearings and Miscellaneous Elements	12 Periods
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Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings – Designing Bearings with Integrated Lubrication Systems to reduce Wear and Extend Life.

Text Books:	1. Bhandari V B, "Design of Machine Elements", 4th Edition , Tata McGraw-Hill Book Co, 2016 2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill , 2015.
Reference Books:	1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co,2004. 2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee EmreyHornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2004. 3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017. 4. Sundararamamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003. 5. Design of Machine Elements SI Edition Eighth Edition By Pearson by M. F. Spotts, Terry E. Shoup,et al. 25 March 2019
MOOC/Web Platforms:	1. https://nptel.ac.in/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the design principles of machine members subjected to static and variable loads.	Applying (BL 2)
CO2	Apply design concepts to shafts, keys, and couplings for safe and efficient operation.	Applying (BL 3)
CO3	Apply design principles to various types of joints including bolted, knuckle, cotter, riveted, and welded joints.	Applying (BL 3)
CO4	Apply design concepts to helical springs, leaf springs, flywheels, connecting rods, and crankshafts considering their functional requirements.	Applying (BL 3)
CO5	Apply design principles to select appropriate sliding and rolling contact bearings, seals, and gaskets based on operating conditions.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	1	-	1	-	-	-	-	-	-	-	3	3
CO-2	3	3	2	1	2	1	-	-	-	-	-	-	3	3
CO-3	3	3	2	1	2	1	-	-	-	-	-	-	3	3
CO-4	3	3	2	1	2	1	-	-	-	-	-	-	3	3
CO-5	3	3	2	1	2	1	-	-	-	-	-	-	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23 ME502 Metrology and Measurements

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V	PCC	3	0	0	3

II - Course Objectives

1.	To learn basic concepts of the metrology and importance of measurements.
2.	To teach measurement of linear and angular dimensions assembly and transmission elements.
3.	To study the tolerance analysis in manufacturing.
4.	To develop the fundamentals of GD & T and surface metrology
5.	To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

III - Course Content

Preamble: This course introduces the fundamentals of metrology, covering measurement principles, instruments, tolerance analysis, surface evaluation, and modern techniques like lasers and CMM. It prepares students to ensure accuracy and quality in engineering and manufacturing.		
Unit – I	Basics of Metrology	9 Periods
Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.		
Unit – II	Measurement of Linear, Angular Dimensions, Assembly and Transmission Elements	9 Periods
Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.		
Unit – III	Tolerance Analysis	9 Periods
Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Proximity Sensors, Process capability, tolerance stack up, tolerance charting.		
Unit – IV	Metrology of Surfaces	9 Periods
Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface		



finish – Functionality of surfaces, Parameters, Comparative, Stylus-based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.		
Unit – V	Advances in Metrology	9 Periods
Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi sensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in process monitoring in production – Basic concepts of reverse engineering		

Text Books:	1. Whitehouse, D. J. (1994). Handbook of Surface Metrology (1st ed.). Institute of Physics Publishing / Routledge. ISBN 978-0750300391. 2. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition 2012. 3. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.
Reference Books:	1. AmmarGrous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011. 2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990. 3. National Physical LaboratoryGuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk. 4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013. 5. Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley & Sons, 2015.
MOOC/ Web Platforms:	1. https://nptel.ac.in/course.html 2. https://www.edx.org 3. https://www.udemy.com 4. https://ocw.mit.edu

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the concepts of measurements to apply in various metrological instruments.	Understand K2
CO2	Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.	Apply K3
CO3	Apply the tolerance symbols and tolerance analysis for industrial applications.	Apply K3
CO4	Apply the principles and methods of form and surface metrology.	Apply K3
CO5	Apply the advances in measurements for quality control in manufacturing Industries.	Apply K3

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	2	-	-	-	-	1	-	-	1	3	2
CO-2	3	2	2	2	-	-	-	-	1	-	-	1	3	2
CO-3	3	2	2	2	-	-	-	-	1	-	-	1	3	2
CO-4	3	2	2	2	-	-	-	-	1	-	-	1	3	2
CO-5	3	2	2	2	-	-	-	-	1	-	-	1	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk PowerP oint	Smart Board/ Video	Demo Model	Case Study Video	Google Classroom	Flipped Classroom s	Activity -based	Tutorial	Project/ Problem- based	Assign ment/ Group Discus sion	Simulation / Trouble shooting
√	√			√			√	√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23ME503 Computer Aided Design and Manufacturing

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V	PCC	3	0	0	3

II - Course Objectives

1.	To understand the product cycle, design process, CAD/CAM concepts, computer graphics, and manufacturing performance models.
2.	To describe the principles of curve, surface, and solid modeling techniques used in engineering design.
3.	To understand CAD standards, data exchange formats, and communication protocols for design and manufacturing.
4.	To interpret the construction, operation, and programming concepts of CNC machines and CAM integration.
5.	To discuss the concepts of Group Technology, Cellular Manufacturing, and Flexible Manufacturing Systems with their applications.

III - Course Content

Preamble: This course introduces CAD/CAM concepts, geometric modeling, standards, CNC programming, and advanced manufacturing systems, providing a foundation for integrating design and production to enhance efficiency.

Unit – I	Introduction	9 Periods
Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – CAD/CAM concepts —Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance		
Unit – II	Geometric Modeling	9 Periods
Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep		
Unit – III	CAD Standards	9 Periods
Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards		
Unit – IV	Fundamental of CNC and Part Programming	9 Periods



Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

Unit – V	Cellular Manufacturing and Flexible Manufacturing System	9 Periods
Group Technology (GT), Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS		

Text Books:	1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co. 2021 2. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2018.
Reference Books:	1. Radhakrishnan P, Subramanyan S. and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2022. 2. Chris McMahon and Jimmie Browne “CAD/CAM Principles”, “Practice and Manufacturing management “ Second Edition, Pearson Education, 2021.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/104/112104289/ 2. https://nptel.ac.in/courses/103106148

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand CAD/CAM architecture and apply basic 2D/3D transformations and production models.	Understanding (BL 2)
CO2	Choose appropriate engineering geometry using curves, surfaces, and solid representation methods.	Understanding (BL 2)
CO3	Identify and use CAD communication and data exchange standards like IGES and STEP.	Understanding (BL 2)
CO4	Acquire knowledge basic CNC programs using G and M codes for turning and milling.	Understanding (BL 2)
CO5	Discuss GT coding, FMS components, and evaluate flexibility in manufacturing.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	1	-	-	-	-	-	-	-	1	3	1



COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO3	3	-	1	1	-	-	-	-	-	-	-	1	3	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23ME513 CAD/CAM Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V	PCC	0	0	4	2

II - Course Objectives

1.	To gain practical experience in handling 2D drafting and 3D modelling software systems
2.	Designing 3-Dimensional geometric model of parts, sub-assemblies, assemblies and exporting it to drawing
3.	Programming G & M Code programming and simulate the CNC program and Generating part programming data through CAM software

III - Course Content

Preamble: This course introduces the fundamentals of CAD/CAM, including 3D modeling, assembly design, CNC part programming, and computer-aided manufacturing processes for effective engineering component development.

Unit – I	CAD Introduction	15 Periods
Sketch: Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft. Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form. Feature manipulation: Copy, Edit, Pattern, Suppress, History operations. Assembly: Constraints, Exploded Views, Interference check Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting		
Unit – II	Creation of 3D assembly model of following machine elements using 3D Modelling software	15 Periods
1. Flange Coupling 2. Plummer Block 3. Screw Jack 4. Lathe Tailstock 5. Universal Joint 6. Machine Vice 7. Stuffing box 8. Crosshead 9. Safety Valves 10. Non-return valves 11. Connecting rod 12. Piston 13. Crankshaft		
Unit – III	Manual Part Programming	30 Periods
1. CNC Machining Centre i) Linear Cutting. ii) Circular cutting.		



- iii) Cutter Radius Compensation.
- iv) Canned Cycle Operations.
- 2. CNC Turning Centre
 - i) Straight, Taper and Radial Turning.
 - ii) Thread Cutting.
 - iii) Rough and Finish Turning Cycle.
 - iv) Drilling and Tapping Cycle.
- 3. COMPUTER AIDED PART PROGRAMMING
 - i) Generate CL Data and Post process data using CAM packages for Machining and Turning Centre.
 - ii) Application of CAPP in Machining and Turning

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design experience in handling 2D drafting and 3D modelling software systems	Applying (BL 3)
CO2	Design 3-Dimensional geometric model of parts, sub-assemblies, assemblies and export it to drawing	Applying (BL 3)
CO3	Demonstrate manual part programming and simulate the CNC program and Generate part programming using G and M code through CAM software	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2
CO1	2	2	2	2	3	-	-	-	2	-	-	3	3
CO2	2	2	2	2	3	-	-	-	2	-	-	3	3
CO3	2	2	2	2	3	-	-	-	2	-	-	3	3
CO4	2	2	2	2	3	-	-	-	2	-	-	3	3
CO5	2	2	2	2	3	-	-	-	2	-	-	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)

I – Course Code & Name: 23ME512 Metrology Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V	PCC	0	0	4	2

II - Course Objectives

1.	To impart knowledge and practical skills in calibration and use of precision measuring instruments for linear, angular, thread, gear, surface finish, and machine tool measurements.
2.	To develop competency in both contact and non-contact measurement techniques, including comparators, optical systems, video measurement, and image processing.
3.	To enable students to apply measurement principles for evaluating dimensional accuracy, surface quality, force, torque, and temperature, thereby ensuring quality control in manufacturing and engineering applications.

III - Course Content**Preamble:**

This laboratory trains students in precision measurement and metrology through calibration, handling, and use of various instruments. The experiments help analyze errors, assess quality, and strengthen understanding of theoretical concepts learned in class.

List of Experiments**List of Experiments:**

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks
2. Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge.
3. Measurement of linear dimensions using Comparators.
4. Measurement of angles using bevel protractor and sine bar.
5. Measurement of screw thread parameters – Screw thread Micrometers and Three wire method (floating carriage micrometer)
6. Measurement of gear parameters – disc micrometers, gear tooth vernier caliper
7. Non-contact (Optical) measurement using Toolmaker's microscope / Profile projector and Video measurement system
8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus-based instruments.
9. Machine tool metrology – Level tests using precision level; Testing of straightness of a machine tool guideway using Autocollimator, spindle tests.
10. Measurement of force, torque, and temperature
11. Non-Contact Measurement using Image Processing

60 Periods

List of Equipment for a Batch of 30 Students

S. No.	Description of Equipment	Quantity
1	Micrometer	5
2	Vernier Caliper	5
3	Vernier Height Gauge	2
4	Vernier depth Gauge	2
5	Slip Gauge Set	1
6	Gear Tooth Vernier	1
7	Sine Bar	1
8	Floating Carriage Micrometer	1
9	Profile Projector / Tool Makers Microscope	1
10	Mechanical / Electrical / Pneumatic Comparator	1
11	Autocollimator	1
12	Temperature Measuring Setup	1
13	Force Measuring Setup	1
14	Torque Measuring Setup	1
15	Surface finish measuring equipment	1
16	Bore gauge	1
17	Telescope gauge	1
18	Image Processing System	1
Text Books:	1. "Metrology and Measurement: Laboratory Manual" is authored by Anand Arumugham and published by Harpercollins 360	
Reference Books:	1. "Metrology and Measurement: Laboratory Manual" is authored by Publication: Harpercollins 360	
MOOC/Web Platforms:	-	

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the principles of calibration to operate and handle basic measuring instruments such as Vernier caliper, micrometer, and height gauge using gauge blocks.	Applying (BL 3)
CO2	Demonstrate proficiency in measuring linear and angular dimensions using depth micrometer, comparators, bore gauges, sine bar, and protractors.	Applying (BL 3)
CO3	Analyze screw thread and gear parameters using specialized instruments and methods to ensure dimensional accuracy.	Analysing (BL4)
CO4	Utilize non-contact optical instruments and surface finish testers to evaluate component profiles and surface characteristics.	Analysing (BL4)
CO5	Assess machine tool metrology parameters and measure force, torque, and temperature for performance evaluation and quality assurance.	Evaluating (BL5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	—	2	2	—	—	—	1	1	—	2	1	-
CO-2	3	2	—	2	3	—	—	—	1	1	—	2	1	-
CO-3	3	3	—	3	3	—	—	—	1	1	—	2	1	-
CO4	3	3	—	3	3	—	—	—	2	2	—	2	1	-
CO5	3	3	—	3	3	—	—	—	2	2	—	3	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI –Pedagogies (Select appropriate Teaching pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√				√		√				√

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



SEMESTER – VI**I – Course Name: 23ME601 Heat and Mass Transfer**

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME301 – Engineering Thermodynamics	B.E. – Mechanical Engineering	VI	PCC	3	1	0	4

II - Course Objectives

1.	To develop a strong understanding of heat conduction fundamentals, including steady and unsteady analysis in various geometries and extended surfaces.
2.	To impart knowledge on convective heat transfer mechanisms, boundary layer theory, and heat-transfer correlations for internal and external flows.
3.	To introduce the concepts of radiation heat transfer, including radiation laws, view factors, and thermal radiation exchange between surfaces.
4.	To provide insight into phase-change heat transfer processes, including boiling and condensation mechanisms and their engineering correlations.
5.	To familiarize students with heat exchangers and mass transfer principles, including LMTD and NTU design methods, diffusion laws, and analogies between heat, mass, and momentum transfer.

III - Course Content

Preamble: This course provides a comprehensive introduction to conduction, convection, radiation, phase-change heat transfer, and mass transfer, enabling students to analyze and design practical thermal and diffusion-based engineering systems.		
Unit – I	Fundamentals of Heat Conduction	12 Periods
Conduction - general 3-D equation – one dimensional steady state heat conduction in simple geometries – plane wall – cylinder and sphere – composite walls – critical thickness of insulation – thermal contact resistance - heat generation in plane wall, Cylinder and sphere – extended surfaces - unsteady state heat conduction.		
Unit – II	Forced and Natural Convection Heat Transfer	12 Periods
Convection - boundary layer theory – conservation equations of mass, momentum and energy for laminar flow over a flat plate – turbulent flow over a flat plate – flow over cylinders – spheres – bank of tubes - internal flows – natural convection – vertical, inclined and horizontal surfaces.		
Unit – III	Fundamentals of Thermal Radiation	12 Periods
Radiation heat transfer – Emissivity– thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect. Thermal Radiation and Heat Management in Solar Panel Systems- Case Study		
Unit – IV	Phase Change Heat Transfer	12 Periods



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Boiling and condensation – pool boiling regimes and correlations – critical heat flux - flow boiling correlations - Nusselt's theory – filmwise and dropwise condensation - Condensation over surfaces. Condensation in shell-and-tube condensers in chemical plants- Case Study		
Unit – V	Heat Exchanger Analysis and Mass Transfer	12 Periods
Heat exchangers - types - fouling factor - LMTD and NTU methods. Mass transfer - Diffusion Mass Transfer - Fick's law - analogy between heat and mass transfer - Convective Mass Transfer Performance evaluation of shell-and-tube heat exchangers in refineries– Case Studies.		

Text Books:	1. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5th Edition – 2020 2. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2023
Reference Books:	1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010 2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112101097

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamentals of steady and unsteady heat conduction in various geometries and materials.	Understand (BL 2)
CO2	Apply conduction and convection heat transfer principles to analyze practical heat transfer problems.	Applying (BL 3)
CO3	Apply conduction and convection heat transfer principles to analyze practical heat transfer problems.	Analyze (BL 4)
CO4	Explain and apply thermal radiation principles, including radiation exchange and shields, to real systems such as solar panels.	Applying (BL 3)
CO5	Analyze phase change heat transfer and heat exchanger performance using standard methods and industrial case studies.	Analyze (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	-	-	1	-	-	-	-	2	3	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	2	3	-

CO-5	3	3	2	1	-	-	1	-	-	--	-	2	3	-
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Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Name: 23ME602 Design of Transmission System

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME302 - Manufacturing Processes	B.E. – Mechanical Engineering	VI	PCC	3	0	0	3

II - Course Objectives

1.	To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
2.	To understand the standard procedure available for Design of Transmission of Mechanical elements spur gears and parallel axis helical gears.
3.	To learn the design bevel and worm gears of Transmission system.
4.	To learn the concepts of design multi and variable speed gear box for machine tool applications.
5.	To learn the concepts of design to brakes and clutches.

(Use of P S G Design Data Book permitted)**III - Course Content**

Preamble: This course imparts the principles and analytical methods required for designing flexible drives, gear systems, gearboxes, clutches, brakes, and bearings used in modern machinery. It equips students to apply design standards, material selection, and performance criteria to develop reliable mechanical power transmission and motion control systems.		
Unit - 1	Design of Flexible Drives	9 Periods
Belt Drives –Types, Materials and Construction – Design of Flat Belts and Pulleys – Design of V Belt drives - Types of Chain drives – Design of Transmission Chain and Sprockets. Applications: conveyors, textile machines, paper mills		
UNIT - 2	Design of Spur and Helical Gears	9 Periods
Tooth terminology – Speed ratios and number of teeth- Factor of safety – Gear materials – Design of spur and helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane – Equivalent number of teeth for helical gears. Applications: automotive transmissions, industrial gearboxes		
UNIT - 3	Design of Bevel and Worm Gears	9 Periods
Design of Straight/Spiral bevel gear: Tooth terminology– equivalent number of teeth – Estimating the dimensions of pair of straight bevel gears. Worm Gear–Terminology – Thermal capacity, materials – Efficiency – Design of Worm Gear drives.		
UNIT - 4	Design of Gear box	9 Periods
Geometric progression – Standard step ratio – Ray diagram – Kinematics layout – Design of gear box: Gear Life Procedure- Design of multi speed gear box for machine tool & automobile applications – Gear Shifting mechanism.		
UNIT - 5	Design of Brakes and Clutches	9 Periods
Clutches: Design of Plate clutches: Single plate and Multi Plate clutches Design of Brakes: Block or Shoe brakes – Single, Pivoted and Double Block or Shoe brakes – Band Brakes – Simple and Differential Band Brakes - Optimization of single plate clutches in industrial conveyor systems - Case Study		



Text Books:	1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016. 2. Richard G Budynas and J Keith Nisbett "Shigley's Mechanical Engineering Design", Tenth Edition, Tata McGraw Hill, 2015. 3. Shigley. J., Mischke. C., Budynas, R., and Nisbett. K., "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2014.
Reference Books:	1. Sundararamamoorthy. T. V. and Shanmugam. N., "Machine Design", 9th Edition, Anuradha Publications, Chennai, 2003 2. Sen and Bhattacharya, "Principles of Machine Tools", New Central Book Agencies, 1975. 3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc24_me71/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the concepts of design to belts, chains and sprockets for various industrial applications.	Apply (BL 3)
CO2	Apply the concepts of design to spur, helical gears.	Apply (BL 3)
CO3	Apply the concepts of design to worm and bevel gears.	Apply (BL 3)
CO4	Apply the concepts of design to gear boxes for machine tools and automobiles.	Apply (BL 3)
CO5	Apply the concepts of design to brakes and clutches for industrial and vehicle applications.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	3	1	1	1	3			3		2	3	3
CO-2	3	3	3	1	1	1	3			3		2	3	3
CO-3	3	3	3	1	1	1	3			3		2	3	3
CO-4	3	3	3	1	1	1	3			3		2	3	3
CO-5	3	1	1		1	1	3			1		2	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√			√				√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I - Course Name: 23ME603 Hydraulics and Pneumatics

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME404 - Fluid Mechanics and Machinery	B.E. – Mechanical Engineering	VI	PCC	3	0	0	3

II - Course Objectives

1.	To introduce the principles, components, and characteristics of hydraulic fluid power systems, including pumps, fluids, flow behavior, and basic laws.
2.	To develop understanding of hydraulic actuators, valves, and accessories, focusing on construction, operation, performance, and selection.
3.	To enable students to design and analyze hydraulic circuits, including industrial, servo, proportional, and hydrostatic transmission systems.
4.	To provide knowledge on pneumatic systems, including air preparation, valves, actuators, and design of industrial pneumatic circuits.
5.	To introduce electro- control systems for various application and trouble shooting of circuits

III - Course Content**Preamble:**

This course introduces the principles, components, and design of hydraulic and pneumatic systems, covering pumps, actuators, valves, circuits, and electro-pneumatic controls. It prepares students to design, analyze, and integrate fluid power systems for industrial, mobile, and automated engineering applications.

Unit – I	Fluid Power Principles and Hydraulic Pumps	9 Periods
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids – Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law – Principles of flow – Friction loss – Work, Power and Torque, Sources of Hydraulic power: Pumping Theory- Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance and Selection criteria of pumps – Fixed and Variable displacement pumps.		
Unit – II	Hydraulic Actuators and Control Components	9 Periods
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators - Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters – types and selection- Applications – Fluid Power ANSI Symbols.		
Unit – III	Hydraulic Systems	9 Periods
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems. Design methodology of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications - Mobile hydraulics applications.		



Unit – IV	Pneumatic Systems	9 Periods
Properties of air – Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification - Single cylinder and multi cylinder circuits - Cascade method – design of pneumatic circuits for industrial applications, tool handling in CNC machine tools.		
Unit – V	Electrical Control and Applications Circuits	9 Periods
Electro hydraulic circuits – Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems. Electro Pneumatic System – Elements – Ladder diagram – Timer circuits. Introduction to fluidics and pneumatic logic circuits – applications of pick and place, Material handling systems, Automotive systems, Packing industries, Manufacturing and Automation. Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems.		

Text Books:	1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009. 2. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition, 2019. 3. Fundamentals of Pneumatics and Hydraulics - Md. Abdus Salam - Springer, 2022 (1st Edition). 4. Hydraulics and Pneumatics, Vinayak V. Gaikwad, A. R. Narode, M. D. Rajkamal - Technical Publications, 2023
Reference Books:	1. Shanmugasundaram. K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006. 2. Joshi.P., Pneumatic Control", Wiley India, 2008.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc24_me55/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics of hydraulic fluid power systems, types of fluids and pumps, and their performance characteristics.	Understand (BL 2)
CO2	Understand the construction and working of hydraulic actuators, valves, and accessories used in hydraulic systems.	Understand (BL 2)
CO3	Design and troubleshoot industrial hydraulic circuits using accumulators, servo valves, and hydrostatic drives	Apply (BL 3)
CO4	Design pneumatic circuits using air preparation units, valves, actuators, and cascade control method.	Apply (BL 3)
CO5	Develop and interpret electrical control circuits for various applications and maintenance.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	1	-	-	-	-	-	-	1	-	-	2	1	1
CO-2	3	2	-	-	-	-	-	-	1	-	-	2	1	1
CO-3	2	3	3	2	1	-	-	-	-	-	-	2	1	1
CO-4	2	2	3	-	1	-	-	-	1	-	-	2	1	1
CO-5	2	2	3	-	3	-	-	-	1	-	-	1	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√			√				√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Name: 23ME611 Heat Transfer Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME301 & Engineering Thermodynamics	B.E. – Mechanical Engineering	VI	PCC	0	0	4	2

II - Course Objectives

1.	To provide hands-on experience in measuring thermal conductivity, convection coefficients, and radiative properties using standard heat transfer experiment setups.
2.	To enable students to analyze heat exchanger performance, including friction factor, heat transfer coefficient, and effectiveness under various flow arrangements.
3.	To familiarize students with experimental determination of radiation constants, such as emissivity and Stefan–Boltzmann constant.
4.	To develop a practical understanding of refrigeration and air-conditioning systems by determining COP and evaluating system performance.
5.	To enhance students' ability to collect, interpret, and validate experimental data, relating it to theoretical heat and mass transfer concepts.

III - Course Content**Preamble:**

This laboratory develops practical skills in measuring thermal properties, heat transfer coefficients, and performance of heat exchange and refrigeration systems through experiments on conduction, convection, radiation, and heat exchanger testing. It enables students to apply theoretical heat and mass transfer concepts to real-world measurements, data analysis, and performance evaluation.

List of Experiments**List of Experiments:**

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall.
3. Determination of thermal conductivity of insulating powder
4. Determination of heat transfer coefficient of air under natural convection.
5. Determination of heat transfer coefficient of air under forced convection.
6. Heat transfer from pin-fin under natural and forced convection.
7. Determination of friction factor, heat transfer coefficient of cold/hot fluid and effectiveness of a tube- in-tube heat exchanger. (Counter Flow)
8. Determination of friction factor, heat transfer coefficient of cold/hot fluid and effectiveness of a tube- in-tube heat exchanger. (Parallel Flow)
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a grey surface.

60 Periods

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S. No.	Description of Equipment	Quantity
1	Guarded plate apparatus	1
2	Lagged pipe apparatus	1
3	Natural convection-vertical cylinder apparatus	1
4	Forced convection inside tube apparatus	1
5	Composite wall apparatus	1
6	Thermal conductivity of insulating powder apparatus	1
7	Pin-fin apparatus	1
8	Stefan-Boltzmann apparatus	1
9	Emissivity measurement apparatus	1
10	Parallel/counter flow heat exchanger apparatus	1
11	Single/two stage reciprocating air compressor	1

IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Determine thermal conductivity of solid insulators, composite walls, and insulating powders using standard experimental setups.	Applying (BL 3)
CO2	Measure natural and forced convection heat transfer coefficients and analyze heat transfer from extended surfaces.	Applying (BL 3)
CO3	Evaluate friction factor, heat transfer coefficient, and effectiveness of heat exchangers under counter-flow and parallel-flow conditions.	Applying (BL 3)
CO4	Determine radiation properties such as emissivity and Stefan-Boltzmann constant using radiative heat transfer experiments.	Applying (BL 3)
CO5	Calculate the coefficient of performance (COP) of refrigeration and air-conditioning systems and relate performance to system	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	3	2	2	-	-	2	3	2	-	3	3	2
CO-2	3	2	3	2	2	-	-	2	3	2	-	3	2	2
CO-3	3	2	3	2	2	-	-	2	3	2	-	3	2	2
CO-4	3	2	3	2	2	-	-	2	3	2	-	3	2	2
CO-5	3	2	3	2	2	-	-	2	3	2	-	3	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



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VI –Pedagogies (Select appropriate Teaching pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓					✓		✓

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Name: 23ME612 Product Design and Fabrication Projects

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	VI	EEC	0	0	4	2

II - Course Objectives

1.	The objective of this course is to help students develop the ability to solve specific engineering problems, from identifying the problem and conducting a literature review to implementing a successful solution, while integrating concepts aligned with the United Nations Sustainable Development Goals (SDGs). Students, working in groups of 3 to 4, will focus on sustainable and impactful solutions, under the guidance of a faculty member, and prepare a comprehensive project report upon completion. The progress will be evaluated through a minimum of three reviews, and the review committee will be constituted by the Head of the Department. The final project work, evaluated based on both oral presentation and the project report, will be assessed by external and internal examiners appointed by the Head of the Department, with particular attention to sustainability, energy efficiency, and societal impact in line with SDG objectives.
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IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply theoretical knowledge gained from coursework to solve a practical engineering problem.	Apply (BL 3)
CO2	Identify, analyze, and define a real-world problem and formulate appropriate technical solutions.	Analyze (BL 4)
CO3	Design and develop a small-scale system, model, or application using relevant tools and technologies, while aligning it with the Sustainable Development Goals (SDGs)	Analyze (BL 4)
CO4	Enhance skills in literature survey, problem modeling, implementation, and testing.	Apply (BL 3)
CO5	Develop teamwork, documentation, presentation, and basic project management skills.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V- Course Guidelines

1. Each student must participate in a project by forming a team of maximum four members.
2. Every team will have a faculty guide from the institution, to be identified within one week from the start of the sixth semester.
3. Students are responsible for selecting a project problem, performing a literature survey, and defining a clear aim and scope for their project work.

4. The team must submit a progress report and a complete project report upon completion.
5. The project progress will be monitored through periodic reviews conducted by a faculty team, including the guide.
6. In the end-semester exam, Project will be evaluated by one internal and one external examiner appointed by the COE.

VI- Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)




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SEMESTER – VII**I – Course Name: 23ME701 & Mechatronics**

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME603 - Hydraulics and Pneumatics	B.E. – Mechanical Engineering	VII	PCC	3	0	0	3

II - Course Objectives

1.	To acquire overview knowledge of multi-domain engineering integration.
2.	To understand and apply the various types of actuators and its drives for interfacing.
3.	To recognize the needs of controller to build a mechatronics system.
4.	To impart knowledge about the industry 4.0 needs and developments.
5.	To render practical exposure in the design and development of mechatronics systems.

III - Course Content

Preamble: This course provides an overview of fundamentals knowledge and skills to integrate sensors, actuators, controllers, and communication systems using controllers enabling the design and implementation of mechatronic systems for real-world applications and global challenges.

UNIT - I	Introduction	9 Periods
Introduction to Mechatronics – Systems – Open Loop and Closed Loop Control Systems, Need for Mechatronics – Measurement and Control parameters overview, Key Elements, Stages in Designing Mechatronics Systems – Traditional and Mechatronic Design - Modular Approach – Hardware and Software – applications.		
UNIT - II	Sensors and Actuators	9 Periods
Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors – Photodetectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors. Types and Characteristics of Micro and Nano Actuators.		
UNIT - III	Controllers	9 Periods
Controllers - P, PD, PI, PID - PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications. Overview of Advanced Microcontrollers - Typical Applications.		
UNIT - IV	Introduction to Industry 4.0	9 Periods
Automation - need-types, basic elements of an automated system, levels of automation. Introduction to Industry 4.0 - Historical Context-General framework-Application areas- Artificial		



intelligence, The Internet of Things and Industrial Internet of Things- Robotization and automation- Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances.

UNIT - V	Case Studies of Mechatronics System	9 Periods
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Case studies of Mechatronics Systems: Pick and Place Robot – Autonomous Robot with Vision System - Product Assembly Line Automation. Automatic Car Park Barrier - Drone actuation and Control - Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control.

Text Books:	1. William Bolton, "Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education Limited, 7th edition, 2019. 2. Vijayaraghavan G.K., Balasundaram M.S, Ramachandran K.P., "Mechatronics: Integrated Mechanical Electronic Systems", Willey, 2013
Reference Books:	1. Bishop R. H, The Mechatronics Handbook, CRC Press, 2002. 2. Patranabis D., "Sensor and Actuators", Prentice Hall of India Pvt Ltd., 2nd Edition 2005. 3. Mohamed Arezki Mellal, "Mechatronic Systems: Design, Performance and Applications", Nova Science Publishers, 2019. 4. John P. Bentley., "Principle of Measurement systems", Pearson Prentice Hall, 4th Edition, 2005. 5. K. Ogata, "Modern Controls Engineering", Prentice Hall of India Pvt. Ltd., New , 2016.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/103/112103316/ 2. https://youtu.be/t i 0E zw6U?si=9qoNiFd9Gk2SZ 3j 3. https://youtu.be/hhNcDtLOJEk?si=pCkTYOb-YOnSDf36

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the design of mechatronics systems and its applications.	Understand (BL 2)
CO2	Understand the working features of sensor and actuators to develop mechatronics systems.	Understand (BL 2)
CO3	Understand the concepts of controller for design of mechatronics system.	Understand (BL 2)
CO4	Apply the Industry 4.0 concepts on any existing systems.	Apply (BL 3)
CO5	Apply selected elements to build a mechatronics system for realizing the application.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	2	-	2	-	2	-	2	-	2	2	-	2	2	1
CO-2	2	-	2	-	2	-	2	-	2	2	-	2	2	1
CO-3	2	-	2	-	2	-	2	-	2	2	-	2	2	1
CO-4	2	-	2	-	2	-	2	-	2	2	-	2	2	1
CO-5	2	-	2	-	2	-	2	-	2	2	-	2	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Name: 23ME702 Computer Integrated Manufacturing

Prerequisites	Program Name	Sem	Category	L	T	P	C
23ME503 – Computer aided design and manufacturing	B.E. – Mechanical Engineering	VII	PCC	3	0	0	3

II - Course Objectives

1.	Introduce the concepts of Product Design, CAD/CAM, CIM, automation, and modern production systems.
2.	Develop understanding of Computer-Aided Process Planning (CAPP), production planning systems, and resource planning tools.
3.	To learn the various Automation tools, include various material handling system
4.	Expose students to industrial robotics, robot programming, and performance measures in robotic systems.
5.	To introduce to basics of data transaction, information integration and control of CIM.

III - Course Content

Preamble: This course provides foundational knowledge of CAD/CAM, process planning, AGVS, and industrial robotics for modern manufacturing systems. It equips students to analyze, plan and implement automated and flexible production environments in industry.		
UNIT - I	Introduction	9 Periods
Various phases in Product Design and CAD, CAM, Concepts of CAD/CAM – Concurrent Engineering – CIM concepts and elements – Types of production – Manufacturing Metrics and Economics – Production Performance Metrics – Manufacturing Cost - Basic Elements of an Automated system – Levels of Automation– Mass Customization - Lean Production and Just-In-Time Production - Sustainable Manufacturing and Circular-Economy Practices.		
UNIT - II	Computer Aided Process Planning	9 Periods
Production planning and Control System - Aggregate Production Planning and Master Production Schedule – Material Requirement Planning (MRP I) - Capacity Planning – Shop Floor Control – Inventory Control – EOQ, WIP costs & Inventory Holding Costs - Introduction to Manufacturing Resource Planning (MRP II) & Enterprise Resource Planning (ERP) - Process planning – Manual Process Planning and case studies Computer Aided Process Planning (CAPP).		
UNIT - III	Automation in Manufacturing Systems	9 Periods
Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly and optimization – Material handling system. Conveyor systems – Types of conveyors – Operations and features. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing.		
UNIT - IV	Industrial Robotics and AGVs	9 Periods



Robot Anatomy and Related Attributes – Classification - Control systems – End Effectors –Sensors – Applications – Basics of Robot Part Programming – Robot Accuracy and Repeatability. Sensor - Sensor and Actuator interactions. Automated Guided Vehicle System (AGVS) –Types of AGVS - Applications – Vehicle Guidance technologies –Vehicle Management & Safety.

UNIT - V	Process Control and Data Analysis	9 Periods
Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control – Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies. - Quality management (SPC) and automated inspection.		

Text Books:	1. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 6 th Edition, 2023.
Reference Books:	1. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 8rd Edition, 2018.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/105/112105126/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the phases of product design, CAD/CAM concepts, CIM elements, automation levels, and lean/JIT production principles.	Understand (BL 2)
CO2	Apply production planning concepts including MRP I, MRP II, ERP, capacity planning, inventory control, and compare manual vs. computer-aided process planning.	Apply (BL 3)
CO3	Apply the automation techniques in modern manufacturing systems.	Apply (BL 3)
CO4	Describe and apply robotics concepts including robot anatomy, control systems, sensors, end-effectors, and develop basic robot part programs while understanding accuracy and repeatability.	Apply (BL 3)
CO5	Understand the knowledge in computer process control techniques.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	1	-	-	-	1	-	-	2	1	1
CO-2	3	2	2	1	1	-	-	-	1	-	-	2	1	1
CO-3	3	2	2	1	1	-	-	-	1	-	-	2	1	1
CO-4	3	2	2	1	1	-	-	-	1	-	-	2	1	1
CO-5	3	2	2		1	-	-	-	1	-	-	2	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√			√				√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I - Course Name: 23GE706 Industrial Management

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	VII	HSMC	3	0	0	3

II - Course Objectives

1	To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2	To study the planning; organizing and staffing functions of management in professional organization.
3	To study the leading; controlling and decision making functions of management in professional organization.
4	To learn the organizational theory in professional organization.
5	To learn the principles of productivity and modern concepts in management in professional organization.

III - Course Content**Preamble:**

This course introduces the principles and functions of management essential for industrial settings. It equips students with knowledge of planning, organizing, leading, and controlling, along with modern management concepts used in engineering and industrial environments

Unit - I	Introduction to Management	9 Periods
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.		
Unit - II	Functions of Management - I	9 Periods
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.		
Unit - III	Functions of Management - II	9 Periods
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mouton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.		
Unit - IV	Organization Theory	9 Periods
Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change		



Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

Unit - V	Productivity and Modern Topics	9 Periods
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).		

Text Books:	1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009. 2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.
Reference Books:	1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987. 2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009. 3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994. 4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012. 5. S. Trevis Certo, "Modern Management Concepts and Skills", Pearson Education, 2018.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/110/107/110107146/ 2. https://www.coursera.org/learn/foundations-of-management 3. https://www.edx.org/learn/management

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the process of acquire knowledge from experts	Understand (BL 2)
CO2	Understand the learning organization.	Understand (BL 2)
CO3	Use the knowledge management tools.	Apply (BL 3)
CO4	Develop knowledge management Applications.	Analyze (BL 4)
CO5	Design and develop enterprise applications.	Evaluate (BL 5)

V - Mapping Table - Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	1	1	1	1	1	2	2	1	1	2	2



CO-2	3	2	2	1	1	1	1	1	2	2	1	1	2	2
CO-3	3	3	2	2	2	1	1	1	3	2	1	2	2	2
CO-4	3	3	2	2	2	1	1	1	3	3	2	2	3	2
CO-5	3	3	3	2	3	1	1	1	3	3	2	2	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√			√				√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23ME703 Finite Element Analysis

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	VII	PCC	3	0	2	4

II - Course Objectives

1.	Introduce the fundamentals of mathematical modeling, governing equations, weighted residual methods, and variational principles in engineering.
2.	Enable students to formulate and solve 1D finite element models for problems in solid mechanics, heat transfer, and fluid mechanics.
3.	Develop skills in 2D finite element formulation for triangular elements under plane stress, plane strain, and axisymmetric conditions.
4.	Familiarize students with vector variable problems, constitutive relations, plate and shell formulations.
5.	Introduce isoparametric elements, numerical integration, solution techniques for dynamic problems, and basics of commercial analysis software.

III - Course Content

Preamble: This course introduces the fundamentals of Finite Element Analysis, covering variational formulations, modeling of 1D and 2D field problems, isoparametric elements, and numerical solution techniques. It enables students to analyze structural, thermal, and vector variable engineering problems using FEM and modern analysis software.		
Unit – I	Introduction	9 Periods
Historical Background – Mathematical Modeling of field problems in Engineering – Governing, Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.		
Unit – II	One Dimensional Problems	9 Periods
One Dimensional Second Order Equations – Discretization Element types – Derivation of Shape functions and Stiffness matrices and force vectors using FEM – Assembly of Matrices – Solution of problems from solid mechanics, heat transfer and fluid mechanics in one dimension.		
Unit – III	Two Dimensional Problems	9 Periods
Second Order 2D Equations – Variational formulation – Finite Element formulation for Triangular elements (CST & LST) – Shape functions and element matrices and vectors – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Application to Field Problems in Structural and Thermal domain using 2D triangular elements.		
Unit – IV	Two-Dimensional Vector Variable Problems	9 Periods
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements.		



Unit – V	Isoperimetric Formulation and Advanced Topics	9 Periods
Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software- Introduction to Non Linearity.		

List of Experiments**(15 Periods)**

1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates. 4. Stress analysis of axis-symmetric components.
4. Thermal stress and heat transfer analysis of plates.
5. Thermal stress analysis of cylindrical shells.
6. Vibration analysis of spring-mass systems.
7. Modal analysis of Beams.
8. Harmonic, transient and spectrum analysis of simple systems.

List of Equipment for a Batch of 30 Students

S. No.	NAME OF THE EQUIPMENT	Quantity
1.	Computer Work Station	30
2.	Color Desk Jet Printer	1
3.	Multibody Dynamic Software Suitable for Mechanism simulation and analysis	1

Text Books:	1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005 2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
Reference Books:	1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013) 2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990 3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002 4. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004 5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112/104/112104121/ 2. https://nptel.ac.in/courses/112105268/ 3. https://nptel.ac.in/courses/112101096/



IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To apply FEM concepts, including mathematical modeling, weighted residual methods, and variational formulation, to solve boundary value problems.	Applying (BL 3)
CO2	To apply FEM procedures to one-dimensional problems by deriving shape functions, stiffness matrices, and force vectors for engineering applications.	Applying (BL 3)
CO3	To apply FEM techniques to two-dimensional problems using triangular elements for plane stress, plane strain, and axisymmetric analyses.	Applying (BL 3)
CO4	To apply FEM formulations for two-dimensional vector variable problems, including elasticity, plate, and shell elements, to compute stresses and displacements.	Applying (BL 3)
CO5	To apply isoparametric element formulations, numerical integration, and matrix solution techniques to solve advanced FEM problems, including dynamic and nonlinear systems.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-2	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-3	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-4	3	3	2	-	1	-	-	-	1	1	-	1	2	1
CO-5	3	3	2	-	1	-	-	-	1	1	-	1	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√		√	√	√			√	√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Name: 23ME711 Summer Internship

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- MECH	VII	EEC	0	0	0	1

II - Course Objectives

1.	To gain hands-on industrial experience.
2.	To understand organizational structure, work ethics, and professional responsibilities.
3.	To develop awareness of industry challenges, emerging technologies, and career opportunities.

III - Instructions**TOTAL: 4 Weeks**

- Students must undergo the internship **only in approved companies/organizations** relevant to their domain.
- A **minimum duration of 4 weeks** is mandatory; attendance must be certified by the industry mentor.
- Students must submit an **Internship Request/ Bonafide Letter** approved by the **Principal** through department before starting.
- Students must **complete the internship** before the **starting of the classes** for VII Semester and may attend for **1 week after reopening** with proper permission from the **Principal** if required.
- Students should strictly follow the **company's code of conduct**, working Periods, and confidentiality rules.
- Any change in internship location/duration must receive **prior approval** from the department.
- On completion, students must submit the following:
 - Completion certificate
 - Internship report
 - Presentation
- Evaluation will be based on **industry feedback, report quality, viva-voce, and presentation.**

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Gain hands-on industrial exposure and understand real-world engineering practices.	Apply (K3)
CO2	Apply engineering concepts and tools in a professional work environment.	Apply (K3)



[Signature]
 Chairperson - Board of Studies,
 Department of Mechanical Engineering
 NPR College of Engineering & Technology
 (Autonomous),
 Natham, Dindigul - 624401

C03	Understand organizational structure, work ethics, and professional responsibilities.	Understand (K2)
C04	Improve technical, communication, and interpersonal skills through workplace interaction.	Apply (K3)
C05	Develop awareness of industry challenges, emerging technologies, and career pathways.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	3	3	3	2	2	3	3	3	2	2	3	2
CO-2	3	3	3	3	3	2	2	3	3	3	2	2	3	2
CO-3	-	-	-	-	-	-	-	3	3	3	2	2	-	-
CO-4	-	-	-	-	-	-	-	3	3	3	2	2	-	-
CO-5	-	-	-	-	-	-	-	3	3	3	3	3	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



I – Course Name: 23ME712 Mechatronics Laboratory

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	VII	PCC	0	0	4	2

II - Course Objectives

1.	To impart knowledge and practical skills in the characterization of sensors.
2.	To enable students to apply measurement principles in force, torque, and temperature measurements.
3.	To enable students to design and verify circuits using simulation knowledge for hydraulic and pneumatic applications.

III - Course Content

Preamble: This laboratory trains students to develop practical skills in sensor characterization, measurement principles, and circuit design for hydraulic and pneumatic applications, while strengthening their understanding of theoretical concepts learned in class.

List of Experiments**List of Experiments:**

1. Experiments on displacement measurement.
2. Experiments on temperature measurement.
3. Experiments on load / force measurement.
4. Demonstration of Interfacing of Stepper motor.
5. Speed and direction control of DC Servomotor.
6. Speed and Direction control of AC Servomotor.
7. Sequencing of Hydraulic circuits using Simulation.
8. Sequencing of Pneumatic circuits using Simulation.
9. Sequencing of Electro-Pneumatic circuits using Simulation.
10. Actuator control using Pneumatic kit.
11. Actuator control using Electro-pneumatic kit.

60 Periods**List of Equipment for a Batch of 30 Students**

S. No.	Description of Equipment	Quantity
1	Temperature Measuring Setup.	1
2	Load / Force Measuring Setup.	1
3	Displacement Measuring Setup.	1
4	Basic of pneumatic trainer kit.	1
5	Basic of Electro pneumatic trainer kit.	1
6	Stepper motor Interface kit.	1
7	AC motor and DC motor kit.	1
8	Computers – As required	1
9	Simulation software – As required	1



IV - Course Outcome

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Apply the operating principles and characteristics of commonly used sensors.	Applying (BL 3)
CO2	Perform characterization of sensors and evaluate parameters such as sensitivity, linearity, and accuracy.	Applying (BL 3)
CO3	Apply measurement principles to experimentally measure force, torque, and temperature.	Analysing (BL4)
CO4	Design and simulate basic circuits used in hydraulic and pneumatic systems.	Create (BL5)
CO5	Analyze experimental results and verify circuit performance for hydraulic and pneumatic applications.	Analysing (BL4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	—	2	2	—	—	—	1	1	—	2	1	1
CO-2	3	2	—	2	3	—	—	—	1	1	—	2	1	1
CO-3	3	3	—	3	3	—	—	—	1	1	—	2	1	1
CO-4	3	3	—	3	3	—	—	—	2	2	—	2	1	1
CO-5	3	3	—	3	3	—	—	—	2	2	—	3	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI –Pedagogies (Select appropriate Teaching pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√				√		√				√

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



[Signature]
Chairperson - Board of Studies,
Department of Mechanical Engineering,
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(Autonomous),
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SEMESTER – VIII**I – Course Name: 23ME811 Project Work**

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	VIII	EEC	0	0	20	10

II - Course Objectives

1.	To enable students to identify a specific engineering problem and carry out an effective literature review.
2.	To develop the ability to plan, execute, and successfully complete a project under faculty guidance.
3.	To train students in teamwork, project management, and systematic problem-solving approaches.
4.	To enhance skills in technical documentation through the preparation of a comprehensive project report.
5.	To prepare students to confidently face project reviews, oral presentations, and viva voce examinations.

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify and define a real-world problem and develop an appropriate technical solution that contributes to achieving with the Sustainable Development Goals (SDGs)	Apply (BL 3)
CO2	Design and implement a system, model, prototype, or software relevant to the chosen project.	Apply (BL 3)
CO3	Maintain proper project documentation, including reports and references.	Understand (BL 2)
CO4	Demonstrate professional ethics, originality, and adherence to academic standards.	Apply (BL 3)
CO5	Present and defend the project effectively through reports, presentations, and viva-voce, meeting evaluation criteria.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V – Course Guidelines

- Each student must participate in a project either individually or as part of a team with a maximum of four members.



2. Students shall dedicate the entire semester to project work under the guide, including library research, lab work, computer analysis, fieldwork, and periodical progress reviews.
3. Any change in team members, project topic, or faculty guide must be approved by the Project Coordinator and Head of the Department
4. Project progress will be continuously evaluated through periodical reviews by a committee constituted by the Head of the Department.
5. Each batch must submit a comprehensive final report covering background, literature survey, problem statement, methodology, project details, results, and conclusions, formatted as per COE guidelines.
6. Project evaluation will be conducted jointly by internal and external examiners based on presentation and report quality, with encouragement to publish in peer-reviewed journals.

VI - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



Mandatory Course – I**I – Course Code & Name: 23MC902 Introduction to Women and Gender Studies**

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to all Branches	III	ESC	3	0	0	0

II - Course Objectives

1.	To investigate feminist theories, gender dynamics, and the intersectionality of oppression and empowerment.
2.	To analyze historical contexts and contemporary issues shaping gender studies today.

III - Course Content

Preamble: A critical exploration of societal constructs and identities. It delves into feminist theories, gender dynamics, and the intersectionality of oppression and empowerment. It is analyzing historical contexts and contemporary issues shaping gender studies today.		
Unit – I	Concepts	9 Periods
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour		
Unit – II	Feminist Theory	9 Periods
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist		
Unit – III	Women's Movements: Global, National and Local	9 Periods
Rise of Feminism in Europe and America. Women's Movement in India		
Unit – IV	Gender and Language	9 Periods
Linguistic Forms and Gender. Gender and narratives		
Unit – V	Gender and Representation	9 Periods
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.		
45 Periods		

Text Books:	1. Gender Trouble: Feminism and the Subversion of Identity" by Judith Butler, Publisher: Routledge, Publication Year: 1990, ISBN: 978-0415389556 2. Feminist Theory: From Margin to Center" by bell hooks, Publisher: South End Press, Publication Year: 1984, ISBN: 978-0896082411
Reference Books:	1. We Should All Be Feminists" by Chimamanda Ngozi Adichie, Publisher: Anchor Books, Publication Year: 2014, ISBN: 978-1101911761



	2. Gender Outlaw: On Men, Women, and the Rest of Us" by Kate Bornstein, Publisher: Vintage Books, Publication Year: 1995, ISBN: 978-0679757016 3. Gender Trouble: Feminism and the Subversion of Identity" by Judith Butler, Publisher: Routledge, Publication Year: 1999, ISBN: 978-0415924993
MOOC/Web Platforms:	1. https://onlinecourses.swayam2.ac.in/arp19_ap54/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Evaluate gender roles and their impact on societal structures using theoretical frameworks.	Understanding (BL 3)
CO2	Critique gender roles through a postmodernist lens, deconstructing traditional binaries and exploring fluidity in identities.	Applying (BL 3)
CO3	Analyze the evolution of feminism in Europe, America, and India, applying historical perspectives to understand societal shifts in gender equality	Applying (BL 3)
CO4	Evaluate linguistic forms and narratives to deconstruct gender norms and representations	Applying (BL 3)
CO5	Analyze advertising, popular visual media, alternative media, and social media to critique gender representation and its societal implications.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	-	-	3	1	-	-	-	-	-
CO-2	-	-	-	-	-	-	-	3	1	-	-	-	-	-
CO-3	-	-	-	-	-	-	-	3	1	-	-	-	-	-
CO-4	-	-	-	-	-	-	-	3	1	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	3	1	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓		✓	✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)

I – Course Code & Name: 23MC903 Disaster Risk Reduction and Management

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to all Branches	III	ESC	3	0	0	0

II - Course Objectives

1.	To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management.
2.	To acquaint with the skills for planning and organizing disaster response.

III - Course Content

Preamble: Disaster Risk Reduction and Management (DRRM), where explore strategies to mitigate and manage risks from natural and man-made disasters. It focuses on enhancing preparedness, response, and recovery efforts, emphasizing resilience-building for communities worldwide.		
Unit – I	Hazards, Vulnerability and Disaster Risks	9 Periods
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced – Earthquake, Landslide, Flood, Drought, Fire etc., - Technological disasters - Structural collapse, Industrial accidents, oil spills - Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals		
Unit – II	Disaster Risk Reduction (DRR)	9 Periods
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders - Early Warning System – Advisories from Appropriate Agencies - Relevance of indigenous Knowledge, appropriate technology and Local resources		
Unit – III	Disaster Management	9 Periods
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmes and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers).		
Unit – IV	Tools and Technology for Disaster Management	9 Periods
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient		



Development –Standard operation Procedure for disaster response – Financial planning for disaster Management.		
Unit – V	Disaster Management: Case Studies	9 Periods
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill.		
45 Periods		

Text Books:	1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications 2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications 3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13: 978-9380386423 4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
Reference Books:	1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005. 2. Government of India, National Disaster Management Policy, 2009. 3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press
MOOC/Web Platforms:	1. https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)	Understanding (BL 2)
CO2	Enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction	Applying (BL 3)
CO3	Develop disaster response skills by adopting relevant tools and technology	Applying (BL 3)
CO4	Enhance awareness of institutional processes for Disaster response in the country	Applying (BL 3)
CO5	Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	2	1	1	-	-	-	3	1	-	-	-	-	1	-
CO-2	2	1	1	-	-	-	3	1	-	-	-	-	2	-
CO-3	2	1	1	-	-	-	3	1	-	-	2	-	2	-
CO-4	2	1	2	2	-	-	3	2	-	-	2	-	2	-
CO-5	2	3	3	3	-	-	3	2	-	-	2	-	2	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓			✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MC910 Elements of Literature

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to all Branches	III	ESC	3	0	0	0

II - Course Objectives

1.	To make the students aware about the finer sensibilities of human existence through an art form.
2.	To acquaint the students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

III - Course Content**Preamble:**

Elements of Literature introduces the fundamental components of storytelling and analysis. It is exploring narrative techniques, literary devices, and thematic exploration across genres. Dive into the world of literature to uncover its profound impact on culture and human experience.

Unit – I**Introduction to Elements of Literature****1. Relevance of literature**

- a) Enhances Reading, thinking, discussing and writing skills.
- b) Develops finer sensibility for better human relationship.
- c) Increases understanding of the problem of humanity without bias.
- d) Providing space to reconcile and get a cathartic effect.

2. Elements of fiction

- a) Fiction, fact and literary truth.
- b) Fictional modes and patterns.
- c) Plot character and perspective.

3. Elements of poetry

- a) Emotions and imaginations.
- b) Figurative language.
- c) (Simile, metaphor, conceit, symbol, pun and irony).
- d) Personification and animation.
- e) Rhetoric and trend

4. Elements of drama

- a) Drama as representational art.
- b) Content mode and elements.
- c) Theatrical performance.
- d) Drama as narration, mediation and persuasion.
- e) Features of tragedy, comedy and satire

Unit – II**Readings**

- 1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
- 2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.



3. The Experience of Poetry, Graham Moore, Open college of Arts with Open Univ Press, 1991. 4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuf, 2114. 5. The Elements of Drama, J.L. Styan, Literary Licensing, 2011.	
Unit – III	Other Session
1. Tutorials 2. Laboratory 3. Project: The students will write a term paper to show their understanding of a particular piece of literature	
Unit – IV	Assessment
1. HA 2. Quizzes-HA 3. Periodical Examination: one 4. Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc. 5. Final Exam:	
45 Periods	

Text Books:	1. To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper
Reference Books:	
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_hs62/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO-2	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO-3	-	-	-	-	-	-	-	-	2	3	-	1	-	-



CO-4	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO-5	-	-	-	-	-	-	-	-	2	3	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√					√	√	√		√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order . thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MC911 Film Appreciation

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. – Common to All Branches	III	ESC	3	0	0	0

II - Course Objectives

1.	To understand the evolution and language of cinema from its origins to contemporary forms.
2.	To analyze films using diverse theoretical perspectives to develop critical thinking skills.
3.	To appreciate the cultural and artistic impact of international and Indian cinema across different eras.

III - Course Content

Preamble: In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.		
Unit – I	Theme - A: The Component of Films	9 Periods
1. The material and equipment 2. The story, screenplay and script 3. The actors, crew members, and the director 4. The process of film making... structure of a film		
Unit – II	Theme - B: Evolution of Film Language	9 Periods
1. Film language, form, movement etc. 2. Early cinema... silent film (Particularly French) 3. The emergence of feature films: Birth of a Nation 4. Talkies		
Unit – III	Theme - C: Film Theories and Criticism/Appreciation	9 Periods
1. Realist theory; Auteurists 2. Psychoanalytic, Ideological, Feminists 3. How to read films? 4. Film Criticism / Appreciation		
Unit – IV	Theme – D: Development of Films	9 Periods
1. Representative Soviet films 2. Representative Japanese films 3. Representative Italian films 4. Representative Hollywood film and the studio system		
Unit – V	Theme - E: Indian Films	9 Periods
1. The early era 2. The important films made by the directors		

3. The regional films
4. The documentaries in India

45 Periods

READING: A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

https://onlinecourses.nptel.ac.in/noc20_hs63/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Recall the key components of film production, including materials, equipment, and roles such as actors and directors.	Remembering (BL 3)
CO2	Explain the evolution of film language from early silent films to the emergence of talkies, emphasizing forms, movements, and significant milestones like "Birth of a Nation."	Understanding (BL 3)
CO3	Apply various film theories such as realist, auteurist, psychoanalytic, and ideological perspectives to analyze and critique films.	Applying (BL 3)
CO4	Analyze representative films from Soviet, Japanese, Italian, and Hollywood cinema, considering their cultural contexts and stylistic contributions.	Applying (BL 3)
CO5	Examine the significance of Indian films across different eras, including early cinema, regional productions, and documentaries, in shaping the nation's cinematic identity.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	-	-	-	-	-	-	-	2	2	3	2	-	-	-
CO-2	-	-	-	-	-	-	-	2	2	3	2	-	-	-
CO-3	-	-	-	-	-	-	-	2	2	3	2	-	-	-
CO-4	-	-	-	-	-	-	-	2	2	3	2	-	-	-
CO-5	-	-	-	-	-	-	-	2	2	3	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
	√		√		√	√			√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



Mandatory Course – II**I – Course Code & Name: 23MC904 History of Science and Technology in India**

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	Common to all	IV	MC	3	0	0	0

II - Course Content

Preamble: Industrial safety is essential in sectors like manufacturing and construction to prevent accidents, injuries, and environmental damage, ensuring the well-being of workers and visitors. It involves establishing safety regulations, protocols, and measures to minimize hazards like machinery accidents, toxic exposures, and fires. Industrial safety goes beyond legal compliance by fostering a culture focused on health, risk management, and safety. Key elements include risk assessments, hazard identification, PPE, and emergency preparedness.		
Unit – I	Concepts and Perspectives	9 Periods
Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.		
Unit – II	Historiography of Science and Technology in India	3 Periods
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.		
Unit – III	Science and Technology in Ancient India	6 Periods
Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.		
Unit – IV	Science and Technology in Medieval India	9 Periods
Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences, Science and Technology on the eve of British conquest		
Unit – V	Science and Technology in Colonial India	9 Periods
Science and the Empire, Indian response to Western Science, Growth of techno-scientific institutions		
UNIT-VI	Science and Technology in a Post-Independent India	9 Periods
Science, Technology and Development discourse, Shaping of the Science and Technology Policy, Developments in the field of Science and Technology, Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology.		
Text Books:	1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER	



	2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
Reference Books:	1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition. 2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition. 3. Dan Petersen (2003) Techniques of Safety Management: A System Approach. 4. Alan Waring (1996) Safety management system: Chapman & Hall, England. Society of Safety Engineers, USA
MOOC/Web Platforms:	1. ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html Indian Standard code of practice on occupational safety and health audit 2. https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 3. https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	---

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MC906 Well-Being with Traditional Practices-Yoga, Ayurveda and Siddha

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	Common to all	IV	MC	3	0	0	0

II - Course Objectives

1.	To enjoy life happily with fun filled new style activities that help to maintain health also
2.	To adapt a few lifestyle changes that will prevent many health disorders
3.	To be cool and handbill every emotion very smoothly in every walk of life
4.	To learn to eat cost effective but healthy foods that are rich in essential nutrients
5.	To develop immunity naturally that will improve resistance against many health disorders

III - Course Content

Unit – I	Health and Its Importance	6 Periods
Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health. Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken		
Unit – II	Diet	10 Periods
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong. Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.		



Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions Definition of BMI and maintaining it with diet -Importance - Consequences of not maintaining BMI - different steps to maintain optimal BMI Common cooking mistakes - Different cooking methods, merits and demerits of each method		
Unit – III	Role of Ayurveda & Siddha Systems in Maintaining Health	8 Periods
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life. Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Panchcheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri- Dosha Theory) - Udal Thathukkal Prevention of illness with our traditional system of medicine Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population.(prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.		
Unit – IV	Mental Wellness	7 Periods
Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions. Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement. Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity		
Unit – V	Yoga	14 Periods
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.		

Text Books:	1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA 2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California
Reference Books:	1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England



	2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
MOOC/ Web Platforms:	1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/ 2. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20c%20ok. 3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html 4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926 5. Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefits-of-healthy-eating.html 6. Food additives https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	---

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MC905 Political and Economic Thought for a Humane Society

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	Common to all	IV	MC	3	0	0	0

II - Course Objectives

1.	This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.
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III - Course Content

Unit – I	10 Periods
Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems,	
Unit – II	7 Periods
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy, Fascism and totalitarianism. World war I and II. Cold war	
Unit – III	8 Periods
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models, Welfare state. Relation with human desires. Empowered human beings, satisfaction	
Unit – IV	9 Periods
Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature, Essential elements of Indian civilization	
Unit – V	6 Periods
Technology as driver of society, Role of education in shaping of society. Future directions. Conclusion	

Text Books:	1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems Khanna Publisher 2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
Reference Books:	Authors mentioned along with topics above 1. A Nagaraj, M K Gandhi, JC Kumarappa 2. Refs: Adam Smith, J S Mill 3. Refs: Marx, Lenin, Mao, M N Roy 4. Refs: M K Gandhi, Schumacher, Kumarappa 5. Refs: Pt Sundarlal, R C Mazumdar, Dharampal 6. Refs: Nandkishore Acharya, David Dixon, Levis Mumford



MOOC/Web Platforms:	1. ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html Indian Standard code of practice on occupational safety and health audit 2. https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 3. https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf
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VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MC907 State, Nation Building and Politics in India

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	Common to all	IV	MC	3	0	0	0

II - Course Objectives

1.	This course explores the functioning of the state, India's constitutional development, and the evolving political system. It also addresses national integration challenges and offers insights for India's future.
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III - Course Content

Unit – I	9 Periods
Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.	
Unit – II	9 Periods
Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary, The idea of India.	
Unit – III	9 Periods
1857 and the national awakening, 1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.	
Unit – IV	9 Periods
Goals, objective and philosophy. Why a federal system?, National integration and nation-building.	
Unit – V	9 Periods
Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?	

Suggested Reading:	1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi. 2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012. 3. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition. 4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013. 5. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991. 6. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition. 7. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.
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VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	---

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23MC908 Industrial Safety

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	Common to all	IV	MC	3	0	0	0

II - Course Objectives

1.	To Understand the Introduction and basic Terminologies safety.
2.	To enable the students to learn about the Important Statutory Regulations and standards.
3.	To enable students to Conduct and participate the various Safety activities in the industry.
4.	To have knowledge about Workplace Exposures and Hazards.
5.	To assess the various Hazards and consequences through various Risk Assessment Techniques.

III - Course Content

Preamble: Industrial safety is essential in sectors like manufacturing and construction to prevent accidents, injuries, and environmental damage, ensuring the well-being of workers and visitors. It involves establishing safety regulations, protocols, and measures to minimize hazards like machinery accidents, toxic exposures, and fires. Industrial safety goes beyond legal compliance by fostering a culture focused on health, risk management, and safety. Key elements include risk assessments, hazard identification, PPE, and emergency preparedness.

Unit – I	Safety Terminologies	9 Periods
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet-MSDS		
Unit – II	Standards and Regulations	9 Periods
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006		
Unit – III	Safety Activities	9 Periods
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment		
Unit – IV	Workplace Health and Safety	9 Periods
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety - Toxic gas Release		



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Unit – V	Hazard Identification Techniques	9 Periods
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment - Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment		

Text Books:	1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER 2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
Reference Books:	1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition. 2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition. 3. Dan Petersen (2003) Techniques of Safety Management: A System Approach. 4. Alan Waring (1996) Safety management system: Chapman & Hall, England 5. Society of Safety Engineers, USA
MOOC/Web Platforms:	1. ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html Indian Standard code of practice on occupational safety and health audit 2. https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 3. https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concept of safety.	Understanding (BL 1)
CO2	Obtain knowledge of Statutory Regulations and standards.	Applying (BL 1)
CO3	Know about the safety Activities of the Working Place.	Applying (BL 1)
CO4	Analyze on the impact of Occupational Exposures and their Remedies.	Applying (BL 2)
CO5	Obtain knowledge of Risk Assessment Techniques.	Applying (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	3	3	1	1	3	2	2	3	3	1	3	1	1
CO-2	2	3	2	2	1	3	2	3	3	2	1	3	1	1
CO-3	2	2	2	2	1	2	2	2	3	2	1	2	1	1
CO-4	3	3	3	2	2	3	2	2	3	2	2	3	1	1
CO-5	3	2	3	2	2	3	2	2	3	2	2	3	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓		✓			✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME11 Automotive Materials, Components, Design and Testing

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1.	Identify the functional requirements of key engine components.
2.	Select suitable materials based on mechanical properties and thermal considerations.
3.	Design components like pistons, connecting rods, and crankshafts.
4.	Analyze the operation and design of flywheels and valve trains.
5.	Understand engine testing methods and emission measurement techniques.

III - Course Content

Preamble: This course delves into the intricate design and material selection processes for various engine components, including pistons, crankshafts, connecting rods, and flywheels. Understanding the functional requirements and appropriate materials is crucial for optimizing engine performance, durability, and efficiency.		
Unit – I	Functional Requirements of Engine Components and Suitable Materials	6 Periods
Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components. Engine components Material Selection for Engine components		
Unit – II	Design of Cylinder and Piston Components	6 Periods
Design of cylinder, cylinder head, piston, piston rings and piston pin – more details in necessary		
Unit – III	Design of Connecting Rod and Crank Shaft	6 Periods
Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.		
Unit – IV	Design of Flywheel and Valve Train	6 Periods
Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Chassis, frame, body and wheel		
Unit – V	Engine Testing	6 Periods
Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO ₂ - HC. -Particle counter.		
	Practical	30 Periods

Experiments

1. Design and animate Piston Cylinder assembly and motion study using CAD software.
2. Design and simulate Connecting rod and crank shaft
3. Design flywheel and valve
4. Design and simulate Two Cylinder Engine assembly using CAD software.
5. Conduct the engine performance test using analysis software
6. Conduct the emission test using analysis software

TOTAL: 60 Periods

Text Books:	1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001. 2. The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello 24 December 2019 3. Hiroshima Yamagata, "The science and technology of materials in automotive engines", Woodhead Publishing Limited, Cambridge, England 4. Jain. R.K, "Machine Design", Khanna Publishers, New Delhi, 2005. 5. Manufacturing Automotive Components from Sustainable Natural Fiber Composites (SpringerBriefs in Materials) by Lobna A. Elseify, Mohamad Midani, et al. 9 August 2021
Reference Books:	1. Mechanical and Materials Engineering of Modern Structure and Component Design (Advanced Structured Materials Book 70) by Andreas Öchsner and Holm Altenbach 6 June 2015 2. Advanced Technology for Design and Fabrication of Composite Materials and Structures: Applications to the Automotive, Marine, Aerospace and Applications of Fracture Mechanics) by George C. Sih, Alberto Carpinteri, et al. 15 December 2010
MOOC/Web Platforms:	1. https://www.youtube.com/playlist?list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr 2. https://digimat.in/nptel/courses/video/108102121/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the requirements of engine components and select suitable materials.	Applying (BL 3)
CO2	Apply the concept of design to cylinder and piston components and solve problems.	Applying (BL 3)
CO3	Apply the concept of design to Connecting rod and crank shaft and solve problems.	Applying (BL 3)
CO4	Apply the concept of design to flywheel and valve train and solve problems.	Applying (BL 3)
CO5	Discuss engine test cycles, dynamometer and emission measurement technologies and Instruments	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	0	0	1	0	0	0	0	0	0	0	1	3	1
CO-2	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-3	3	0	1	1	0	0	0	0	0	0	0	1	3	1
CO-4	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-5	3	0	1	1	0	0	0	0	0	0	0	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME12 Conventional and Futuristic Vehicle Technology

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand advanced gasoline and diesel engine technologies, including direct injection, turbocharging, variable compression, and intelligent engine management systems.
2.	Explain the principles of combustion in SI and CI engines, including advanced combustion strategies such as partially premixed and reactivity-controlled compression ignition.
3.	Analyze the properties, combustion characteristics, and applications of alternative fuels such as alcohol, ammonia, methane, hydrogen, and dimethyl ether.
4.	Understand hybrid and electric vehicle architectures, including micro, mild, full hybrid systems, and pure electric vehicles, along with their operational challenges.
5.	Explore fuel cell technologies, hydrogen storage methods, and control systems for automotive applications, understanding their potential and roadmap to commercialization

III - Course Content

Preamble: This course introduces advanced automotive powertrain technologies, covering modern engine systems, alternative fuels, hybrid and electric vehicles, and fuel cell applications. Emphasis is on efficiency, emission control, and emerging trends in sustainable mobility.		
Unit – I	Advanced Engine Technology	9 Periods
Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture		
Unit – II	Combustion Technology	9 Periods
SI Engine Combustion -Stages of Combustion, Phases of Ignition, Flame Propagation – Factors, Flame Structure, Burning Velocity, Cycle to Cycle Variations Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.		
Unit – III	Low Carbon Fuel Technology	9 Periods
Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward		
Unit – IV	Hybrid And Electric Vehicle (Battery Powered)	9 Periods
Micro hybrid vehicles, mild hybrid vehicles, full hybrid vehicles, configuration of hybrid electric Vehicles -Parallel hybrid, series Hybrid, Series-Parallel Hybrid, Complex Configuration. Pure Electric Vehicle Technology – Challenges and Way forward		
Unit – V	Fuel Cell Technology	9 Periods



Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.

Text Books:	1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004. 2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6, SPRINGER 3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003. 4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
Reference Books:	1. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998 2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003. 3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
MOOC/Web Platforms:	-

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the latest trends in engine technology	Applying (BL 3)
CO2	Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment.	Applying (BL 3)
CO3	Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals.	Applying (BL 3)
CO4	Discuss the working and energy flow in various hybrid and electric configurations.	Applying (BL 3)
CO5	Analyzing the need for fuel cell technology in automotive applications.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	0	0	1	0	0	0	0	0	0	0	1	3	1
CO-2	3	2	1	1	0	0	0	0	0	0	0	1	3	1



CO-s/ PO-s	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-3	3	0	1	1	0	0	0	0	0	0	0	1	3	1
CO-4	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-5	3	0	1	1	0	0	0	0	0	0	0	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME13- Renewable Powered Off Highway Vehicles and Emission Control Technology

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Identify and evaluate low- and zero-carbon fuels such as ethanol, methanol, biodiesel, CNG, LNG, DME, PODE, ammonia, and hydrogen for off-highway vehicles.
2.	Understand the use of solar and green energy technologies for powering off-highway vehicles, including hydrogen production and smart grid integration.
3.	Explain the principles, types, and applications of fuel cells in off-highway vehicles, including design and sizing considerations.
4.	Analyze advanced low-temperature combustion modes and gasoline direct injection control techniques for reducing emissions.
5.	Understand emission after-treatment technologies, including diesel oxidation catalysts, particulate filters, selective catalytic reduction, CO ₂ absorption, and waste heat recovery systems.

III - Course Content

Preamble: This course covers sustainable propulsion and emission control technologies for off-highway vehicles, including low- and zero-carbon fuels, fuel cells, green energy, advanced combustion, and after-treatment systems.		
Unit – I	Low And Zero Carbon Fuels Powered Off-Highway Vehicles	9 Periods
Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE), Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles.		
Unit – II	Green Energy Powered Off-Highway Vehicles	9 Periods
Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles.		
Unit – III	Fuel Cell Powered Off-Highway Vehicles	9 Periods
Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications.		
Unit – IV	N-Cylinder Treatment Technologies	9 Periods
Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Controlling Techniques – Catalytic Converters		
Unit – V	After Treatment Technologies	9 Periods



Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO₂ absorption techniques, Waste Heat Recovery and Organic Rankine Cycle.

Text Books:	1. John Twidell, and Tony Weir. Renewable Energy Sources – 3 rd Edition 2015, 2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines 3. Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering, 4. W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control.
Reference Books:	1. Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill 1 June 2011 2. Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. 7 April 2022 3. The Political Economy of Low Carbon Transformation: Breaking the habits of capitalism (Routledge Studies in Low Carbon Development) by Harold Wilhite 21 December 2017
MOOC/Web Platforms:	1. https://www.youtube.com/playlist?list=PLvqSpQzTE6M9spod-UH7Q69wQ3uRm5thr 2. https://digimat.in/nptel/courses/video/108102121/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Evaluate the availability, suitability, and its role in off-road vehicle categories in reducing the carbon footprint on the environment.	Applying (BL 3)
CO2	Gain the knowledge on various green energy production methods and its impact on meeting energy demand of off-road vehicle applications	Applying (BL 3)
CO3	Develop the working of fuel cell, various fuel cell types, and its design for off-road vehicle applications	Applying (BL 3)
CO4	Gain the knowledge on various in-cylinder low temperature combustion technologies and its key role in controlling the engine-out emissions.	Applying (BL 3)
CO5	Develop the working of various existing aftertreatment systems in controlling the engine out emissions.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	0	0	1	0	0	0	0	0	0	0	1	3	1
CO-2	3	2	1	1	0	0	0	0	0	0	0	1	3	1



COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-3	3	0	1	1	0	0	0	0	0	0	0	1	3	1
CO-4	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-5	3	0	1	1	0	0	0	0	0	0	0	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME14 Vehicle Health Monitoring, Maintenance and Safety

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the importance and classification of vehicle maintenance, including scheduled services and basic fault diagnosis.
2.	Perform maintenance and fault diagnosis on powertrain components, emission control systems, batteries, and electrical systems using OBD and scan tools.
3.	Carry out servicing and maintenance of vehicle systems such as clutch, brakes, suspension, steering, and tyres, including computerized wheel balancing and alignment.
4.	Explain and apply vehicle safety technologies, including active safety systems (ABS, EBD, CSC, traction control) and passive safety features (seat belts, airbags, collapsible steering).
5.	Analyze and simulate safety concepts for both active and passive safety, including collision detection, crash behavior, and accident investigation procedures.

III - Course Content

Preamble: This course covers vehicle maintenance, system servicing, and safety technologies, including fault diagnosis, electronic safety systems, and collision prevention, to enhance vehicle performance and occupant safety.		
Unit – I	Introduction	9 Periods
Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services – service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools;		
Unit – II	Powertrain Maintenance	9 Periods
Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical -Fault Diagnosis Using Scan Tools.		
Unit – III	Vehicle System Maintenance	9 Periods
Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering		
Unit – IV	Vehicle Safety Technologies	9 Periods



Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers.		
Unit – V	Simulation of Safety Concepts	9 Periods
Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, accident reporting and investigation procedures		

Text Books:	1. Safety Management System and Documentation Training Programme Handbook by S. V. Paul ISBN: 9788123923444 2. Ed May, "Automotive Mechanics Volume One" and Two, Mc Graw Hill Publications, Tenth edition, 2018. 3. Bosch Automotive Handbook, Tenth Edition, 2018. 4. Jack Erjavek, "A systems approach to Automotive Technology", Cengage Learning, 5th Edition, 2012.
Reference Books:	1. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", Tata McGraw Hill, 10th Edition, 2004. 2. Vehicle Service Manuals of Reputed Indian Manufacturers.
MOOC/Web Platforms:	1. https://www.youtube.com/playlist?list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr 2. https://digimat.in/nptel/courses/video/108102121/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	The students have the knowledge of vehicle health monitoring, maintenance and safety.	Applying (BL 3)
CO2	The students able to maintenance of powertrain.	Applying (BL 3)
CO3	The students can ability to maintenance of Vehicle system	Applying (BL 3)
CO4	Explain and awareness of vehicle safety.	Applying (BL 3)
CO5	Explain the simulation of safety concepts.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	0	0	1	0	0	0	0	0	0	0	1	3	1
CO-2	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-3	3	0	1	1	0	0	0	0	0	0	0	1	3	1
CO-4	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-5	3	0	1	1	0	0	0	0	0	0	0	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME15 CAE and CFD Approach in Future Mobility

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the fundamental principles of conservation laws, Reynolds transport theorem, and the role of CFD in design and mobility engineering.
2.	Apply CAD techniques, geometric and solid modeling, and rapid prototyping methods for component and system design.
3.	Comprehend the basic concepts of finite element analysis, including discretization, shape functions, stiffness matrices, and solution of engineering problems.
4.	Perform CFD modeling, discretization, and simulation for incompressible and compressible flows, including panel methods and grid generation.
5.	Solve engineering problems using CFD and FEA, including turbulence modeling, vehicle aerodynamics, boundary layer analysis, and error analysis in computational methods.

III - Course Content

Preamble: This course introduces CAE, CAD, FEA, and CFD, focusing on modeling, simulation, and computational tools for design and analysis in mechanical and mobility engineering.		
Unit – I	Introduction to CAE /CFD	6 Periods
Fundamental principles of conservation, Reynolds transport theorem, Conservation of mass, Conservation of linear momentum. Introduction to design process and role of computers in the design process, use of modern computational tools used for design and analysis, Concept of modelling and simulation. CFD as a design and research tool, Applications of CFD in mobility engineering		
Unit – II	CAD and Rapid Prototyping	6 Periods
Curves and Surfaces: Geometric modelling curves and surfaces, Wire frame models, Parametric representations, Parametric curves and surfaces, Solid modelling: Fundamentals of solid modelling, Different solid representation schemes, Boundary representation (B-rep), Constructive solid geometry (CSG). Mechanism design and assembly. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards. CAD Data and Programming Techniques for RP: Transformations, Solid modelling for RP, Surface modelling, STL file generation, Defects in STL files and repairing algorithms, Interface formats		
Unit – III	Introduction to FEA	6 Periods
Basic Concept of Finite Element Method, Ritz and Rayleigh Ritz methods, Method of weighed residuals, Galerkin method. Governing differential equations of one- and two-dimensional problems, One Dimensional Second Order Equations – Discretization – Linear and Higher order Elements – Interpolation and shape functions, Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Finite Volume Discretization of 2-D unsteady State Diffusion type problems.		



Unit – IV	Introduction to CFD	6 Periods
CFD vs. experimentation; continuity, navier-stokes and energy equations; modelling and discretization techniques; basic steps in CFD computation Various simplifications, Dimensionless equations and parameters, Incompressible inviscid flows, Source panel method, and Vortex panel method. Conservation form of the equations, shock fitting and shock capturing, Time marching and space marching. 3-D structured and unstructured grid generation, mesh smoothing and sensitivity checks		
Unit – V	Problem Solving Using CFD	6 Periods
Turbulence Modelling, different turbulent modelling scheme. Incompressible Viscous Flows; Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; Norm of a vector, Norm of a matrix, some important properties of matrix norm, Error analysis of elimination methods.		
Practical		30 Periods
CAE and CFD Laboratory 1. Coupled analysis of structural / thermal 2. buckling analysis 3. CFD simulation of flow analysis over a Cylinder Surface 3D 4. CFD simulation of Intermixing of Fluids in a Bent-Pipe 3D 5. CFD simulation of flow and heat transfer analysis of Double Pipe Counter Flow Heat Exchanger 6. Design & processing of Engine components by RPT		

Total 60 Periods

Text Books:	1. Computational Fluid Dynamics: A Practical Approach by Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu Applied Computational Fluid Dynamics by S. C. Gupta 2. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007 3. Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008 4. Tirupathi R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.
Reference Books:	1. Dhanaraj. R and Prabhakaran Nair. K, "Finite Element Analysis", Oxford Publications, 2015. 2. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014. 3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill, 1998.
MOOC/Web Platforms:	1. https://www.youtube.com/playlist?list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr 2. https://digimat.in/nptel/courses/video/108102121/L01.html



IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Discuss the basic concept of the CAE /CFD	Applying (BL 3)
C02	Develop the computer aided design and rapid prototyping.	Applying (BL 3)
C03	Discuss the basic concept of Finite Element methods	Applying (BL 3)
C04	Discuss the concepts of computational fluid dynamics	Applying (BL 3)
C05	solving the problem and simulation using computational fluid dynamics	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	0	0	1	0	0	0	0	0	0	0	1	3	1
CO-2	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-3	3	0	1	1	0	0	0	0	0	0	0	1	3	1
CO-4	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-5	3	0	1	1	0	0	0	0	0	0	0	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



[Signature]

Chairperson - Board of Studies,
Department of Mechanical Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul 624401

I – Course Code & Name: 23PME16 Hybrid and Electric Vehicle Technology

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the fundamentals of vehicle performance, power sources, and the significance of hybrid and electric vehicles.
2.	Explain hybrid and electric drive-train topologies, power flow control, and fuel efficiency analysis.
3.	Comprehend the configuration and control of AC and DC drives used in hybrid and electric vehicles.
4.	Analyze energy storage technologies including batteries, fuel cells, and supercapacitors, and their hybridization.
5.	Perform drive sizing and apply energy management strategies for optimal performance of hybrid and electric vehicles.

III - Course Content

Preamble: This course introduces the principles, components, and performance aspects of hybrid and electric vehicles. It covers hybrid and electric drive-trains, control of AC and DC drives, energy storage technologies, and drive sizing with energy management strategies, emphasizing efficiency, sustainability, and environmental impact.		
Unit – I	Introduction	9 Periods
Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, Gradeability – Acceleration performance – Brake performance		
Unit – II	Hybrid Electric Drive Trains	9 Periods
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.		
Unit – III	Control of Ac & Dc Drives	9 Periods
Introduction to electric components used in hybrid and electric vehicles, Configuration, and control - DC Motor drives, Induction Motor drives EV recharging and refueling system design		
Unit – IV	Energy Storage	9 Periods
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices.		
Unit – V	Drive Sizing and Energy Management Strategies	9 Periods
Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage		



technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues.

Text Books:	1. Iqbal Husain, —Electric and Hybrid Vehicles: Design Fundamentals , Third Edition, 2021. 2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003. 3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004. 4. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998.
Reference Books:	1. Hybrid, Electric and Fuel-Cell Vehicles, International Edition by Jack Erjavec 6 June 2012. 2. Energy Management in Hybrid Electric Vehicles using Co-Simulation by Christian Paar 11 February 2011. 3. Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids (Mechanical Engineering) by Yangsheng Xu , Jingyu Yan, et al. 16 December 2013.
MOOC/Web Platforms:	1. https://www.youtube.com/playlist?list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr 2. https://digimat.in/nptel/courses/video/108102121/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss Characterise and configure hybrid drivetrains requirement for a vehicle.	Applying (BL 3)
CO2	Design and apply appropriate hybrid and electric drive trains in a vehicle.	Applying (BL 3)
CO3	Design and install suitable AC and DC drives for electric vehicles.	Applying (BL 3)
CO4	Discuss arrive at a suitable energy storage system for a hybrid / electric vehicle.	Applying (BL 3)
CO5	Apply energy management strategies to ensure better economy and efficiency.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	0	0	1	0	0	0	0	0	0	0	1	3	1
CO-2	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-3	3	0	1	1	0	0	0	0	0	0	0	1	3	1
CO-4	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-5	3	0	1	1	0	0	0	0	0	0	0	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



Bmy
Chairperson - Board of Studies,
Department of Mechanical Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul 624401

I – Course Code & Name: 23PME17 Thermal Management of Batteries and Fuel Cells

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand Li-ion battery chemistry, formats, aging, efficiency, and battery management systems.
2.	Analyze various thermal management systems for batteries, including PCM, heat pipes, and thermo-electric methods.
3.	Examine case studies of EV battery thermal management, including heat exchanger design and optimization.
4.	Comprehend fuel cell operation, thermal management techniques, and energy balance considerations.
5.	Apply concepts to fuel cell system design, power plant sizing, and vehicle energy management strategies for EVs and FCVs.

III - Course Content

Preamble: This course covers advanced battery technologies, fuel cell systems, and their thermal management in electric and hybrid vehicles. It emphasizes design, fabrication, testing, and case studies for efficient and safe energy storage and conversion.		
Unit – I	Advanced Batteries	9 Periods
Li-ion Batteries- chemistry, different formats, , operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S- 18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Supercapacitors Vs batteries. Diamond battery concepts. Fabrication and Testing of Lithium-Ion Half-Cell-Anode material		
Unit – II	Thermal Management	9 Periods
Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications. Fabrication and Testing of Lithium-Ion Full-Cel.		
Unit – III	Battery Thermal Management Case Studies	9 Periods
EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study. Fabrication and Testing of Activated Carbon Electrode-Based Supercapacitor		
Unit – IV	Thermal Management in Fuel Cells	9 Periods
Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy		



balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.

Unit – V	Fuel Cell Thermal	9 Periods
Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell, Electric Vehicle Fuel economy calculations-Battery EVs Vs Fuel Cell EVs. Toyota Mirai FCV- Operating, principle, High pressure hydrogen tank, Boost convertor, NiMH Battery, Circuits for Balancing; Vehicle Energy Management Systems		

Text Books:	1. Ibrahim Dincer, Halil S. Hamut, and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", Wiley, 2017. 2. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteries in Electric Drive Vehicles", Wiley, 2015. 3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals, Theory, and Design", CRC Press, 2005. 4. John G. Hayes and G. Abas Goodarzi, "Electric Powertrain", Wiley, 2018. 5. Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.
Reference Books:	1. Nag. P. K, "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill Education, New Delhi, 2013. 2. Younes Shabany, "Heat Transfer: Thermal Management of Electronics Hardcover" 2010, CRC Press. 3. T. Yomi Obidi, "Thermal Management in Automotive applications", 2015, SAE International. 4. Jerry Sargent, Al Krum, "Thermal Management Handbook: For Electronic Assemblies Hardcover", 1998, Mc Graw- Hill
MOOC/Web Platforms:	

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the different Li-ion Batteries and Fuel Cell performances.	Applying (BL 3)
CO2	Design a Battery Pack with appropriate PCM.	Applying (BL 3)
CO3	Apply Cooling Models using Simulation	Applying (BL 3)
CO4	Estimate fuel economy.	Applying (BL 3)
CO5	Utilize different Thermal Management System approaches during real world usage.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	0	0	1	0	0	0	0	0	0	0	1	3	1
CO-2	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-3	3	0	1	1	0	0	0	0	0	0	0	1	3	1
CO-4	3	2	1	1	0	0	0	0	0	0	0	1	3	1
CO-5	3	0	1	1	0	0	0	0	0	0	0	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME18 Value Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental concepts, origin, and principles of Value Engineering and Value Analysis.
2.	To explain the Value Engineering job plan, its phases, and organizational aspects.
3.	To impart knowledge on VE techniques such as brainstorming, FAST diagrams, FCWA, LCC, and ABC analysis.
4.	To develop skills in preparing VE worksheets, feasibility ranking, and cost analysis for proposals.
5.	To explore applications of VE in maintenance, repair, construction, infrastructure, and non-hardware projects.

III - Course Content

Preamble: Value Engineering (VE) is a systematic approach to improve the value of products, processes, and services by analyzing their functions and cost.		
Unit-I	Introduction	9 Periods
Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis. (No Change)		
Unit –II	Value Engineering Job Plan and Process	9 Periods
Seven phases of job plan - FAJT Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - VE Job Plan phases: Information, Analysis, Creative, Judgement, Development & Implementation- Benefits of Value Engineering.		
Unit-III	Value Engineering Techniques	9 Periods
Creativity - Brain storming -- Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost (LCC) - MISS Technique for Function Evaluation		
Unit-IV	Worksheets and Guidelines	9 Periods
Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial		



aspects - List cycle cost analysis - - Audit - Case studies and Discussion

Unit-V	Versatility of Value Engineering	9 Periods
Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties - VE in construction and infrastructure projects		

Text Books:	1. Iyer. S.S., "Value Engineering", New Age International (P) Limited, 9th Edition, 2009. 2. Anil Kumar. and Mukhopadhyaya., "Value Engineering: Concepts Techniques and applications", SAGE Publications, 1st Edition, 2003.
Reference Books:	1. Del L. Younker., "Value Engineering: analysis and methodology", CRC Press, 2003. 2. Richard Park., "Value Engineering A Plan for Invention", CRC Press, 1998. 3. Arthur E. Mudge., "Value Engineering :A systematic approach", McGraw Hill, 1989. 4. Alphonse Dell'Isola., "Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations", R.S. Means Company, 1997. 5. Lawrence D. Miles., "Techniques of Value Analysis and Engineering", Lawrence D. Miles Value Foundation, 3rd Edition, 2015.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112107282

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.	Understanding (BL 2)
CO2	Discuss the product and articulate it in various phases of value engineering.	Understanding (BL 2)
CO3	Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training.	Understanding (BL 2)
CO4	Apply querying theory and FAST to prefect a value engineering project implementation.	Applying (BL 3)
CO5	Develop various case studies related to value engineering project implementation.	Analyze (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



(Signature)
 Chairperson - Board of Studies,
 Department of Mechanical Engineering,
 NPR College of Engineering & Technology
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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO-1	PSO-2
CO-1	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	2	2	1	1	1	-	-	-	1	-	-	-	2	1
CO-3	3	3	2	2	2	-	-	1	2	2	1	-	3	2
CO-4	3	2	2	2	2	-	1	-	2	2	1	-	3	2
CO-5	2	2	1	1	1	-	-	-	1	-	-	-	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓		✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME19 Additive Manufacturing

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the fundamentals, development, and applications of Additive Manufacturing technologies.
2.	To impart knowledge on Design for Additive Manufacturing including topology optimization
3.	To understand polymerization and directed energy deposition processes along with critical process parameters.
4.	To explore powder bed fusion and material extrusion techniques, including process benefits, limitations, and defect analysis.
5.	To examine other AM processes such as binder jetting, material jetting, and sheet lamination, highlighting applications and constraints.

III - Course Content

Preamble: Additive Manufacturing (AM) is a transformative technology that enables layer-by-layer fabrication of complex components directly from digital models.

Unit-I	Introduction	6 Periods
Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping - Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare- Role of AM in modern product development cycles		
Unit –II	Design for Additive Manufacturing (DfAM)	6 Periods
Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- Design rules for Extrusion based AM- Basics of 3D Scanning and Digitization in CAD model creation for AM		
Unit–III	Polymerization and Directed Energy Deposition	6 Periods
Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications. - Critical process parameters: geometry, temperature, composition, phase transformation		
Unit–IV	Powder Bed Fusion and Material Extrusion	6 Periods



Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process- Materials -Applications and Limitations. - Defects in SLM, SLS, FDM		
Unit-V	Other Additive Manufacturing Processes	6 Periods
Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.		
Additive Manufacturing Laboratory		30 Periods
Experiments 1. Modelling and converting CAD models into STL file. 2. Manipulation and error fixing of STL file. 3. Design and fabrication of parts by varying part orientation and support structures. 4. Fabrication of parts with material extrusion AM process. 5. Fabrication of parts with vat polymerization AM process. 6. Design and fabrication of topology optimized parts.		
Total: 60 Periods		

Text Books:	1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0. 2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.
Reference Books:	1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati, Ohio, 2011, ISBN :9783446425521. 2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333. 3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590. 4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006, ISBN: 978-1-4614-9842-1. 5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_me151



IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.	Understanding (BL 2)
CO2	Acquire knowledge on process of transforming a concept into the final product in AM technology.	Understanding (BL 2)
CO3	Elaborate the vat polymerization and direct energy deposition processes and its applications.	Understanding (BL 2)
CO4	Acquire knowledge on process and applications of powder bed fusion and material extrusion.	Applying (BL 3)
CO5	Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.	Analyze (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	1	-	-	-	-	-	-	-	-	-	2	1	-
CO-2	2	2	1	1	1	-	-	1	1	-	-	2	2	1
CO-3	3	3	2	2	2	-	1	-	2	2	1	2	2	2
CO-4	3	2	2	2	2	-	-	-	2	2	1	2	3	3
CO-5	2	2	1	1	1	-	-	-	1	-	-	2	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓		✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME20 Design of X

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce general design principles for manufacturability, reliability, energy efficiency, and regulatory compliance.
2.	To explore factors influencing form design including material-process compatibility and manufacturing constraints.
3.	To understand component design for machining, assembly, and accessibility, including DFMA software tools.
4.	To study design considerations for castings and apply guidelines to simplify and optimize casting components.
5.	To apply DFX principles for additive manufacturing, including design freedoms, part orientation, supports, and post-processing.

III - Course Content

Preamble: Design for X (DFX) integrates multiple design considerations - manufacturability, assembly, reliability, and sustainability into the product development process.

Unit – I	Introduction	9 Periods
General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances – Assembly limits -Datum features - Tolerance stacks - Design for reliability – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards		
Unit – II	Factors Influencing Form Design	9 Periods
Working principle, Material, Manufacture, Design integration – Evaluation of form variants based on material-process compatibility and manufacturing constraints - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings		
Unit – III	Component Design - Machining Consideration	9 Periods
Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for clampability – Design for accessibility – Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly- Introduction to DFMA software tools.		
Unit – IV	Component Design – Casting Consideration	9 Periods



Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Die/Investment casting guidelines- Modifying the design - group technology - Computer Applications for DFMA

Unit – V	Design For Additive Manufacturing	9 Periods
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Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Post-processing in AM, AM case studies

Text Books:	1. James G. Bralla, "Design for Manufacturability Handbook", McGraw Hill Professional, 1998. 2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.
Reference Books:	1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001. 2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004. 3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014. 4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996. 5. Boothroyd, G, Hartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_me121

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Elaborate the design principles for manufacturability.	Understanding (BL 2)
CO2	Discuss the factors influencing in form design.	Analyze (BL 3)
CO3	Apply the component design features of various machine.	Applying (BL 3)
CO4	Discuss the design consideration principles of welding in the design of welded products.	Applying (BL 3)
CO5	Discuss the design consideration principles of additive manufacturing.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	2	2	1	1	1	-	-	-	1	-	-	-	2	1
CO-3	3	3	2	2	2	-	1	1	2	-	1	-	2	2
CO-4	3	2	2	2	2	-	-	-	2	-	1	-	2	2
CO-5	2	2	1	1	1	-	-	-	1	-	-	-	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME21 Ergonomics in Design

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals of ergonomics and its role in industrial design and man-machine environment systems.
2.	To explain anthropometric data applications, postural analysis, and workstation/chair design for safe production.
3.	To understand design principles of displays, controls, and human-system cognitive interaction.
4.	To study the influence of colour, environmental stressors, and psychological aspects in ergonomic design.
5.	To explore aesthetic concepts, participatory ergonomics, and layout design for better human compatibility.

III - Course Content

Preamble: This course provides knowledge of ergonomics and industrial design principles to enhance human-machine-environment interaction, safety, comfort, and efficiency.

Unit – I	Introduction	9 Periods
An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, , general approach to the man-machine relationship, Man-machine-environment interaction: a design perspective Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.,		
Unit – II	Ergonomics and Production	9 Periods
Introduction, Anthropometric data and its applications in ergonomic, working postures, Postural analysis and evaluation for a practical case, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form		
Unit – III	Design Principles for Display and Controls	9 Periods
Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, Cognitive aspects of human-system interaction – perception, behavior, error, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls; Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy		



lever, Pedals. Design of controls in automobiles, Machine Tools.		
Unit – IV	Component Design – Casting Consideration	9 Periods
Colour: Colour and light, Colour and objects, Environmental stressors – temperature, noise, vibration, fatigue, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style		
Unit – V	Aesthetic Concepts	9 Periods
Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design. Participatory ergonomics and human compatibility		

Text Books:	1. Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares , Francisco Rebelo 2. Ergonomics in Product Design by Sendpoints Publishing Co. Ltd.
Reference Books:	1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7thEdition, 2002. 2. Brain Shakel, "Applied Ergonomics Hand Book", Butterworth Scientific London 1988. 3. Bridger, R.C., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications. 4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006. 5. Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/107103004

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Appreciate ergonomics need in the industrial design.	Understanding (BL 2)
CO2	Apply ergonomics in creation of manufacturing system.	Applying (BL 3)
CO3	Discuss on design of controls and display.	Applying (BL 3)
CO4	Consider environmental factors in ergonomics design.	Applying (BL 3)



CO5	Report on importance of aesthetics to manufacturing system and product.	Applying (BL 3)
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(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	1	1	-	-	-	-	-	-	-	-	-	-	1	-
CO-2	2	2	1	1	1	-	-	-	1	-	-	-	2	1
CO-3	3	3	2	2	2	-	-	1	2	2	1	-	2	2
CO-4	3	2	2	2	2	-	1	-	2	2	1	-	2	2
CO-5	2	2	1	1	1	-	-	-	1	-	-	-	1	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME22 New Product Development

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the systematic process of product planning and customer need identification.
2.	Apply tools such as QFD, Pugh's method, and concept testing for product specification and selection.
3.	Develop competencies in costing, product architecture, ergonomics, and aesthetics.
4.	Integrate creativity, value engineering, and economic analysis into product design and development.

III - Course Content

Preamble: This course provides knowledge of ergonomics and industrial design principles to enhance human-machine-environment interaction, safety, comfort, and efficiency.		
Unit-I	Product Planning	9 Periods
Product Planning Process- Identify Opportunities- Evaluating and Prioritizing Projects- Allocating Resources and Timing- Pre-Project Planning-Reflect on the Results and the Process-Identifying Customer Needs- Raw Data from Customers- Interpreting Raw Data in Terms of Customer Needs- Organizing the Needs into a Hierarchy- Establishing the Relative Importance of the Needs-Case study - Reflecting on the Results and the Process		
Unit-II	Product Specifications	9 Periods
Specifications –Specifications Established-Establishing Target Specifications-QFD-Setting the Final Specifications-Concept Generation-The Activity of Concept Generation- Clarify the Problem-Search Externally-Search Internally-Explore Systematically- Case study -Reflect on the Results and the Process		
Unit-III	Concept Selection	9 Periods
Concept Selection- Overview of Methodology- The Decision matrix – Pugh's method - Concept Screening- Concept Testing-Define the Purpose of the Concept Test- Choose a Survey Population-Choose a Survey Format- Communicate the Concept- Measure Customer Response- Interpret the Results- Case study -Reflect on the Results and the Process		
Unit-IV	Costing And Product Architecture	9 Periods
Material – manufacturing –assembly – structure - Ergonomics and aesthetic aspects. Implications of the Architecture- Establishing the Architecture-- System Level Design Issues - Case study		
Unit-V	Ergonomics And Aesthetics	9 Periods



Gross human anatomy. Anthropometry. Man-Machine interaction. Concepts of size and texture, colour. Comfort criteria. Psychological & Physiological considerations. Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design. Value Engineering and Value Analysis: Definition and basic concepts only. Economic analysis (Basic concepts): Qualitative & Quantitative. Product costing.

Text Books:	1. Product Development – Sten Jonsson 2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger 3. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
Reference Books:	1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_me121

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply product planning methods to identify opportunities, prioritize projects, and allocate resources effectively.	Understanding (BL 2)
CO2	Develop and finalize product specifications using QFD and systematic approaches.	Applying (BL 3)
CO3	Generate alternative concepts, evaluate them using decision-making tools, and select the most viable product concept.	Applying (BL 3)
CO4	Analyze product costing, ergonomics, aesthetic aspects, and product architecture for practical implementation.	Analyze (BL 3)
CO5	Create innovative product designs using creativity techniques, value engineering, and economic analysis.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	2	1	1	1	1	2	2	1	1	1	3
CO-2	3	2	3	2	2	1	2	1	2	2	1	2	2	2



CO-3	3	2	3	2	2	1	1	1	2	3	2	3	3	2
CO-4	3	2	3	3	3	1	2	2	3	2	2	1	2	1
CO-5	3	2	3	3	2	1	2	2	3	-1	2	2	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME23 Product Life Cycle Management

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Introduce the fundamentals, strategies, and benefits of PLM and PDM.
2.	Familiarize students with product development approaches and collaborative design methods.
3.	Explain product modeling concepts, standards, and industrial demands.
4.	Develop knowledge of PDM functions, architectures, and implementation.
5.	Provide exposure to PLM-ERP integration and PLM software applications.

III - Course Content

Preamble: This course imparts knowledge on Product Life Cycle Management (PLM) concepts, strategies, tools, and software integration for effective product development and data management.

Unit-I	Introduction To Plm And Pdm	9 Periods
Introduction to PLM, Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study. PLM Strategies, strategy elements, its identification, selection and implementation. Product Data Management, implementation of PDM systems.		
Unit -II	Product Development	9 Periods
Product Development Approaches: Bottom-up design, Top-down design, Front-loading design workflow, Design in context, Modular design. Concurrent engineering, partnership with supplier, collaborative and Internet based design, work structuring and team deployment, Product and process systemization, problem, identification and solving methodologies, improving product development solutions		
Unit-III	Product Modeling	9 Periods
Product Modelling - Definition of concepts - Fundamental issues - Role of Process chains and product models -Types of product models - model standardization efforts-types of process chains - Industrial demands. Foundation technologies and standards (e.g. visualization, collaboration and enterprise application integration),		
Unit-IV	Product Data Management	9 Periods
Product Data Management (PDM) –Benefits and Terminology, PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and		



implementation. Information authoring tools (e.g., MCAD, ECAD, and technical publishing), Core functions (e.g., data vaults, document and content management, workflow and program management), Functional applications (e.g., configuration Management).

Unit-V	Integration of PLM with other Applications, PLM Software's	9 Periods
---------------	---	------------------

Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD. Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD. PLM Softwares-Basic features and modules of ENOVIA and Windchill

Text Books:	1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10 : 3662516330 2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10 : 0899303196
Reference Books:	1. Ivica Crnkovic, Ulf Askund and Annita Persson Dahlqvist Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc23_me123

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand PLM, its need, strategies, and feasibility studies.	Understanding (BL 2)
CO2	Apply product development approaches and collaborative engineering practices.	Applying (BL 3)
CO3	Analyze product modeling, process chains, and standardization techniques.	Analyze (BL 3)
CO4	Evaluate PDM functions, architectures, and information authoring tools.	Applying (BL 3)
CO5	Integrate PLM with ERP and CAD, and demonstrate the use of PLM software.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO-1	PSO-2
CO-1	3	2	2	1	1	-	-	-	-	2	-	1	-	-
CO-2	2	3	3	2	2	1	-	-	2	2	1	2	1	2
CO-3	2	3	2	3	3	-	1	-	-	2	-	3	-	3
CO-4	2	2	3	3	3	-	-	-	-	2	-	2	-	2
CO-5	2	2	2	2	2	-	-	-	-	2	2	1	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓		✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME24 Sensors and Instrumentation

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the basics of measurement systems, errors, transducer characteristics, and sensor classifications.
2.	To learn the principles and applications of motion, proximity, and ranging sensors used in engineering systems.
3.	To analyze the working principles of force, magnetic, and heading sensors for accurate measurements.
4.	To explore optical, pressure, temperature, acoustic, radiation, and smart sensor technologies with modern trends like MEMS and nano sensors.
5.	To apply signal conditioning, data acquisition, and data logging systems in real-world applications such as automobiles, aerospace, home appliances, and environmental monitoring.

III - Course Content

Preamble: This course introduces the principles of measurement, sensors, and transducers with emphasis on error analysis, characteristics, and calibration. It also covers signal conditioning and data acquisition for practical applications in engineering systems.

Unit – I	Introduction	9 Periods
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.		
Unit – II	Motion, proximity and ranging sensors	9 Periods
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).		
Unit – III	Force, magnetic and heading sensors	9 Periods
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclometers.		
Unit – IV	Optical, pressure and temperature sensors	9 Periods
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors – Smart Sensors – Film sensor, MEMS & Nano Sensors, LASER sensors.		



Unit – V	Signal conditioning and DAQ systems	9 Periods
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.		

Text Books:	1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009. 2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", Dhanpat Rai & Co, 12th edition New Delhi, 2013.
Reference Books:	1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001. 2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001. 3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999. 4. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011. 5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
MOOC/Web Platforms:	1. nptel.ac.in/courses/108102191

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain measurement fundamentals, error analysis, sensor classification, calibration techniques, and evaluate sensor performance characteristics.	Understanding (BL 2)
CO2	Analyze the working principles and applications of motion, proximity, and ranging sensors used in measurement and navigation systems.	Analyzing (BL 4)
CO3	Explain the principles and applications of force, magnetic, and heading sensors, and analyze their roles in measurement and navigation.	Understanding (BL 2)
CO4	Analyze the principles, types, and applications of optical, pressure, temperature, acoustic, radiation, and smart sensors.	Analyzing (BL 4)
CO5	Explain and apply signal conditioning techniques and data acquisition systems for diverse applications including automotive, aerospace, and environmental monitoring.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)




 Chairperson - Board of Studies,
 Department of Mechanical Engineering,
 NPR College of Engineering & Technology
 (Autonomous),
 Natham, Dindigul 624401

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



[Signature]
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I – Course Code & Name: 23PME25 Electrical Drives and Actuators

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the principles, characteristics, and operation of power semiconductor switching devices and their associated driver and snubber circuits.
2.	To learn the motor load dynamics, multi-quadrant operation, and criteria for the selection of electric drives.
3.	To analyze the performance, characteristics, and control of DC motors and drives including PMDC and BLDC systems.
4.	To explore various speed control techniques of AC motors, particularly three-phase induction motor drives and slip power recovery methods.
5.	To apply knowledge of stepper motors and servo mechanisms in designing drive systems for industrial and automation applications.

III - Course Content

Preamble: This course focuses on power semiconductor devices and electric drive systems, highlighting their characteristics, control techniques, and dynamics. It also covers DC, AC, stepper, and servo motor drives with industrial applications.		
Unit – I	Relay and power semi-conductor devices	9 Periods
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT:- SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits		
Unit – II	Drive Characteristics	9 Periods
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.		
Unit – III	DC motors and drives	9 Periods
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications		
Unit – IV	AC motors and drives	9 Periods
Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.		



Unit – V	Stepper and servo motor	9 Periods
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.		

Text Books:	1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012. 2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2016.
Reference Books:	1. Gopal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001. 2. Theraja B.L. & Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2012. 3. Singh M.D. & Lanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007
MOOC/Web Platforms:	1. nptel.ac.in/courses/108104140

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the operation and switching characteristics of relays and power semiconductor devices, and analyze their triggering, commutation, and protection circuits.	Understanding (BL 2)
CO2	Analyze motor load dynamics and drive characteristics to evaluate performance in multi-quadrant operations and select appropriate electric motors for specific applications.	Analyzing (BL 4)
CO3	Analyze the operating principles, characteristics, and control of DC motors and implement drive circuits including H-bridge and four-quadrant operation for various applications.	Analyzing (BL 4)
CO4	Explain and apply various speed control methods for three-phase induction motors using advanced AC drive techniques.	Understanding (BL 2)
CO5	Analyze the construction and operating principles of stepper and servo motors, and apply appropriate control techniques for precision motion applications.	Analyzing (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)




 Chairperson - Board of Studies,
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 NPRCET College of Engineering & Technology
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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23PME26 Embedded Systems and Programming

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the architecture, features, and instruction sets of microcontrollers, particularly the 8051 family.
2.	To develop assembly and C programming skills for microcontroller applications including timers, counters, interrupts and serial communication protocols.
3.	To analyze interfacing techniques of microcontrollers with memory, input/output devices, sensors, and actuators for real-time control applications.
4.	To explore the architecture, instruction sets, and basic programming of ARM processors for embedded system applications.
5.	To apply TIVA-C microcontroller programming concepts such as GPIO, WDT, interrupt handling, and power management in embedded system design.

III - Course Content

Preamble: This course introduces the architecture, programming, and interfacing of microcontrollers, including 8051, ARM7, and TIVA-C. It emphasizes practical applications in embedded systems, sensors, and real-time control:

Unit – I	Introduction to microcontroller	6 Periods
Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.		
Unit – II	Programming and communication	6 Periods
Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.		
Unit – III	Peripheral interfacing	6 Periods
I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays,- Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light		
Unit – IV	ARM processor	6 Periods
Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.		



Unit – V	TIVA-C microcontroller	6 Periods
TIVA-C Microcontroller Architecture and Its memory map, GPIO Programming, WDT Programming, Interrupt Programming, LPM Programming.		
Embedded Systems Lab		30 Periods
List of Experiments 1. Assembly Language Programming and Simulation of 8051. 2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller. 3. Input switches and keyboard interfacing of 8051. 4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051. 5. Timer, Counter and Interrupt Program Application for 8051. 6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051. 7. UART Serial and Parallel Port Programming of 8051. 8. I2C, SPI and CAN Programming of 8051. 9. Interfacing and Programming of Bluetooth and Wi-Fi with 8051 10. Programming of ARM Processor for Sensor Interface. 11. Stepper Motor and Servo Motor Control Using ARM Processor. 12. Serial Communication of ARM Processor with Computation Platform. 13. Wireless Communication of ARM Processor with Computation Platform. 14. GPIO Programming of Real Time Embedded Operating Systems. 15. IOT application using SBC. (any 7 experiments)		

Text Books:	1. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley. 2. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2003.
Reference Books:	1. Muhammad Ali Mazidi and Janice GillispieMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006. 2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition, 2015 3. James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003. 4. John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 2005. 5. Embedded System Design Using TIVA, TI University Program, Learning Material.
MOOC/Web Platforms:	1. nptel.ac.in/courses/106/105/159

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Explain and analyze the architecture, memory organization, and instruction sets of 8051 microcontrollers, and compare CISC and RISC microcontroller types.	Understanding (BL 2)



CO2	Design and program 8051 microcontrollers using assembly and C languages, and implement communication protocols including serial, I2C, SPI, CAN, Bluetooth, and Wi-Fi.	Creating (BL 6)
CO3	Apply programming techniques to interface microcontrollers with peripherals such as displays, sensors, actuators, and implement control applications like motor control and traffic light systems.	Applying (BL 3)
CO4	Analyze the architecture and operational modes of the ARM7 processor, and apply instruction sets and programming techniques for embedded applications.	Analyzing (BL 4)
CO5	Apply TIVA-C microcontroller programming techniques including GPIO, watchdog timer, interrupts, and low power modes for embedded system design.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME27 Robotics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals, types, configurations, and applications of industrial and mobile robots in manufacturing and challenging environments.
2.	To analyze the representation of robot joints and links, coordinate transformations, and kinematics using D-H parameters for multi-DOF manipulators.
3.	To apply trajectory planning methods and motion profiles for precise robot movement in joint and Cartesian spaces.
4.	To develop robot programming skills through manual, online, and offline methods for applications like welding, palletizing, and inspection.
5.	To explore artificial intelligence applications in robotics, including vision-based systems, collaborative robots, and digital twin robots.

III - Course Content

Preamble: This course introduces the fundamentals, configurations, and applications of industrial and mobile robots, including kinematics, trajectory planning, and programming. It also covers artificial intelligence, vision systems, and collaborative robotics for advanced automation.

Unit – I	Introduction to Industrial Robotics	9 Periods
Introduction – brief history, Robot – types – Industrial, Mobile; Classification and usage, configuration, Anatomy, Elements/subsystems of Robots, Point to point and continuous applications, Mobile manipulators, Grippers – Types; Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading Inspection – Palletizing - Hostile and remote environments.		
Unit – II	Representation and Transformation of joints, links	9 Periods
Mechanical Structure notations, Coordinate frames, Description of objects in space, Transformation and fundamental rotation matrices, Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Kinematics: Forward kinematics of multi DOF manipulator - Inverse kinematics of 2DOF manipulator. Dynamics: Introduction – Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation. Examples of D-H parameters and link transforms. Introduction to Robo Analyser – Visualization of DH parameters. Introduction to Robot Operating System (ROS) – Demonstration.		
Unit – III	Trajectory planning	9 Periods
Definitions and planning tasks, Joint techniques – Motion profiles- cubic polynomial motion, Cartesian Space techniques. Robot Controller – open, closed		
Unit – IV	Robot Programming	9 Periods



Robot Programming: Manual programming – Teach Pendant, Online programming – Deburring, Palletizing and Inspection, Offline Programming – Welding.

Unit – V Artificial Intelligence in Robotics 9 Periods

Artificial Intelligence – Types – Edge based; Cloud based, Security concerns - Consciousness, Scalability, Data Security. Case studies - Vision based robot picking, Collaborative Robots, Digital Twin Robots.

Text Books:	1. Dr Jisu Elsa Jacob, "Robotics Simplified: An Illustrative Guide to Learn Fundamentals of Robotics, Including Kinematics, Motion Control, and Trajectory Planning", BPB Publications, 2022
Reference Books:	1. Robotics, AI, and Humanity, Science, Ethics, and Policy, Springer, 2021 2. Shuai Li, Long Jin, Mohammed Aquil Mirza, "Kinematic Control of Redundant Robot Arms Using Neural Networks", IEEE press, April 29, 2019. 3. John J Craig, "Introduction to Robotics, Mechanics and Control, third edition, Pearson education, 2005 4. K.S.Fu, R.C Gonzalez and C.S Lee, Robotics – Control, sensing Vision and Intelligence, Tata McGraw – Hill Editions, 2008. 5. S.K. Saha, "Introduction to Robotics", second edition, Mc Graw Hill education India Private limited, New Delhi, 2008. 6. Mikell P Groover, Mitchell Weiss, Roger N Nagel and Nicholas G Odrey, "Industrial Robotics – Technology, Programming and Applications", Tata McGraw Hill Edition, 2008. 7. Robert J Schilling, Fundamentals of Robotics: Analysis and Control", Indian reprint, Prentice hall of India Private Limited, 1996
MOOC/Web Platforms:	1. nptel.ac.in/courses/107106090

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamentals, types, and applications of industrial and mobile robots, and describe robot configurations and subsystems.	K2 – Understanding
CO2	Represent and analyze robot joints, links, and coordinate transformations using D-H parameters, and solve forward and inverse kinematics problems.	K4 – Analyzing
CO3	Develop and implement trajectory planning for robotic manipulators using joint and Cartesian space techniques.	K3 – Applying
CO4	Program robots using manual, online, and offline methods for industrial applications such as welding, palletizing, and inspection.	K3 – Applying
CO5	Evaluate the integration of artificial intelligence, vision systems, collaborative robots, and digital twin technologies in modern robotic applications.	K5 – Evaluating

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME28 Smart Mobility and Intelligent Vehicles

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals, types, configurations, and applications of industrial and mobile robots in various manufacturing and hostile environments.
2.	To analyze the representation of robot joints and links, coordinate transformations, and kinematics using D-H parameters for multi-DOF manipulators.
3.	To apply trajectory planning techniques and motion profiles for efficient robot motion in joint and Cartesian space.
4.	To develop robot programming skills using manual, online, and offline methods for applications such as welding, palletizing, and inspection.
5.	To explore the role of artificial intelligence, vision systems, and collaborative robots in enhancing robotics capabilities and automation.

III - Course Content

Preamble: This course introduces the fundamentals, configurations, and applications of industrial and mobile robots, including kinematics, trajectory planning, and programming. It also covers emerging trends such as artificial intelligence, vision systems, and collaborative robotics for modern automation.		
Unit – I	Introduction to automated, connected, and intelligent vehicles	9 Periods
Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles		
Unit – II	Sensor technology for smart mobility	9 Periods
Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems		
Unit – III	Connected autonomous vehicle	9 Periods
Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy		
Unit – IV	Vehicle wireless technology & networking	9 Periods
Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks		



Unit – V	Connected car & autonomous vehicle technology	9 Periods
Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues		
Hands-on experience with ADAS systems:		

Text Books:	1. "Intelligent Transportation Systems and Connected and Automated Vehicles", 2016, Transportation Research Board 2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 2019, Springer
Reference Books:	1. Tom Denton, "Automobile Electrical and Electronic systems, Routledge", Taylor & Francis Group, 5th Edition, 2018. 2. C. Jotin Khisty, "Transportation Engineering, An Introduction", Pearson India, 2016 3. Paul H. Wright, "Transportation Engineering: Planning and Design", McGraw-Hill 4th edition 1998. 4. C. S. Papacostas, "Transportation Engineering and Planning", 3rd ed, Pearson, 2015
MOOC/Web Platforms:	1. nptel.ac.in/courses/108106170

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the development and key components of automotive electronics and evaluate automated, connected, and intelligent vehicle technologies using case studies.	Understanding (BL 2)
CO2	Analyze key sensor technologies and demonstrate integration of sensor data for effective control in smart mobility systems.	Analyzing (BL 4)
CO3	Explain control systems and cyber-physical concepts applied to connected autonomous vehicles, and analyze the roles of sensing and wireless networks in vehicle autonomy.	Understanding (BL 2)
CO4	Analyze wireless communication and networking technologies and integrate them with on-board vehicle systems to support autonomous vehicle functions.	Analyzing (BL 4)
CO5	Evaluate connectivity technologies and applications in autonomous vehicles, addressing technical, legal, security, and ethical challenges.	Evaluating (BL 5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME29 Haptics and Immersive Technologies

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II – Course Objectives

1.	To understand the concepts of Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and Extended Reality (XR), along with their devices and applications.
2.	To develop basic programming skills and proficiency in Unity and Unreal Engine for VR and AR application development.
3.	To apply AR software development kits (SDKs) for creating interactive AR applications using Unity and Unreal Engine.
4.	To design and build VR applications using Unity and Unreal Engine, including industrial applications and digital twin creation.
5.	To explore extended reality systems, haptic perception, device integration, and custom haptic device development for immersive experiences.

III – Course Content

Preamble: This course introduces Virtual, Augmented, Mixed, and Extended Reality technologies, their devices, and applications. It emphasizes software development using Unity and Unreal Engine, as well as immersive experiences through haptics and XR integration.		
Unit – I	Introduction to immersive technologies	9 Periods
Introduction on Virtual reality – Augmented reality – Mixed reality – Extended reality – VR Devices – AR Devices – Applications		
Unit – II	Software tools	9 Periods
Intro to Unity – Unity editor workspace – Intro to C# and visual studio – Programming in Unity – Intro to Unreal Engine – UE4 Editor workspace – Intro to Blueprint programming – Programming in Ue4		
Unit – III	Building AR application with unity	9 Periods
AR SDKs for unity and unreal engine – Working with SDKs for unity – Developing AR application in unity – Building AR application		
Unit – IV	Building VR application with unreal engine	9 Periods
VR SDKs for unity and unreal engine – Developing VR application in Ue4 – Building VR application. VR in Industrial Applications & Digital Twin creation		
Unit – V	Haptic perception and extended reality	9 Periods
Extended Reality – Introduction to Haptics – Devices and possibilities – Custom Device development – Device Integration		



Text Books:	1. Immersive Multimodal Interactive Presence, by Angelika Peer (Editor), Christos D. Giachritsis (Editor), Springer; 2012th edition (13 April 2014), ISBN-10 : 1447162137 2. XR Haptics, Implementation & Design Guidelines, by Eric Vezzoli , Chris Ullrich , Gijs den Butler , Rafal Pijewski, March 13, 2022
Reference Books:	1. Practical Augmented Reality, by Steve Aukstakalnis, Addison-Wesley Professional; 1st edition (8 September 2016) 2. Augmented Reality – Theory, Design and Development, by Chetankumar G Shetty. 3. Strategic Communication and AI, by Simon Moore , Roland Hübscher, Routledge; 1st edition (10 September 2021), ISBN-10 : 0367627795 4. Immersive Analytics, by Kim Marriott , Falk Schreiber, Springer; 1st ed. 2018 edition (15 October 2018). 5. Immersive Analytics A Clear and Concise Reference, by Gerardus Blokdyk, 5STARCooks (5 September 2018).
MOOC/Web Platforms:	1. https://onlinecourses.swayam2.ac.in/ntr24_ed76/preview

IV – Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the concepts of virtual, augmented, mixed, and extended reality, identify associated devices, and explore their practical applications across various domains.	Understanding (BL 2)
CO2	Develop interactive applications using Unity and Unreal Engine by applying C# and Blueprint programming skills within their editor environments.	Applying (BL 3)
CO3	Apply AR SDKs to design and develop augmented reality applications using Unity's development environment.	Applying (BL 3)
CO4	Apply VR SDKs to design, develop, and build immersive virtual reality applications using Unreal Engine.	Applying (BL 3)
CO5	Explain haptic technology concepts, explore various devices, and demonstrate integration and custom development of haptic systems.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-



COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME30 Drone Technologies

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals of drone technology, its history, terminology, types, and impact on businesses and entrepreneurship.
2.	To learn the design considerations, selection, and assembly of drone components including airframe, propulsion, and control systems.
3.	To develop skills in operating drones, including flight modes, controls, sensor usage, and data management in a controlled environment.
4.	To analyze commercial applications of drones across sectors such as agriculture, inspection, delivery, insurance, and media.
5.	To explore emerging trends in drone technology, safety regulations, autonomy, miniaturization, and swarm operations for industrial and commercial use.

III - Course Content

Preamble: This course introduces the fundamentals of drone technology, including design, assembly, operation, and commercial applications. It also covers safety regulations, emerging trends, and the use of drones for industrial, commercial, and entrepreneurial purposes.		
Unit – I	Introduction to Drone Technology	9 Periods
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability		
Unit – II	Drone Design and Assembly	9 Periods
Design considerations for drone airframe and propulsion systems, Selecting and assembling drone components such as motors, batteries, flight controllers, and cameras, Basic wiring and soldering techniques.		
Unit – III	Drone flying and operation	9 Periods
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications		
Unit – IV	Drone commercial applications	9 Periods
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing		
Unit – V	Future drones and safety	9 Periods



The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms, Overview of commercial and industrial drone applications, Case studies and examples of successful drone deployments.

Text Books:	1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc. 2. Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones ", Maker Media, Inc, 2016
Reference Books:	1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016 2. Završnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_ae30/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Know about a various type of drone technology, drone fabrication and programming.	Understanding (BL 2)
CO2	Execute the suitable operating procedures for functioning a drone.	Applying (BL 3)
CO3	Select appropriate sensors and actuators for Drones.	Remembering (BL 1)
CO4	Develop a drone mechanism for specific applications.	Applying (BL 3)
CO5	Create the programs for various drones.	Creating (BL 6)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-



COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME31 Digital Manufacturing and IoT

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1	To study the various aspects of digital manufacturing.
2	To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
3	To formulate of smart manufacturing systems in the digital work environment.
4	To interpret IoT to support the digital manufacturing.
5	To elaborate the significance of digital twin.

III - Course Content

Preamble: This course provides an overview of digital manufacturing concepts, technologies, and applications, including smart factories, Industry 4.0, and digital twins.

UNIT-I	Introduction	9 Periods
Introduction – Evolution and Need- Key Enablers: AI, Big Data, Edge, Cloud- Aspects: Product Life Cycle, Smart Factory, Digital Value Chain- Benefits: Cost, Customization, Flexibility- Sustainable and Circular Manufacturing.		
UNIT -II	Digital Life Cycle and Supply Chain Management	9 Periods
Digital Product Lifecycle Management (PLM)- Model-Based Definition (MBD)- Blockchain in Supply Chain- AI for Forecasting & Inventory Optimization- Sustainable & Resilient SCM- Risk-aware SCM Strategy		
UNIT-III	Smart Factory	9 Periods
Smart Factory: Architecture & Components- Technologies: IoT, Edge, AI/ML, AR/VR, 5G- Predictive Maintenance & Real-time Monitoring- Human-Machine Collaboration- Cybersecurity & Data Privacy		
UNIT-IV	Industry 4.0	9 Periods
Industry 4.0 Technologies: IoT, IIoT, CPS, Cloud, Edge, Fog- Data Analytics & Interoperability- Frameworks: RAMI 4.0, OPC-UA- Human-Machine Interaction- Cross-sector Case Studies		
UNIT-V	Study of Digital Twin	9 Periods
Digital Twin Framework: Thread, Shadow, Simulation- Real-time Monitoring & Predictive Analysis- Interoperability & Cross-platform Design- Extended Reality (XR), Metaverse Applications- Industry 5.0 Perspective.		



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TEXT BOOKS	1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012. 2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.
REFERENCES	1. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009. 2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019. 3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017. 4. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.
MOOC/Web Platforms:	1. https://www.coursera.org/specializations/digital-manufacturing-design-technology 2. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals and evolution of digital manufacturing, including smart factories and value chain management.	Understand (BL 2)
CO2	Explain digital product lifecycle management and apply digital technologies in supply chain management.	Apply (BL 3)
CO3	Describe smart factory architecture, intelligent automation technologies, and cybersecurity considerations.	Understand (BL 2)
CO4	Illustrate Industry 4.0 ecosystem components such as IoT, CPS, cloud computing, and interoperability frameworks.	Apply (BL 3)
CO5	Analyze the concepts of digital twins, industrial metaverse applications, and their impact on future manufacturing systems.	Analyze (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3		1	1	3	3		1	2	2	-	2	3	2
CO-2	3	2	3	1	3	3	2	2	2	2	-	2	3	2
CO-3	3		3	1	3	3	2		3	2	-	2	3	2
CO-4	3	2	2	2	3	3	2	2	2	2	2	2	3	2
CO-5	3		2		1	3		2	2	2	-	2	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



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VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME32 Lean Manufacturing

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

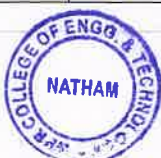
II - Course Objectives

1	To introduce the basics of 6 SIGMA
2	To learning about the lean manufacturing tools.
3	To study about the deeper understanding methodologies of Lean manufacturing.
4	To study the lean concepts and its elements
5	To learn implementation and challenges of lean manufacturing.

III - Course Content

Preamble: This course introduces Six Sigma and Lean Manufacturing tools and methodologies to improve quality, optimize processes, and drive continuous improvement in manufacturing systems.		
UNIT-I	Fundamentals of Six Sigma	9 Periods
Introduction and significance of Six Sigma in modern industries, sigma levels with industry examples, shifting mean, COPQ		
UNIT-II	Lean Manufacturing Tools	9 Periods
Process Capability Indices and interpretation, Fishbone Diagram, Control Charts fundamentals, FMEA, APQP, PPAP, Core Six Sigma methodologies		
UNIT-III	Advanced Process and Quality Management	9 Periods
Process definition and management principles, differences between Six Sigma and process management, continuous improvement methodologies, TPS basics and synergy with Six Sigma		
UNIT-IV	Lean Concepts and Implementation	9 Periods
Lean manufacturing principles: In-built quality, JIT production, lead time reduction, efficient utilization of capital and HR, zero-defect philosophy, organizational culture and human factors		
UNIT-V	Implementation Strategies and Challenges	9 Periods
Building effective checks and balances, robust information systems, dashboard creation, CAPA, audits, risk assessments, sustaining continuous improvement, implementation challenges		

TEXT BOOKS	1. Quality Planning and Analysis- JM Juran, FM Gryna. Tata Mc Graw Hill 2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile South Asia 3. The Toyota Way: 14 Management Principles 4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Masaki Imai
REFERENCES	1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/ 2. International Society of Six Sigma Professionals: https://issp.org/about-us/ 3. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP.



	These are great sources of information on Quality Planning and has basics of Project Management and required skills. 4. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones
MOOC/Web Platforms:	1. https://onlinecourses.swayam2.ac.in/imb24_mg119/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the basics of 6 SIGMA	Understand (BL 2)
CO2	Elaborate the lean manufacturing tools	Apply (BL 3)
CO3	Illustrate about the deeper understanding methodologies of Lean manufacturing	Analyze (BL 4)
CO4	Discuss lean concepts and its elements.	Understand (BL 2)
CO5	Describe the implementation and challenges of lean manufacturing	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO-2	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO-3	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO-4	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO-5	1	1	2	1	1	-	-	-	1	-	3	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME33 Modern Robotics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1	To introduce definition, history of robotics and robot anatomy.
2	To learn the simulation of robot kinematics
3	To study the grasping and manipulation of robots
4	To study about mobile robot and manipulation.
5	To study the applications of industrial, service, domestic robots

III - Course Content

Preamble: Robotics studies machines that perform tasks autonomously. This course covers robot motion, control, manipulation, mobile robots, and applications in industry and healthcare.		
UNIT-I	Introduction To Robotics, Collaborative Robots, And Industry 4.0	9 Periods
Introduction to Robotics and Modern Concepts: Definition and history; Robot anatomy; Coordinate systems; Types and classification; DOF; Configuration and velocity constraints; Task space and workspace; Rigid body motions and transformations; Collaborative Robots (Cobots); Human-Robot Interaction (HRI); Robotics trends in Industry 4.0 & 5.0		
UNIT-II	Robot Kinematics, Dynamics, And Ai-Driven Motion Control	9 Periods
Robot Kinematics and Dynamics with AI Integration: Forward/inverse kinematics (2-6 DOF), Velocity kinematics, D-H parameters, Dynamics, Trajectory generation, Motion planning, Feedback control systems; AI & machine learning for adaptive motion planning and data-driven control		
UNIT-III	Advanced Grasping, Soft Robotics, And Sensor Fusion Techniques	9 Periods
Advanced Grasping and Manipulation Techniques: Kinematics of contact; Contact types; Friction models and force analysis; End effectors and grippers; Force/torque sensing; Soft robotics; Bio-inspired grippers; Tactile sensing; Manipulation in unstructured environments; Sensor fusion		
UNIT-IV	Mobile And Autonomous Robots: Navigation, Slam, And Swarm Robotics	9 Periods
Mobile and Autonomous Robots: Kinematics of wheeled robots (omnidirectional and non-holonomic); Controllability; Odometry; Localization; Motion planning; Feedback & feedforward control; Autonomous navigation; SLAM; Sensor fusion (LIDAR, Cameras, IMUs); Multi-robot coordination; Swarm robotics		
UNIT-V	Robotics Applications in Industry 5.0, Ai Integration, And Ethics	9 Periods
Applications of Robotics in Industry and Society: Industrial, Service, Medical, Military, Agricultural, Aerial, Underwater robots; Roles in inspection, assembly, material handling, healthcare; Collaborative robots in Industry 5.0; AI-powered applications; Ethical & social implications; Smart factories & healthcare robotics		



TEXT BOOKS	1. Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park , Cambridge University Press; 1st edition (25 May 2017), ISBN-10 : 110715 2. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751
REFERENCES	1. Modern Robotics: Designs, Systems and Control, by Jared Kroff, Willford Press (18 June 2019) ISBN-10 : 1682856763 2. Advanced Technologies in Modern Robotic Applications, by Chenguang Yang, Hongbin Ma , Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN-10 : 981109263X 3. Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition (1 August 2006), ISBN-10 : 0816057451 4. Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; Standard Edition (30 August 2018), ISBN-10 : 1788835441 5. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10 : 1639873732
MOOC/Web Platforms:	1. https://www.coursera.org/specializations/modernrobotics?utm_source=chatgpt.com 2. https://www.edx.org/course/autonomous-mobile-robots 3. https://www.edx.org/course/ethics-of-ai-and-robotics

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Learn the basics of robots, collaborative robots, and Industry 4.0/5.0 concepts.	Understand (BL 2)
CO2	Understand robot movement and control using AI and machine learning.	Understand (BL 2)
CO3	Explore how robots grasp and handle objects, including soft and sensor-based methods.	Apply (BL 3)
CO4	Study how mobile robots navigate, locate themselves, and work together.	Analyze (BL 4)
CO5	Know how robots are used in different fields and the ethical issues involved.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	3	1	2	-	-	-	1	-	-	1	1	2
CO-2	2	1	3	1	2	-	-	-	1	-	-	1	1	2
CO-3	2	1	3	1	2	-	-	-	1	-	-	1	1	2



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CO-4	2	1	3	1	2	-	-	-	1	-	-	1	1	2
CO-5	2	1	3	1	2	-	-	-	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME34 Green Manufacturing Design and Practices

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To introduce the concept of environmental design and industrial ecology.
2	To impart knowledge about air pollution and its effects on the environment.
3	To enlighten the students with knowledge about noise and its effects on the environment.
4	To enlighten the students with knowledge about water pollution and its effects on the environment.
5	To introduce the concept of green co-rating and its need.

III - Course Content

Preamble: This course introduces sustainable design, life cycle assessment, and smart environmental management practices, integrating digital technologies, pollution monitoring, water conservation, and green certification frameworks to build climate-resilient industries.		
UNIT-I	Design for Environment and Life Cycle Assessment	9 Periods
Principles of Green Design & LCA- Sustainable Material Selection- Circular Economy & Product Stewardship- Material Flow Analysis (MFA)- Life Cycle Thinking (LCT)- Zero-waste & Net-zero Manufacturing- Industrial Symbiosis- Strategies for Product Recovery & Reuse		
UNIT-II	Air Pollution Sampling and Measurement	9 Periods
Urban & Industrial Air Pollution Sources- Advanced Air Quality Monitoring Sensors- Smart Air Sampling Systems- Real-Time Data Logging and Analysis- AI-based Dispersion Modeling- Climate-resilient Air Quality Standards- Satellite-based Monitoring (Overview)		
UNIT-III	Noise Pollution and Control	9 Periods
Noise Mapping & Zoning- Digital Noise Measurement Tools- Impact of Urbanization on Noise- Smart Noise Barriers & Acoustic Materials- Noise Control in Green Buildings- Health Risk Assessment- Climate-responsive Urban Noise Planning		
UNIT-IV	Water Demand and Water Quality	9 Periods
Sustainable Water Management in Industry- Smart Water Monitoring (IoT-based)- Water Footprint & Life Cycle Water Analysis- Emerging Contaminants (Microplastics, Pharmaceuticals)- Circular Water Economy (Reuse & Recharge)- Global Frameworks for Water Governance (SDG 6)- Case Studies of Water-Efficient Industries		
UNIT-V	Green Co-Rating	9 Periods
Green Certification Systems (LEED, IGBC, GRIHA)- Framework for Industrial Rating- Lifecycle Carbon and Energy Rating Tools- ESG (Environmental, Social, Governance) Metrics- Sustainable Procurement and Green Audit- Climate Resilience Index in Industries- Updated Case Studies: Smart Cities, Green Campuses		



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TEXT BOOKS	1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010 2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006.
REFERENCES	1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010. 2. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993. 3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005. 4. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006. 5. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006. 6. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.
MOOC/Web Platforms:	1. https://www.edx.org/course/sustainable-development 2. https://www.coursera.org/learn/air-pollution-health 3. https://www.coursera.org/learn/water-management

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the environmental design and selection of eco-friendly materials.	Understand (BL 2)
CO2	Analyse manufacturing processes towards minimization or prevention of air pollution.	Analyse (BL 4)
CO3	Analyse manufacturing processes towards minimization or prevention of noise pollution.	Analyse (BL 4)
CO4	Analyse manufacturing processes towards minimization or prevention of water pollution.	Analyse (BL 4)
CO5	Evaluate green co-rating and its benefits.	Evaluate (BL 5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	1	3	1	-	-	3	-	1	-	-	1	1	2
CO-2	1	1	3	1	-	-	3	-	1	-	-	1	1	2
CO-3	1	1	3	1	-	-	3	-	1	-	-	1	1	2
CO-4	1	1	3	1	-	-	3	-	1	-	-	1	1	2
CO-5	1	1	3	1	-	-	3	-	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓		✓	✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME35 Environment Sustainability and Impact Assessment

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
2	To familiarize the students in environmental decision-making procedure
3	Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities
4	To provide information on the environmental consequences for decision making
5	To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures

III - Course Content

Preamble: This course introduces environmental impact assessment, sustainable decision-making, policies, life cycle assessment, and smart urban economic development to enable climate-resilient and resource-efficient solutions.		
UNIT-I	Environmental Impact Assessment	9 Periods
Updated EIA objectives - Recent international protocols - Case studies from EU/global directives		
UNIT-II	Environmental Decision-Making	9 Periods
Integrated sustainability appraisal - Adaptive mitigation and monitoring - Recent socio-economic case studies		
UNIT-III	Environmental Policy, Planning and Legislation	9 Periods
Updated environmental policies – Multi - sector cumulative effects assessment - Climate adaptation and risk management		
UNIT-IV	Life Cycle Assessment	9 Periods
LCA basics - Circular economy principles - Updated foot printing and digital tools		
UNIT-V	Sustainable Urban Economic Development	9 Periods
Fundamentals of spatial economics - Knowledge economy's role - Smart and sustainable urban trends		

TEXT BOOKS	1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter Duinker, Tony R. Walker, Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194 2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10 : 0367244470
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REFERENCES	1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development – Edward Elgar Publishing, 2007 2. Robert B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005 3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008 4. Canter, R.L., “Environmental Impact Assessment”, McGraw Hill Inc., New Delhi, 1996. 5. Shukla, S.K. And Srivastava, P.R., “Concepts In Environmental Impact Analysis”, Common Wealth Publishers, New Delhi, 1992. 6. John G. Rau And David C Hooten “Environmental Impact Analysis Handbook”, McGraw Hill Book Company, 1990.
MOOC/Web Platforms:	1. https://www.coursera.org/learn/environmental-decision-making 2. https://www.coursera.org/learn/life-cycle-assessment

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the concepts of Environment Sustainability and trained to make decision related to Environment.	Understand (BL-2)
CO2	Make decision that has an effect on our environment	Apply (BL-3)
CO3	Evaluate the basics of environmental policy, planning and various legislation Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.	Evaluate (BL-5)
CO4	Explain the Life cycle assessment of Environmental sustainability.	Understand (BL-2)
CO5	Explain sustainable urban economic development	Understand (BL-2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	-	2	-	-	-	3	-	1	-	-	1	1	2
CO-2	1	-	2	-	-	-	3	-	1	-	-	1	1	2
CO-3	1	-	2	-	-	-	3	-	1	-	-	1	1	2
CO-4	1	-	2	-	-	-	3	-	1	-	-	1	1	2
CO-5	1	-	2	-	-	-	3	-	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



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VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME36 Energy Saving Machinery and Components

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To introduce the various energy saving machineries and components to the students for the purpose of conserving energy.
2	To study the basics and principles of transforms, Pumps and motors.
3	To impart the knowledge about the methods of energy conservation.
4	To introduce the energy efficiency devices and concepts of ENCON.
5	To impart the knowledge about CO2 mitigation.

III - Course Content

Preamble: A comprehensive course designed to provide updated knowledge and practical insights into modern energy management, conservation techniques, efficient equipment usage, and CO₂ mitigation strategies for sustainable industrial and electrical practices.

UNIT-I	Basics of Electrical Energy Usage	9 Periods
Fuel to Power and Cascade Efficiency – Updated Electricity Billing Components and Smart Metering – kVA Demand Control and Consumption – Time of Use Tariff – Power Factor Concepts and Advanced Correction Techniques – Demand Side Management Overview – Energy Monitoring and Data Analytics		
UNIT-II	Transformers and Motors	9 Periods
Transformer Fundamentals and Advanced Types – AVR and OLTC Updated Concepts – Transformer Selection Criteria and Predictive Performance Models – Energy Efficient Transformers – Motor Specifications, Selection, and Efficiency Assessment under Operating Conditions – Rewinding Effects – Energy Efficient Motors – ENCON Scope and Updates – Transmission Line Parameters and Loss Reduction Techniques – Application of Kelvin's Law with Modern Tools		
UNIT-III	Fans, Pumps and Compressors	9 Periods
Basics and Advanced Selection Criteria – Performance Evaluation Techniques – Causes for Inefficiency – Energy Conservation Opportunities – Latest ENCON Methods – Economic Analysis of Energy Conservation Measures		
UNIT-IV	Study of Illumination and Energy Efficient Devices	9 Periods
Luminaire Specifications and Energy Efficiency – Types and Applications – Updated ENCON Opportunities and Economic Benefits – Modern Luminaries (LED, OLED, Induction Lighting) – Soft and Smart Starters – APFC – Variable Speed Drives and Frequency Converters – Smart Sensors (Time, Occupancy) and IoT Integration		
UNIT-V	CO2 Mitigation and Case Studies	9 Periods
CO2 Mitigation Strategies and Updated PAT Scheme Overview – Energy Conservation Techniques – Cost-Benefit Analysis – Recent Case Studies on Industrial Energy Audits and Energy Management Systems		



TEXT BOOKS	1. Energy-Efficient Shutdown of Circuit Components and Computing Systems, by Ehsan Pakbaznia, Proquest, Umi Dissertation Publishing (1 September 2011) ,ISBN-10 : 1243819898. 2. Handbook on Energy Efficiency, TERI, New Delhi, 2001.
REFERENCES	1. Hamies, Energy Auditing and Conservation; Methods Measurements, management and Case Study, Hemisphere, Washington, 1980. 2. Trivedi, PR and Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997. 3. Handbook on Energy Efficiency, TERI, New Delhi, 2001. 4. Peters, Kraushaar and Ristenen, Sustainable Energy, beta – test – draft, Energy and Problems of a Technical Society, 1993. 5. Guide book for National Certification Examination for Energy Managers and Energy Auditors (www.energymanagertraining.com) 6. Nagrath IJ and Kothari DP, Power system engineering, TMH, 2007.
MOOC/Web Platforms:	1. https://swayam.gov.in/nc_details/NPTEL 2. https://www.edx.org/ 3. https://www.udemy.com/ 4. https://www.iea.org/training

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the various energy saving machinery and components.	Understand (BL 2)
CO2	Evaluate the various methods of conservation of energy.	Apply (BL 3)
CO3	Evaluate the performance and energy conservation of fans, pumps and compressors.	Apply (BL 3)
CO4	Discuss the various energy efficiency devices.	Analyze (BL 4)
CO5	Explain the co2 mitigation and cost factor.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	2	1	1	-	-	3	-	1	-	-	1	1	2
CO-2	2	2	1	1	-	-	3	-	1	-	-	1	1	2
CO-3	2	2	1	1	-	-	3	-	1	-	-	1	1	2
CO-4	2	2	1	1	-	-	3	-	1	-	-	1	1	2
CO-5	2	2	1	1	-	-	3	-	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI - Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Classroom	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME37 Green Supply Chain Management

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II – Course Objectives

1	To familiar the various standards and legislation of modern electronic manufacturing.
2	To know the conventional electronic processing and lead-free electronic manufacturing
3	To recognize the steps involved in assembly process and understand the need of recycle
4	To implement reliability and product life cycle estimation tools in green electronic
5	To demonstrate the green electronic manufacturing procedure in applications

III – Course Content

Preamble: This course provides an in-depth understanding of green electronics by integrating sustainable materials, eco-design principles, advanced recycling technologies, and global regulations to promote environmentally responsible innovation and industry practices.

UNIT-I	Introduction To Green Electronics	9 Periods
Environmental concerns and sustainable development goals (SDGs)- Electronics industry overview with additional regulations: USA (EPA), India (E-Waste Rules 2022)- Updated RoHS (RoHS 3) and WEEE directives- Global and regional strategy including Global Electronics Council (GEC)- Emphasis on harmonized international policies and emerging regulations		
UNIT-II	Green Electronics Materials and Products	9 Periods
IC manufacturing basics with focus on sustainable materials- Lead (Pb)-free solder and conductive adhesives- Introduction to bio-based and biodegradable polymers- Use of halogen-free and recyclable substrates, eco-nanomaterials (graphene, etc.)- Portable and advanced XRF analyzers for hazardous substance detection- Focus on flexible electronics and recyclable composites		
UNIT-III	Green Electronics Assembly and Recycling	9 Periods
Detailed assembly processes with environmental impact evaluation- Use of robotics and AI in e-waste sorting and disassembly- Urban mining concepts for material recovery- Extended Producer Responsibility (EPR) and reverse logistics- Global and regional e-waste management collaboration and emerging technologies		
UNIT-IV	Product Design and Sustainable Eco-Design	9 Periods
Green product development with circular economy principles- Digital Product Passports (DPP) and traceability- Advanced Life Cycle Assessment (LCA) tools including carbon footprint calculators- Updated eco-design standards including ISO 14006- Environmental management integrated with corporate sustainability goals		
UNIT-V	Case Studies	9 Periods
Reliability and durability studies of modern green electronics- Case studies on reuse and recycling of smartphones, LEDs, and lithium-ion batteries- Green Supply Chain with carbon and water footprint modeling- Industry case studies: Apple, Dell, other leaders in circular economy- Life-cycle assessment focusing on current technologies and eco-innovations.		



TEXT BOOKS	1. Green Supply Chain Management, by Charisios Achillas , Dionysis D. Bochtis , Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10: 1138644617. 2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill,, 2008.
REFERENCES	1. David Austen, Green Electronic Morning, Ingleby Gallery, 2006. 2. John Hu. Mohammed Ismail, CMOS High Efficiency on – Chip Power Management, Springer Publications 4th edition, 2011. 3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014. 4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006. 5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010. 6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill,, 2008.
MOOC/Web Platforms:	1. https://swayam.gov.in/nc_details/NPTEL 2. https://www.edx.org/learn/sustainable-energy 3. https://www.udemy.com/courses/search/?q=green%20technology

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Get concise awareness of standards and legislation of modern electronic manufacturing for green environment.	Understand (BL 2)
CO2	Explain the conventional electronic processing and lead free electronic manufacturing techniques.	Understand (BL 2)
CO3	Realize the assembly process and the need of recycle of electronics	Apply (BL 3)
CO4	Use reliability and product life cycle estimation tools for electronic manufacturing.	Analyze (BL 4)
CO5	Validate the green electronic manufacturing procedures in applications	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	1	2	-	-	-	2	-	1	-	3	1	1	2
CO-2	1	1	2	-	-	-	2	-	1	-	3	1	1	2
CO-3	1	1	2	-	-	-	2	-	1	-	3	1	1	2
CO-4	1	1	2	-	-	-	2	-	1	-	3	1	1	2
CO-5	1	1	2	-	-	-	2	-	1	-	3	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



V – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME38 Design of Pressure Vessels

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To introduce the Mathematical knowledge to design pressure vessels and piping
2	To learn the ability to carry of stress analysis in pressure vessels and piping
3	To study the design of vessels and theory of reinforcement.
4	To study buckling and fracture analysis in vessels.
5	To learn piping layout and flow diagram.

III - Course Content

Preamble: This course is designed to provide students with a strong foundation in the design, analysis, and layout of pressure vessels and piping systems used in process, chemical, and power industries. It emphasizes the application of mathematical and engineering principles to ensure safety, reliability, and efficiency in pressurized systems.		
Unit – I	Introduction	9 Periods
Methods for determining stresses – Terminology and Ligament Efficiency – Applications-- Industrial Case Studies: Failures in pressure vessels – Bhopal Gas tragedy, Challenger Disaster.		
Unit – II	Stresses in Pressure Vessels	9 Periods
Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels-- Thermal Stress in Chemical Plants: Real-life implications in reactors and heat exchangers.		
Unit – III	Design of Vessels	9 Periods
Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design-- Support Types Used in Industry: Skirt, leg, saddle supports with real design examples.		
Unit – IV	Buckling And Fracture Analysis in Vessels	9 Periods
Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading-- Fracture Mechanics in Failure Analysis: Industrial use of fracture mechanics in failure investigations.		
Unit – V	Piping	9 Periods



Introduction – Flow diagram – piping layout and piping stress Analysis-- Pipe Routing and Support: Based on industrial best practices.

Text Books:	1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987. 2. Theory And Design of Pressure Vessels (Pb 2001) by HARVEY J.F. 1 January 2001.
Reference Books:	1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987. 2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988. 3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997. 4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985. 5. Theory and design of Pressure Vessels (Pb 2001) by HARVEY J.F. 1 January 2001
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_ch63/preview 2. https://nptel.ac.in/courses/103107143

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications	Understanding (BL 2)
CO2	Analyse stress in pressure vessels	Analyze (BL 4)
CO3	Design and analysis of pressure vessels.	Applying (BL 3)
CO4	Analysis of buckling and fracture analysis in vessels	Analyze (BL 4)
CO5	Design and analysis piping layout and piping.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	3	1	1	-	-	-	1	-	-	1	2	3
CO-2	3	2	3	1	1	-	-	-	1	-	-	1	2	3
CO-3	3	2	3	1	1	-	-	-	1	-	-	1	2	3
CO-4	3	2	3	1	1	-	-	-	1	-	-	1	2	3
CO-5	3	2	3	1	1	-	-	-	1	-	-	1	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓							✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME39 Failure Analysis and NDT Techniques

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce need and scope of failure analysis and fundamental sources of failures.
2.	To learn about non-destructive testing and basic principles of visual inspection.
3.	To study about magnetic testing and principles, techniques.
4.	To learn the principle of radiography testing and its inspection techniques and methods.
5.	To study the acoustical testing principle and technique and instrumentation.

III - Course Content

Preamble: This course is designed to provide students with a comprehensive understanding of failure analysis and non-destructive testing (NDT) techniques used to ensure the reliability, safety, and quality of engineering components. The emphasis is on identifying causes of failure and applying suitable NDT methods for detection and prevention.

Unit – I	Introduction	9 Periods
Introduction and need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing & Assembly. Tree diagram and FMEA-- Industrial Failure Modes: Examples from industries like aerospace, automotive, civil engineering, and manufacturing. For instance, common failures in turbine blades, automotive crash components, or welding failures in pipelines.		
Unit – II	Visual Inspection	9 Periods
Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Sensitivity, Applications, Limitations and Standards- Industry Applications: In-depth focus on how LPT is used in industries like aerospace for detecting surface cracks in turbine blades, and in oil & gas pipelines for checking welding integrity.		
Unit – III	Magnetic Testing	9 Periods
Magnetic Particle Testing, Eddy Current Testing: Magnetism-basic definitions and principle of magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Sensitivity Advanced Eddy Current Test Methods, Applications, Limitations--Industrial Application Examples: Discuss how MPT is used in industries like railway, aerospace, and nuclear to detect surface and near-surface cracks. E.g., inspecting rail tracks for fatigue cracks or detecting stress corrosion cracking in aircraft fuselages.		



Unit – IV	Radiography Testing	9 Periods
Radiography, Ultrasonic Testing: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for Normal Beam Inspection, Techniques for Angle Beam Inspection, Flaw characterization techniques, Ultrasonic flaw detection equipment, Modes of Display, Immersion Testing, Applications of Ultrasonic Testing, Advantages, Limitations-- Industrial Examples: Deep dive into radiography used in the inspection of welded joints in pipelines in the oil and gas industry, welds in nuclear reactors, or casting defects in automotive components.		
Unit – V	Acoustic Testing	9 Periods
Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications, Standards. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Codes and Standards. In Situ Metallographic Examination: Approach to the Selection of Site for Metallographic examination, Replication process, Significance of Microstructure observation, Decision making, Applications, Codes and Standards. (digital signal process) Industrial Examples: Deep dive into radiography used in the inspection of welded joints in pipelines in the oil and gas industry, welds in nuclear reactors, or casting defects in automotive components.		

Text Books:	1. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014. 2. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010.
Reference Books:	1. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17. 2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing. 3. Charles, J. Hellier, Handbook of Non destructive evaluation, McGraw Hill, New York 2001. 4. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 2005 5. J.Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112107241 2. https://onlinecourses.nptel.ac.in/noc21_me14/preview



IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the need and scope of failure analysis and fundamental sources of failures.	Understand (BL 2)
CO2	Describe about non-destructive testing and basic principles of visual inspection.	Understand (BL 2)
CO3	Explain about magnetic testing and principles, techniques.	Understand (BL 2)
CO4	Explain the principle of radiography testing and its inspection techniques and methods.	Understand (BL 2)
CO5	Describe the acoustical testing principle and technique and instrumentation.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	2	1	2	2	-	-	-	1	-	-	1	2	1
CO-2	2	2	1	2	2	-	-	-	1	-	-	1	2	1
CO-3	2	2	1	2	2	-	-	-	1	-	-	1	2	1
CO-4	2	2	1	2	2	-	-	-	1	-	-	1	2	1
CO-5	2	2	1	2	2	-	-	-	1	-	-	1	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√					√	√		√	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME40 Material Handling and Solid Processing Equipment

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To provide knowledge on materials handling equipment.
2.	To provide knowledge on Industrial Vehicles
3.	To provide knowledge on conveyor equipment.
4.	To provide knowledge on Auxiliary Equipment and Hoisting Equipment.
5.	To provide knowledge on Bulk Handling Equipment and Systems

III - Course Content

Preamble: The course is designed to provide comprehensive knowledge and understanding of Materials Handling Systems used in modern industries. The objective is to equip learners with the technical know-how, applications, and selection criteria of various handling equipment essential for efficient production, warehousing, logistics, and supply chain management.		
Unit – I	Introduction to Materials Handling	9 Periods
Basic principles & objectives in material handling and its benefits - Classification of material handling equipment - selection of material handling equipments - guidelines for effective utilisation of material handling equipments -unit load concept.		
Unit – II	Industrial Vehicles	9 Periods
Introduction and types - Hand trucks - Two-wheel Hand Trucks - Multiple wheel Hand Trucks - Hand Lift Trucks - Power Trucks - Fixed Platform Truck - Platform Lift Truck - Pallet Lift Truck - Walkie Truck - Straddle Carrier - Fork Lift Trucks - Specifications of FLT - FLT Attachments - Tractors - Industrial Tractor-Trailer-Self-propelled trucks and fork trucks - Automated guided vehicles Theory.		
Unit – III	Conveyors	9 Periods
Classification of conveyors- Definition - Description - General Characteristics - types and uses of belt Conveyors - Roller conveyors - Haulage Conveyors - Screw Conveyors - Bucket Conveyors - Chain Conveyors - Cable Conveyors - Pneumatic and Hydraulic conveyors - Computer controlled conveyor system.		
Unit – IV	Auxiliary Equipment and Hoisting Equipment	9 Periods
Hoppers - Gates- Feeders- Chutes-positioners- Ball Table- Weighing and Control Equipment- Pallet loaders and unloaders -applications and advancements. - Hoisting Equipment - parts of hoisting equipment - Description and uses of hoists - Description and uses of ropes - description and purpose of crane hooks - Elevators - Cranes - Derricks - and its types.		



Unit – V	Bulk Handling Equipment and Systems	9 Periods
Storage of bulk solids - bulk handling equipment - Robotic handling - Materials handling at the workplace - Robots and their classification - Major components of a robot - classification of Robotic manipulators - Robotic handling applications.		

Text Books:	1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors, Delhi, 1987. 2. Siddharta Ray, Introduction to Materials Handling, New Age International Publishers.
Reference Books:	1. Bolz, H. A and Hagemann, G. E (ed.), “Materials Handling Handbook”, Ronald Press. 8005:1976, Classification of Unit Loads, Bureau of Indian Standards. 2. Apple, J.A., “Material Handling System Design”, John Wiley & Sons. 3. Theodore H., Allegre Sr., Material Handling Principles and Practice, CBS Publishers and Distributors. 4. Immer J. R., Material Handling, Tata McGraw Hill Publication.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_mm20/preview 2. https://www.youtube.com/watch?v=guYD2zyUT6o

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the basic concepts of material handling equipment.	Understanding (BL 2)
CO2	Explain the basic working principles of various industrial Vehicles.	Understanding (BL 2)
CO3	Develop the basic working principles of various conveyors.	Applying (BL 3)
CO4	Elaborate the basic working principles of various Auxiliary Equipment and Hoisting Equipment.	Understanding (BL 2)
CO5	Explain the basic working principles of various Bulk Handling Equipment and Systems.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	1	1	-	-	-	1	-	-	1	1	2
CO-2	2	1	1	1	1	-	-	-	1	-	-	1	1	2



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CO-3	2	1	1	1	1	-	-	-	1	-	-	1	1	2
CO-4	2	1	1	1	1	-	-	-	1	-	-	1	1	2
CO-5	2	1	1	1	1	-	-	-	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME41 Rotating Machinery Design

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To provide knowledge on materials handling equipment.
2.	To provide knowledge on Industrial Vehicles
3.	To provide knowledge on conveyor equipment.
4.	To provide knowledge on Auxiliary Equipment and Hoisting Equipment.
5.	To provide knowledge on Bulk Handling Equipment and Systems

III - Course Content

Preamble: The course is designed to provide knowledge on the principles, applications, and selection of materials handling systems used across industries. It focuses on equipping students with an understanding of various equipment and their role in improving productivity, efficiency, and safety in material movement.

Unit – I	Introduction	9 Periods
Overview of the different operational regimes for gas turbine applications: base load, peak load, standby and backup operations, alongside their individual operational requirements. Fundamentals of Creep and Fatigue damage mechanisms. Material, design and operational parameters that affect creep and fatigue. Experimental and test procedures to characterize creep and fatigue damage-- Case studies on in-service failures and condition monitoring techniques (thermal imaging, eddy current testing, etc.).		
Unit – II	Designing Forces	9 Periods
Loads/forces/stresses in gas turbine engines: loads - rotational inertia, flight, precession of shafts, pressure gradient, torsion, seizure, blade release, engine mountings and bearings-Discussion of major loadings-rotating components and pressure casing components--Design case studies: Bearings and engine mountings in aircraft turbines--Blade failure due to over-speed events or seizure.		
Unit – III	Failure Criteria	9 Periods
Monotonic failure criteria: proof, ultimate strength. Theories of failure - bi-axial loads. Other failure mechanisms - gas turbine engines including creep and fatigue. Fatigue properties - SN and RM diagrams. Stress concentration, mean stress, Cumulative fatigue, Goodman diagram and safety		



Factor for gas turbine components. Larson-Miller time-temperature parameter-- Case studies: Fatigue in compressor blades, creep rupture in turbine vanes.		
Unit – IV	Blade Design	9 Periods
Design of discs, blades. Illustration of magnitude stresses in conventional axial flow blades- simple desk-top method -effects of leaning the blade. Design of flanges and bolted structures. Leakages through a flanged joint and failure from fatigue-- Application of aero-mechanical optimization: weight reduction, cost vs. performance.		
Unit – V	Blade Vibrations and Damage Mechanisms	9 Periods
Natural frequencies turbo machine blades. Blade twist, centrifugal stiffening, Sources of blade excitation, Stationary flow disturbance, rotating stall and flutter. Campbell diagram and troublesome resonances. Allowances for temperature, pre-twist and centrifugal stiffening. Methods for dealing with resonances-- Real-world sources of excitation: flow-induced vibration, aerodynamic instabilities (rotating stall, surge, flutter).		

Text Books:	1. A S Rangawala, Turbomachinery Dynamics-Design and operations, McGraw Hill, 2005, ISBN-13: 978-0071453691. 2. Design, Modeling and Reliability in Rotating Machinery, Robert X. Perez (Editor) ISBN: 978-1- 119-63169-9.
Reference Books:	1. P.P Walsh and P. Peletcher, Gas Turbine Performance' Blackwell Science, 1998, ISBN0632047843. 2. Turbines, Compressors & Fans S. M. Yahya Tata McGraw Hill Co. Ltd 2nd edition, 2002 3. Principals of Turbo machines D. G. Shepherd The Macmillan Company 1964. 4. Fluid Mechanics & Thermodynamics of Turbo machines S. L. Dixon Elsevier 2005. 5. Shaft Alignment Handbook (Mechanical Engineering) by John Piotrowski 2 November 2006.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_ee14/preview 2. https://cce.iisc.ac.in/self-support-courses/rotating-machinery/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Differentiate the operational regimes and requirements related to different gas turbine applications.	Understanding (BL 2)
CO2	Describe and distinguish the design requirements and loads encountered by gas turbine components during normal operation;	Understanding (BL 2)
CO3	Analyse, evaluate and assess the loads, stresses, failure criteria and factors of safety used in gas turbine engines.	Analyze (BL 4)
CO4	Evaluate impact of vibrations on design and operation of gas turbine.	Analyze (BL 4)



COS	Assess the creep and fatigue damage of gas turbine components based on design and operational parameters	Understanding (BL 2)
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(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COS/ POS	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	3	1	-	-	-	-	1	-	-	1	2	3
CO-2	3	2	3	1	-	-	-	-	1	-	-	1	2	3
CO-3	3	2	3	1	-	-	-	-	1	-	-	1	2	3
CO-4	3	2	3	1	-	-	-	-	1	-	-	1	2	3
CO-5	3	2	3	1	-	-	-	-	1	-	-	1	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME42 Thermal and Fired Equipment Design

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the concepts of thermal and fired equipment.
2.	To study the basis, design and construction of boilers.
3.	To study of typical fuel firing systems in the boiler.
4.	To study of materials requirements for pressure parts.
5.	To study of various boiler auxiliaries system.

III - Course Content

Preamble: This course is designed to introduce students to the concepts, design, and applications of thermal and fired equipment widely used in process and power industries. The primary focus is on the basis, design, and construction of boilers, enabling learners to understand their role as critical components in energy generation and utilization.

Unit – I	Introduction	9 Periods
Principal equipment in Thermal Power Plant, Historical developments of Boiler, Utility, Industrial boilers, Modern trends in boiler design, Basic knowledge of different types of Thermal Fired Equipment, sub critical and super critical boilers - Coal, Oil, Gas, Pulverised fuel cyclone, FBC, CFBC, MSW, and Stoker firing, Boiler efficiency, auxiliary power consumption, Performance data, Performance Correction Curves -- Focus on energy-saving methods and optimization of auxiliary power systems to reduce operational costs. Introduce advanced performance correction curves to understand plant efficiency under variable operational conditions.		
Unit – II	Basis of Boilers and Design	9 Periods
Codes- Design and Construction, IBR, ISO, ASME, BS, Heat balance diagram, Boiler parameters, Fuel analysis and variations, Site conditions, Furnace heat loadings, FOT, Plan area loading, Volumetric loading, Balanced Draft and Pressurised Furnace, Natural / Controlled Circulation, Constant and Sliding Pressure, Boiler heat transfer surfaces, Flue gas velocities, boiler auxiliaries, Boiler schemes, Boiler Layouts-- Advanced Boiler Layouts: Industry-based boiler layout configurations, focusing on space utilization and ease of maintenance for large-scale plants.		
Unit – III	Firing System- Fuel and Milling	9 Periods
Coal / Oil / Natural Gas in any combination, Lignite, Blast Furnace Gas / Coke Oven Gas / Corex Gas Carbon Monoxide / Tail gas, Asphalt, Black Liquor, Bagasse, Rice Husk, Washery Rejects, Wheat / Rice straw MSW, wind box, Burner, Type of Stokers, Pulverisers - Bowl mill, Tube mill, Direct firing, Indirect firing, Wall firing (Turbulent / Vortex Burners), Tangential firing (Jet Burners), Fire Ball--		



Discuss low-NOx burners, flue gas recirculation, and selective catalytic reduction (SCR) systems in industrial operations		
Unit – IV	Pressure Parts and Design and Materials	9 Periods
Economiser, Drums, Water Walls, Headers, Links, Super Hater, Super Heaters, Reheaters, Tubes, Spiral Tubes, Surface area, Free Gas Area, Metal temperature, LMTD, Acid Due Point Temperature, Carbon steel, Low alloy steel, Titanium alloy steel-- Advanced Materials for High-Efficiency Boilers: Cutting-edge materials, such as ceramic coatings and high-performance alloys, which can withstand extreme operating conditions.		
Unit – V	Boiler Auxiliaries	9 Periods
Air preheaters (APH) – bi sector APH , Tri sector APH, Cold PA System, Hot PA System, Tubular APH, Steam coil Air preheater , FANS – Axial, Radial, Performance curves, MILLS- Tube , Vertical mills , Air quality Control systems ,Dust Collection System - Mechanical Precipitator, Electrostatic Precipitator, FGD , SCR , SNCR--Industrial Boiler Performance Enhancement: Practical methodologies for improving boiler efficiency in industries through the use of advanced controls, monitoring systems, and predictive maintenance.		

Text Books:	1. A Course in Power Plant Engineering; Dhanapat Rai and Sons – Domkundwar. 2. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar.
Reference Books:	1. Elwakil M, Power Plant Technology, McGraw Hill, New York, 1964. 2. Steam Generators and Waste Heat Boilers: For Process and Plant Engineers (Mechanical Engineering) by V. Ganapathy. 3. Steam Generators: Description and Design by Donatello Annaratone. 4. An Introduction to Coal and Wood Firing Steam Generators (Power Plants Engineering) by J Paul Guyer. 5. Advances in Power Boilers (JSME Series in Thermal and Nuclear Power Generation) by Mamoru Ozawa and Hitoshi Asano 28 January 2021.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/103107207 2. https://onlinecourses.nptel.ac.in/noc24_ch38/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the concepts of thermal and fired equipment.	Understanding (BL 2)
CO2	Discuss the basis, design and construction of boilers.	Understanding (BL 2)
CO3	Describe of typical fuel firing systems in the boiler.	Understanding (BL 2)



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CO4	Discuss the materials requirements for pressure parts.	Understanding (BL 2)
CO5	Discuss of various boiler auxiliaries system.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	3	1	-	-	-	-	1	-	-	1	2	3
CO-2	2	1	3	1	-	-	-	-	1	-	-	1	2	3
CO-3	2	1	3	1	-	-	-	-	1	-	-	1	2	3
CO-4	2	1	3	1	-	-	-	-	1	-	-	1	2	3
CO-5	2	1	3	1	-	-	-	-	1	-	-	1	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME43 Industrial Layout Design and Safety

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
2.	To learn the facilities layout design algorithms and selecting appropriate software.
3.	To study the facilities layout problem modelling tools and algorithms for production, warehouse, and material handling.
4.	To learn the safety planning and management principles in industries.
5.	To learn the various safety management approaches in industries.

III - Course Content

Preamble: This course is intended to provide students with a comprehensive understanding of industrial facility layout design and safety management principles essential for modern manufacturing and service industries. It emphasizes the systematic planning of facilities for improved productivity, material handling efficiency, and workplace safety.

Unit – I	Introduction	9 Periods
Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.		
Unit – II	Facilities Layout Design and Algorithms	9 Periods
Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP-PLANOPT, Factory CAD, Factory FLOW, Plant Simulation).		
Unit – III	Facilities Layout Problem Models & Algorithms	9 Periods
Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material-Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.		
Unit – IV	Safety Planning and Management	9 Periods



Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety.		
Unit – V	Approaches in Safety Management	9 Periods
Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.		

Text Books:	1. Sunderesh S. Heragu, "Facilities Design", 3 rd Edition, CRC Press Taylor & Francis Group, 2008 2. L. M. Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", Tata McGraw-Hill Publishing Co. Ltd., 2005.
Reference Books:	1. Eric Teicholz, "Facility Design and Management Handbook", Tata McGraw-Hill Publishing Co. Ltd., 2001. 2. James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, "Facilities Planning", 4th Edition, John Wiley & Sons, 2010. 3. Matthew P. Stevens and Fred E. Meyers, "Manufacturing Facilities Design and Material Handling", 5th Edition, Purdue University Press, 2013. 4. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003. 5. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017. 6. Industrial Hazard and Safety Handbook: (Revised impression by Ralph W King and John Magid 24 September 2013
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc20_mg43/preview 2. http://www.digimat.in/nptel/courses/video/112107292/L22.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.	Understanding (BL 2)
CO2	Discuss the facilities layout design algorithms and selecting appropriate software.	Understanding (BL 2)
CO3	Describe the facilities layout problem modeling tools and algorithms for production, warehouse, and material handling.	Understanding (BL 2)



CO4	Explain the safety planning and management principles in industries.	Understanding (BL 2)
CO5	Illustrate the various safety management approaches in industries.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	2	2	1	3	3	3	2	1	1	3	2	2
CO-2	1	2	2	2	1	3	3	3	2	1	1	3	2	2
CO-3	1	2	2	2	1	3	3	3	2	1	1	3	2	2
CO-4	1	2	2	2	1	3	3	3	2	1	1	3	2	2
CO-5	1	2	2	2	1	3	3	3	2	1	1	3	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME44 Design Codes and Standards

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To study the Codes and Standards and Need for them in the industry.
2.	To know the different sources and the bodies that publish Codes and Standards.
3.	To familiarize the Government Regulations and its applicability.
4.	To familiarize with different codes used in Different Industry.
5.	To familiarize the Codes and Standards used in Process Industry.

III - Course Content

Preamble: This course is designed to provide students with an understanding of the importance, development, and application of codes and standards in industries. Emphasis is placed on the role of codes and standards in ensuring safety, quality, uniformity, and compliance with legal and regulatory requirements across various engineering domains.

Unit – I	Introduction	9 Periods
Introduction to Codes and Standards. What is code - What is Standard- Need for codes and standards. Objective of Codes and Standards-- Key objectives such as risk mitigation, quality assurance, and sustainability in industrial processes. Codes, Standards and Good Engineering Practices.		
Unit – II	Codes	9 Periods
Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry- Standards for machinery used in mass production, automotive assembly lines, and industrial heavy equipment. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes.		
Unit – III	Standards	9 Periods
Sources of Codes and Standards. Who publishes Codes and Standards-International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies- How industry-specific committees develop and review standards for mass manufacturing, energy production, and infrastructure projects- Interdisciplinary Codes.		
Unit – IV	Regulations	9 Periods
Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers-- Key regulatory bodies such as IS		



(Indian Standards), ISO, and ASTM and how they affect global industries in sectors like food, healthcare, and construction.		
Unit – V	Design Codes	9 Periods
Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes-- Standards for machinery design in industries like automotive manufacturing and robotics. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE.		

Text Books:	1. Mechanical Engg. Handbook. ASME. ASTM.API 2. Perrys Chemical Engg Handbook
Reference Books:	1. ASME 2. API 3. ISO, IBR, OISD 4. AWS 5. ISHRAE
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_me56/preview 2. https://onlinecourses.nptel.ac.in/noc22_mg32/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the need for codes and Standards in Industry.	Understanding (BL 2)
CO2	Discuss the different codes and standards used in different industry.	Understanding (BL 2)
CO3	Discuss the sources of different codes and standards and the societies that publish them and how these are evolved	Understanding (BL 2)
CO4	Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International	Understanding (BL 2)
CO5	Discuss knowledge of codes and standards used in Process equipment design for Oil and Gas Industry.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	3	-	-	-	-	-	1	-	-	1	1	2
CO-2	2	1	3	-	-	-	-	-	1	-	-	1	1	2



C0-3	2	1	3	-	-	-	-	-	1	-	-	1	1	2
C0-4	2	1	3	-	-	-	-	-	1	-	-	1	1	2
C0-5	2	1	3	-	-	-	-	-	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME45 Bioenergy Conversion Technologies

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals of biomass, its types, characteristics, conversion mechanisms, and role in carbon neutrality.
2.	To analyze the bio-methanation process, including feedstocks, influencing parameters, biogas plant designs, and appliances for energy generation.
3.	To apply principles of combustion, stoichiometry, and air-fuel ratios for efficient biofuel utilization in fixed and fluidized bed systems.
4.	To explore advanced thermochemical conversion methods such as gasification, pyrolysis, and carbonization, including performance, applications, and economics.
5.	To develop knowledge on production and separation of liquid biofuels (biodiesel, bioethanol, SVO) and their comparison with conventional fuels for engine performance and emissions.

III - Course Content

Preamble: This course introduces the fundamentals of biomass, bio-methanation, combustion, and thermochemical conversion processes. It also covers the production, separation, and applications of liquid biofuels for sustainable energy and industrial use.		
Unit – I	Introduction	9 Periods
Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies		
Unit – II	Bio methanation	9 Periods
Biomethylation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.		
Unit – III	Combustion	9 Periods
Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion		
Unit – IV	Gasification, pyrolysis and carbonisation	9 Periods
Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation		



Unit – V	Liquified biofuels & Bioseparations	9 Periods
Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications- Centrifugation/Filtration for Biomass Separation; Distillation (bioethanol and biodiesel production)		

Text Books:	1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550 2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni, Solomon U. Oranusi, Springer (30 June 2022).
Reference Books:	1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984. 2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S 3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986 4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication, 1997 5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981
MOOC/Web Platforms:	1. nptel.ac.in/courses/103103222

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the types, characteristics, and conversion technologies of biomass, and assess its potential for carbon-neutral energy in the Indian context.	Understanding (BL 2)
CO2	Understand the biomethanation process, design and applications of biogas systems, and evaluate the use of various feedstocks including industrial effluents for sustainable energy production.	Understanding (BL 2)
CO3	Analyze combustion processes of biofuels, including air-fuel ratios and combustion system types, to ensure efficient and clean energy conversion.	Analyzing (BL 4)
CO4	Evaluate thermochemical conversion processes-gasification, pyrolysis, and carbonisation—based on their principles, performance, yield, and economic viability for biomass utilization.	Evaluating (BL 5)
CO5	Understand the production, properties, and performance of liquified biofuels such as biodiesel and alcohols, and evaluate their suitability as alternatives to conventional fuels.	Understanding (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME46 Carbon Footprint Estimation and Reduction Techniques

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals of climate change, greenhouse gas emissions, and carbon footprint concepts for activities, products, and organizations.
2.	To analyze product life cycle GHG accounting, including data collection, scope definition, and uncertainty assessment.
3.	To apply methodologies for calculating carbon footprints in agriculture, biofuels, wood products, and other industrial processes.
4.	To explore emission mitigation strategies, carbon sinks, carbon pricing, and policies for sustainable development and climate action.
5.	To evaluate real-world case studies on carbon footprint estimation across buildings, urban planning, mechanical and electronic products, and waste management systems.

III - Course Content

Preamble: This course introduces the principles of climate change, greenhouse gas emissions, and carbon footprint assessment for products, processes, and organizations. It also covers mitigation strategies, policies, and real-world applications across industries and urban systems.

Unit – I	Climate Change and Carbon Footprint	9 Periods
Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations		
Unit – II	Product Life Cycle and Ghg Emissions	9 Periods
Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality Allocation and Assessing Uncertainty		
Unit – III	Methodological Aspects of Carbon Footprint	9 Periods
Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes		
Unit – IV	Emission Mitigation and Carbon Sink	9 Periods



Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Policies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing.

Unit – V	Case Studies	9 Periods
Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation - Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management		

Text Books:	1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10 : 9811011737 2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10 : 9814585742
Reference Books:	1. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press 2. Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers 3. World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard 4. ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation. 5. IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc24_ar25/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the causes, impacts, and mitigation strategies of climate change, and calculate carbon footprints using GHG emission factors.	Understanding (BL 2)
CO2	Apply principles of product life cycle GHG accounting to accurately assess, analyze, and report emissions with proper data management and uncertainty evaluation.	Applying (BL 3)
CO3	Evaluate and model carbon footprints across diverse systems, incorporating life cycle stages, spatial-temporal variability, and alternative functional units for accurate GHG accounting.	Evaluating (BL 5)



CO 4	Analyze and design strategies for GHG emission mitigation and carbon sequestration, incorporating technologies, policies, social factors, and economic instruments.	Analyzing (BL 4)
CO 5	Apply carbon footprint assessment methods to real-world case studies across building, urban planning, products, agriculture, and waste management sectors.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME47 Energy Conservation in Industries

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the global and national energy scenario, environmental impacts of energy generation, and the principles and methodology of energy auditing.
2.	To analyze electrical supply systems, tariff structures, demand-side management, and strategies for energy conservation in HT and LT systems.
3.	To apply energy conservation techniques in major thermal utilities, including boilers, furnaces, steam distribution, and waste heat recovery systems.
4.	To explore energy efficiency measures in major electrical utilities such as motors, pumps, fans, HVAC systems, and illumination.
5.	To evaluate energy monitoring, targeting, labeling, and economic assessment methods, including life cycle costing and investment analysis for energy conservation projects.

III - Course Content

Preamble: This course introduces the principles and practices of energy auditing, energy conservation techniques, and efficiency measures for thermal and electrical utilities. It also covers energy monitoring, targeting, labeling, and economic evaluation for sustainable energy management.		
Unit – I	Introduction	9 Periods
Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.		
Unit – II	Electrical supply systems	9 Periods
Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics.		
Unit – III	Energy conservation in major thermal utilities	9 Periods
Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices		
Unit – IV	Energy conservation in major electrical utilities	9 Periods
Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems		
Unit – V	Energy monitoring, targeting, labelling and economics	9 Periods



Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme.

life cycle costing – case study

Text Books:	1. Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4 Volumes). Available at http://www.em-ea.org/gbook1.asp. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2. K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers & Dist, 2007.
Reference Books:	1. Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006. 2. Albert Thumann and Paul Mehta D, “Handbook of Energy Engineering”, 7th Edition, The Fairmont Press, 2013. 3. Murphy.W.R. and McKay.G, “Energy Management”, Butterworth, London 1982. 4. Paul W.O'Callaghan, Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers, Pergamon Press, 1981. 5. Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009.
MOOC/Web Platforms:	1. nptel.ac.in/courses/112105221

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyze energy scenarios, environmental impacts, material and energy balances, and energy auditing practices including roles of energy managers and audit instruments.	Analyzing (BL 4)
CO2	Analyze electrical supply systems, tariff structures, billing methods, demand side management, power factor, energy conservation in transformers, and harmonics in HT and LT supply.	Analyzing (BL 4)
CO3	Apply energy conservation techniques in thermal utilities using combustion principles, covering boilers, furnaces, heaters, cooling towers, D.G. sets, insulation, and waste heat recovery.	Applying (BL 3)
CO4	Apply energy conservation techniques in major electrical utilities including motors, pumps, fans, blowers, compressed air systems, HVAC, and illumination systems.	Applying (BL 3)
CO5	Analyze energy monitoring and targeting systems, energy labelling, and apply economic evaluation techniques including life cycle costing, cost indices, and PAT/ESCO concepts for energy management.	Analyzing (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME48 Energy Efficient Buildings

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the principles of sustainable building design, net-zero concepts, and relevant standards such as IGBC, LEED, GRIHA, IEQ, and ECBC.
2.	To analyze landscape design, building envelope characteristics, heat loss/gain, and energy-efficient materials and insulation techniques.
3.	To apply environmental heat transfer principles and calculate heating and cooling loads for building design. (K3 – Applying)
4.	To explore energy conservation measures in building utilities including HVAC, hot water systems, motors, pumps, and lighting systems.
5.	To evaluate the integration of renewable energy systems such as solar PV, solar water heating, small wind turbines, and poly-generation systems in buildings.

III - Course Content

Preamble: This course introduces sustainable building design, energy-efficient construction, and relevant standards for net-zero buildings. It also covers energy conservation in building utilities and the integration of renewable energy systems for sustainable built environments.		
Unit – I	Introduction	9 Periods
Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ and ECBC Standards		
Unit – II	Landscape And Building Envelopes	9 Periods
Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools		
Unit – III	Environmental Heat Transfer and Load Calculations	9 Periods
Heating load: Steady-state building heat transfer, indoor and outdoor design conditions, heating load calculation. Solar radiation: Earth's motion about the sun, time, solar angles, solar irradiation, heat gain through fenestration. Cooling load: Heat gain, cooling load, heat extraction rate, indoor and outdoor design conditions, cooling load calculation		
Unit – IV	Energy Conservation in Building Utilities	9 Periods
Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors, Pumps, Illumination Systems, Electrical distribution systems, Cooling Towers, Refrigeration and Air Conditioning Systems, Water and Waste Management systems		



Unit – V	Renewable Energy in Buildings	9 Periods
Introduction of Renewable sources in buildings, , Stand-alone PV systems, BIPV, Solar water heating, Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings		

Text Books:	1. Advanced Decision Making for HVAC Engineers, by Javad Khazaii, Springer; Softcover reprint of the original 1st ed. 2016 edition (23 June 2018), ISBN-10 : 3319814869. 2. Thermal Comfort and Energy-Efficient Cooling of Nonresidential Buildings, by Doreen E. Kalz, Jens Pfafferott, Springer; 2014th edition (8 April 2014), ISBN-10 : 9783319045818. 3. ASHRAE Handbook – Fundamentals / Equipment's/ Applications – ASHRAE 2021,2020, 2019 Editions .
Reference Books:	1. Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 1998. 2. Baruch Givoni: Passive Low Energy Cooling of Buildings by, John Wiley & Sons, 15-Jul-1994. 3. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley & Sons, 2006. 4. Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and Cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 28-Dec-2009.
MOOC/Web Platforms:	1. https://onlinecourses.swayam2.ac.in/nou24_ge85/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply principles of climate-responsive design, solar analysis, load calculations, and green building standards for sustainable and energy-efficient buildings.	Applying (BL 3)
CO2	Evaluate landscape strategies and building envelope components to minimize heat gain/loss and enhance energy efficiency using appropriate materials, design methods, and tools.	Evaluating (BL 5)
CO3	Apply principles of environmental heat transfer to analyze solar radiation and calculate heating and cooling loads based on building design and climatic conditions.	Applying (BL 3)
CO4	Analyze and apply energy conservation techniques in building utility systems including HVAC, lighting, water management, and electrical distribution.	Analyzing (BL 4)
CO5	Evaluate and integrate renewable energy systems such as solar, wind, and poly-generation technologies for sustainable building applications.	Evaluating (BL 5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	3	-	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME49 Energy Storage Devices

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals, types, and forms of energy storage, including mechanical, thermal, chemical, electrochemical, and electrical systems.
2.	To analyze the performance, efficiency, and characteristics of various energy storage systems such as pumped air, compressed air, flywheels, thermal storage, and batteries.
3.	To apply knowledge of mobile and hybrid energy storage systems, including batteries for electric vehicles, V2G/G2V technologies, and hybrid energy storage solutions (HESS).
4.	To explore renewable energy storage integration, energy management in microgrids and smart grids, and battery management systems for efficient energy utilization.
5.	To evaluate practical applications of energy storage systems in industries, power plants, food preservation, greenhouse heating, and process heating systems.

III - Course Content

Preamble: This course introduces the principles, types, and technologies of energy storage systems, including mechanical, thermal, chemical, and electrochemical methods. It also covers energy storage applications in renewable energy, electric vehicles, industrial processes, and smart grids for efficient energy management.

Unit – I	Introduction to Energy Storage	9 Periods
Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.		
Unit – II	Energy Storage Systems	9 Periods
Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types Charging and Discharging – Battery testing and performance.		
Unit – III	Mobile and Hybrid Energy Storage Systems	9 Periods
Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.		
Unit – IV	Renewable Energy Storage and Energy Management	9 Periods
Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management		



Unit – V	Application of Energy Storage Systems	9 Periods
Some areas of application of energy storage: Food preservation; Waste heat Recovery; Solar energy storage; Greenhouse heating; Power plant applications; Drying and heating for process industries		

Text Books:	1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", 2nd Edition, Springer, 2015. 2. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001 3. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt, "Energy Storage in Power Systems" Wiley Publication, 2016.
Reference Books:	1. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons, 2002. 2. Lindon David, "Handbook of Batteries", McGraw Hill, 2002. 3. Aulice Scibioh M. and Viswanathan B, "Fuel Cells – principles and applications", University Press(India), 2006 4. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_ph56/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and evaluate various energy storage technologies, their types, principles, and efficiencies for effective energy management.	Understanding (BL 2)
CO2	Understand and evaluate different energy storage systems including mechanical, thermal, thermochemical, and electrochemical technologies, along with their performance and testing methods	Understanding (BL 2)
CO3	Understand battery technologies for electric vehicles and portable devices, and evaluate Vehicle-to-Grid (V2G), Grid-to-Vehicle (G2V), and hybrid energy storage systems (HESS)	Understanding (BL 2)
CO4	Understand and evaluate renewable energy storage solutions, smart grids, battery management systems, and energy audit techniques for efficient energy management.	Understanding (BL 2)
CO5	evaluate the applications of energy storage systems in food preservation, waste heat recovery, solar energy, greenhouse heating, power plants, and industrial processes.	Evaluating (BL 5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)




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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
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CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23PME50 Renewable Energy Technologies

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the global and Indian energy scenario, including conventional and renewable energy sources, consumption patterns, and future energy plans.
2.	To analyze solar energy principles, solar radiation measurements, solar thermal collectors, photovoltaic conversion, and system applications.
3.	To explore wind energy resources, turbine technologies, site selection, hybrid systems, and environmental considerations.
4.	To apply bio-energy concepts, including biomass conversion, gasification, biogas, biodiesel, ethanol production, and their industrial applications.
5.	To evaluate ocean, geothermal, and fuel cell technologies, their working principles, power generation methods, applications, and environmental impacts.

III - Course Content

Preamble: This course introduces the fundamentals, principles, and applications of renewable energy sources, including solar, wind, bio-energy, ocean, geothermal, and fuel cells. It emphasizes sustainable energy solutions, system technologies, and environmental considerations for modern energy systems.

Unit – I	Energy Scenario	9 Periods
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status – Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.		
Unit – II	Solar Energy	9 Periods
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.		
Unit – III	Wind Energy	9 Periods
Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics – Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.		
Unit – IV	Bio-Energy	9 Periods



Bioresources – Biomass direct combustion – thermochemical conversion - biochemical conversion - mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration – Carbonisation – Pyrolysis - Biogas plants – Digesters – Biodiesel production – Ethanol production - Applications.

Unit – V	Ocean, Geothermal, and Fuel Cell Technology	9 Periods
Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact. Fuel Cells: Introduction, principle of fuel cells, types of fuel cells, fuel cell batteries, applications of fuel cells.		

Text Books:	1. Fundamentals and Applications of Renewable Energy Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10: 9390385636. 2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707.
Reference Books:	1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012. 2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014. 3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009. 4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015. 5. Twidell, J.W. & Weir A., "Renewable Energy.
MOOC/Web Platforms:	1. nptel.ac.in/courses/103103206

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand India's energy use in different sectors, know the status of conventional and renewable sources, compare global and national trends, and learn how energy use affects future planning.	Understanding (BL 2)
CO2	Understand the principles of solar radiation, measurement techniques, solar thermal and photovoltaic systems, and their practical applications.	Understanding (BL 2)
CO3	Understand wind energy fundamentals, turbine types, site selection, energy estimation, and applications.	Understanding (BL 2)
CO4	Understand biomass resources, conversion methods, gasifiers, biogas and biofuel production, and their applications.	Understanding (BL 2)



CO-5	Understand geothermal energy sources, power plants, applications, environmental impacts, and the principles, types, and uses of fuel cells.	Understanding (BL 2)
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(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
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CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME51 Equipment for Pollution Control

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the sources, characteristics, and impacts of water, air, and solid pollutants, along with relevant Indian environmental legislations and standards.
2.	To analyze the operational principles, design criteria, and selection of equipment for water pollution control and wastewater treatment.
3.	To explore air pollution control technologies and equipment, including cyclones, wet scrubbers, bag filters, electrostatic precipitators, and biofilters.
4.	To apply solid waste processing and management techniques, including dewatering, size reduction, incineration, and pyrolysis equipment.
5.	To evaluate pollution monitoring methods and equipment, and understand global environmental issues, clean technologies, and concepts such as carbon credits.

III - Course Content

Preamble: This course introduces the sources, impacts, and regulatory framework for water, air, and solid pollution. It also covers the design and operation of pollution control and monitoring equipment, along with global environmental issues and sustainable technologies.		
Unit – I	Pollution Control Regulations and Standards	9 Periods
Pollutants in water and wastewater – sources and impacts- Characteristics and impacts of solid and hazardous wastes - Indian Constitution and Environmental Protection Legislations - Environmental Standards under different Environmental legislations - Water Act (1974), Air Act (1981), Environmental Protection Act (1986) and major Notifications, Municipal solid Wastes (Management and Handling) Rules -Bio Medical Wastes (Management and Handling) Rules - Hazardous Wastes (Management and Handling Rules), Environment Impact Assessment Notifications - Unit operations and unit processes in Pollution Control- - Selection criteria for Pollution Control Equipment.		
Unit – II	Equipment for Water Pollution Control	9 Periods
Operational principles and Design criteria of Flash mixers, Flocculators, Clarifiers, Sand Filters, Adsorption Columns, Aerators, Air blowers, Distillation units, Centrifugal and Reciprocating Pumps, Chemical dosing systems, Motors, Pipes, valves and Fittings - Field visit to a wastewater treatment plant.		
Unit – III	Equipment for Air Pollution Control	9 Periods
Operational principles and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electrostatic precipitators, Biofilters - Field visit to an industry with air pollution control systems		
Unit – IV	Equipment for Solid Waste Processing	9 Periods



Operational principles and Design criteria of Dewatering equipment – centrifuge, Vacuum Filter, Filter Press- Size Reduction equipment – shredders, grinders – Trommel and Disc Screens – Air Classifiers - bailing and briquetting – incinerators –Pyrolysis – field visit to a solid waste processing facility		
Unit – V	Pollution Monitoring Equipment & Global Issues of Environmental Engineering	9 Periods
Equipment's for sampling of water, solids and air- Sample preservation Equipment – incubators – Cold Storage systems- equipment for analysis of water and air samples- Ambient air and flue gas sampling and monitoring equipment. Global warming, ozone depletion, acid rain, oil pollution, radiation hazards and their control, concept of clean technology and carbon credits.		

Text Books:	1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015. 2. Rao. C.S (2006)., "Environmental Pollution and Control Engineering", 2nd Edition, Revised, Wiley Eastern Limited, India. 3. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford, 2001.
Reference Books:	1. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2014. 2. Noel de Nevers, "Air Pollution Control Engg", Mc Graw Hill, New York, 2016. 3. CPCB (2021), "Pollution Control Acts, Rules and Notifications issued thereunder, PCL Series- Central Pollution Control Board, Delhi. 4. CPHEEO, "Manual on Municipal Solid waste management, Vol I, II and III, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2016.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_ce04/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand environmental pollutants, analyze relevant Indian environmental legislations and standards, and evaluate appropriate pollution control methods and equipment.	Understanding (BL 2)
CO2	Understand the working and design of water and air pollution control equipment through theoretical study and field visits	Understanding (BL 2)
CO3	Understand the principles and design of air pollution control equipment and observe their application through industrial field visits.	Understanding (BL 2)
CO4	Understand the operational principles and design of solid waste processing equipment and gain practical insight through field visits to processing facilities.	Understanding (BL 2)



CO 5	Understand the principles and applications of pollution monitoring equipment for water, air, and solids, including sampling, preservation, and analysis systems	Understanding (BL 2)
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(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
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CO-2	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	3	-	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




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I – Course Code & Name: 23PME52 Computational Solid Mechanics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To study the definition and basics on theory of elasticity
2	To learn finite element method and procedure for static linear elasticity
3	To study the Non-Linear and History depend problems
4	To study time dependent and dynamic problems of small and large strain visco-plasticity
5	To study Structural Elements & Interfaces and contact using penalty method.

III - Course Content

Preamble: This course covers advanced elasticity concepts and computational methods, focusing on finite element analysis for linear and nonlinear materials, dynamic behavior, and structural interactions including contact mechanics.

UNIT-I	Basic on Theory of Elasticity	9 Periods
Fundamental elasticity concepts with emphasis on anisotropic and composite materials- Advanced tensor notation and matrix representation- Updated compatibility conditions for complex materials- Application of Mohr's circle in multi-axial stress states- Introduction to micromechanics of materials and scale effects.		
UNIT-II	Finite Element Method for Static Linear Elasticity	9 Periods
Implementation of 2D and 3D FE codes including quadrilateral and tetrahedral elements- Use of isoperimetric elements and higher order shape functions- Introduction to commercial FE software (e.g., ANSYS, Abaqus) workflow and scripting- Mesh refinement strategies and error estimation techniques- Emphasis on solver algorithms and preconditioning.		
UNIT-III	Non-Linear And History Depend Problems	9 Periods
Basic Behavior of Materials Beyond Elasticity- Small and Large Deformations- Time-Dependent Plasticity and Creep		
UNIT-IV	Time Dependent and Dynamic Problems	9 Periods
Material and structure response over time- Numerical methods for vibrations and dynamics (Newmark etc.)- Time step analysis.		
UNIT-V	Structural Elements & Interfaces and Contact	9 Periods
Beams and shells basics- Modeling joints and connections simply- How parts come into contact using penalty/Lagrange methods.		

TEXT BOOKS	1. L.S.Srinath, Advanced Mechanics of Solids, 3rd Edition 2008. (0070139881 · 9780070139886).
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[Signature]
 Chairperson - Board of Studies,
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 NPR College of Engineering & Technology
 (Autonomous),
 Natham, Dindigul 624401

	2. J.N.Reddy, Introduction to Finite Element Method, 4th Edition 2020. (939038527X · 9789390385270). 3. R.D.Cook, Concepts and Applications of Finite Element Analysis, 4th Edition 2001 (978-0- 471-35605-9). 4. S.Timoshenko, Theory of Elasticity, McGraw-Hill Education (India) Pvt Limited, 2010. (9780070701229-0070701229). 5. G. Ramamurty, Applied Finite Element Analysis, I.K. International Publishing House Pvt. Limited, 2013, (9789380578453- 9380578458).
REFERENCES	1. The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution (Computational Fluid and Solid Mechanics) by Miguel Luiz Bucalem and KlausJurgen Bathe 25 February 2013. 2. The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics) by Dominique Chapelle and Klaus-Jurgen Bathe 27 January 2013. 3. Inelastic Analysis of Solids and Structures (Computational Fluid and Solid Mechanics) by M. Kojic and Klaus-Jurgen Bathe 22 October 2010. 4. High-Resolution Methods for Incompressible and Low-Speed Flows (Computational Fluid and Solid Mechanics) by D. Drikakis and W. Rider 22 October 2010. 5. Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer (Computational Fluid and Solid Mechanics) by Ben Q. Li 22 October 2010.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_ce95/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the definition and basics on theory of elasticity	Understand (BL 2)
CO2	Derive the finite element method for static linear elasticity, solve problems.	Apply (BL 3)
CO3	Discuss the Non-Linear and History depend problems, Solve problems.	Apply (BL 3)
CO4	Discuss time dependent and dynamic problems, solve problems.	Apply (BL 3)
CO5	Discuss Structural Elements & Interfaces and contact, solve problems.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs



COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	2	1	-	-	-	-	1	-	-	1	3	1
CO-2	3	3	2	1	-	-	-	-	1	-	-	1	3	1
CO-3	3	3	2	1	-	-	-	-	1	-	-	1	3	1
CO-4	3	3	2	1	-	-	-	-	1	-	-	1	3	1
CO-5	3	3	2	1	-	-	-	-	1	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME53 Computational Fluid Dynamics and Heat Transfer

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To study the fluid flow simulation techniques and its mathematical behaviour.
2	To learn the discretise 1D and 2D systems using finite difference and finite volume techniques.
3	To Formulate diffusion –convection problems using finite volume method.
4	To study the flow field for different types of grids.
5	To learn the need for turbulence models and its types.

III - Course Content

Preamble: Introduces CFD fundamentals, numerical methods, turbulence modeling, and simulation tools for solving real-world fluid flow problems.		
UNIT-I	Introduction to CFD	9 Periods
Overview of CFD & applications- Governing equations (Continuity, Momentum, Energy)- Boundary & initial conditions- Turbulence overview (RANS)- PDE classification (brief)- Basics of discretization and numerical errors.		
UNIT-II	Finite Difference and Finite Volume Methods for Diffusion	9 Periods
Finite volume method basics for diffusion & convection-diffusion (1D & 2D)- Key discretization schemes (Upwind, Central, QUICK)- Stability & convergence criteria- Introduction to adaptive mesh refinement (AMR).		
UNIT-III	Finite Volume Method for Convection Diffusion	9 Periods
Pressure-velocity coupling: SIMPLE, PISO algorithms- Staggered vs collocated grids- Pressure correction methods- Solver types (segregated & coupled)- Intro to parallel computing for CFD		
UNIT-IV	Flow Field Analysis	9 Periods
Turbulence modeling: mixing length, k- ϵ , k- ω models- LES basics- Validation methods: grid independence, residuals, benchmarks- Intro to data-driven/machine learning in turbulence modeling.		
UNIT-V	Turbulence Modelling	9 Periods
Overview of CFD software (ANSYS Fluent, Open FOAM)- Mesh generation & quality assessment- Post-processing- Case studies (aerodynamics, heat exchangers, electronics cooling)- Best practices for CFD workflow.		

TEXT BOOKS	1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014 .
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	2. Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2017
REFERENCES	1. John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, 2013. 2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994. 3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009. 4. Uriel Frisch, Turbulence, Cambridge University Press, 1999. 5. Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2002.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/112105045 2. https://onlinecourses.nptel.ac.in/noc24_ae23/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the fundamentals of CFD, and develop case specific governing equations.	Apply (BL 3)
CO2	Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems. Implement various mathematical schemes under finite volume method for convection diffusion.	Understand (BL 2)
CO3	Solve complex problems in the field of fluid flow and heat transfer with the support of high-speed computers.	Analyze (BL 4)
CO4	Apply the various discretization methods, solution procedure and the concept of turbulence modelling.	Evaluate (BL 5)
CO5	Apply the fundamentals of CFD, and develop case specific governing equations.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	1					1			1	3	2
CO-2	3	2	1	1					1			1	3	2
CO-3	3	2	1	1					1			1	3	2
CO-4	3	2	1	1					1			1	3	2
CO-5	3	2	1	1					1			1	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



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VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME54 Theory on Computation and Visualization

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To study the concepts and techniques of discrete mathematics for theoretical computer science.
2	To learn different formal languages and their relationship.
3	To classify and construct grammars for different languages and vice-versa.
4	To study Visualization, Graphical and Quantitative Information.
5	To learn Visualization design and data Ink.

III - Course Content

Preamble: This course covers foundational concepts in mathematical theory, automata, and formal languages, alongside key principles and techniques in information visualization and design.		
UNIT-I	Review of Mathematical Theory	9 Periods
Sets, Functions, Logical statements, Principle of Mathematical Induction, Recursive and Structural Induction, Basics of Proof Techniques, Relations		
UNIT-II	Regular Languages and Finite Automata	9 Periods
Regular Expressions, Finite Automata (Moore & Mealy), NFA to DFA conversion, Kleene's theorem, Minimization of automata, Pumping lemma for regular languages		
UNIT-III	Context Free Grammar (CFG) and Pushdown Automata	9 Periods
CFG definitions, Derivations, Ambiguity, BNF and CNF, Deterministic PDA, Equivalence of CFG and PDA, Pumping lemma for CFL		
UNIT-IV	Value of Visualization	9 Periods
Information Visualization, Graphical Excellence, Graphical Integrity, Visual Perception Principles, Ethical Visualization Practices		
UNIT-V	Visualization Design	9 Periods
Effective chart design principles, Data-Ink concept, Graphical redesign, Use of color and layout, Introduction to basic visualization software/tools		

TEXT BOOKS	1. Introduction to the Theory of Computation by Michael Sipser 2. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman.
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REFERENCES	1. Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill. 2. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria & Sons. 3. Introduction to computer theory By Deniel I. Cohen, John Wiley & Sons, Inc
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc25_mg155/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand basics of mathematical theory and proofs.	Understand (BL 2)
CO2	Apply concepts of finite automata and regular languages.	Apply (BL 3)
CO3	Explain context-free grammar and pushdown automata.	Understand (BL 2)
CO4	Understand principles of information visualization.	Understand (BL 2)
CO5	Design effective visualizations using tools and principles.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-2	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-3	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-4	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-5	3	2	1	1	-	-	-	-	1	-	-	1	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME55 Computational Bio-Mechanics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To Introduction of principles and concepts of bio-mechanics.
2	Focuses on the studies of tissues and structure of musculoskeletal system.
3	To study the mechanics of joints and human motion.
4	To explain the computational approaches in biomechanics.
5	To learn the quantification of forces and motion

III - Course Content

Preamble: This course covers the basics of biomechanics, human motion analysis, computational modeling, and modern tools like wearable sensors and 3D printing to understand and analyze musculoskeletal functions.

UNIT-I	Introduction to Biomechanics	9 Periods
Introduction to Biomechanics of Bone, Cartilage, Tendons, Ligaments, Skeletal Muscle; Basic injury mechanics; Biomechanical properties of tissues		
UNIT-II	Biomechanics of Tissues and Structures	9 Periods
Kinematic and kinetic concepts for human motion; Mechanical behavior of soft and hard tissues; Basic wearable sensor applications		
UNIT-III	Biomechanics Of Joints and Human Motion	9 Periods
Biomechanics of Major Joints (Hip, Knee, Spine, Shoulder, etc.); Human movement analysis using instrumentation		
UNIT-IV	Computational Approaches in Biomechanics	9 Periods
Finite Element Analysis for Bone and Implant Modeling; Basic simulation of prosthetics and scaffolds		
UNIT-V	Gait Analysis	9 Periods
Gait Analysis fundamentals; Ergonomic assessment; Sports mechanics; 3D printing in orthopedics		

TEXT BOOKS	1. Susan J Hall, Basic Biomechanics, 6th Edition, The McGraw-Hill Companies Inc., 2011 2. Jay D Humphrey and Sherry L Delange, An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, 1st edition, Springer-Verlag, 2010
REFERENCES	1. Margareta Nordin and Victor H Frankel, Basic Biomechanics of the Musculoskeletal System, 3rd Edition, Lippincott Williams and Wilkins, 2001.



	2. Ozkaya, Nihat, Nordin, and Margareta, Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, 2nd Edition, Springer, 2009. 3. Pritam Pain, Sreerup Banerjee, Goutam Kumar Bose, Advances in Computational Approaches in Biomechanics, 2022 4. Kinetics and Dynamics: From Nano- to Bio-Scale: 12 (Challenges and Advances in Computational Chemistry and Physics) by Piotr Paneth and Agnieszka Dybala-Defratyka 12 August 2010 5. Computational Approaches to Biochemical Reactivity: 19 (Understanding Chemical Reactivity) by Gábor Náray-Szabó and Arie Warshel 31 March 2002
M OOC/Web Platforms:	1. https://nptel.ac.in/courses/112/104/112104143/ 2. https://www.coursera.org/learn/biomechanics 3. https://www.udemy.com/course/biomechanics-for-beginners/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the biomechanics of bones, cartilage, tendons, ligaments, and muscles.	Remember (BL 1)
CO2	Apply kinematic and kinetic concepts to analyze human motion and tissue mechanics.	Apply (BL 3)
CO3	Analyze biomechanical functions of major joints and interpret movement data using instrumentation.	Analyze (BL 4)
CO4	Utilize computational tools like Finite Element Analysis for modeling bones and implants.	Apply (BL 3)
CO5	Evaluate gait patterns, ergonomic factors, and the application of 3D printing in orthopedics.	Evaluate (BL 5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	1					1			1	3	2
CO-2	3	2	1	1					1			1	3	2
CO-3	3	2	1	1					1			1	3	2
CO-4	3	2	1	1					1			1	3	2
CO-5	3	2	1	1					1			1	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME56 Advanced Statistics and Data Analytics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To introduce the basic concepts of linear regression and multiple regression
2	To introduce exploratory data analysis
3	To study logistic regression models for classification
4	To develop the forecasting techniques for the predictions
5	To introduce the time series analysis for the prediction of future behavior

III - Course Content

Preamble: This course covers essential data science methods including regression, visualization, classification, forecasting, and time series analysis. It combines theory and practical tools to build and evaluate predictive models for real-world applications.

UNIT-I	Modern Regression and Predictive Modeling	9 Periods
Introduction to regression in data science - Simple and Multiple Linear Regression - Assumptions and diagnostics - Residual analysis, Goodness of fit - Polynomial regression, Feature engineering - Ridge, Lasso, ElasticNet - Cross-validation, Model Selection (AIC, BIC) - Handling categorical variables (one-hot/label) - Multicollinearity and VIF		
UNIT-II	Exploratory Data Analysis and Visualization Tools	9 Periods
Data science lifecycle - Cleaning, preprocessing - Outlier and missing value handling - Best practices in visualization - Tools: Seaborn, Plotly, Altair - Univariate/bivariate/multivariate analysis - PCA, t-SNE, UMAP - Dashboards using Tableau/Power BI		
UNIT-III	Classification Techniques and Model Evaluation	9 Periods
Logistic regression (binary, multinomial) - Maximum Likelihood Estimation - Model metrics: Confusion matrix, ROC, AUC - F1-score, Precision, Recall - Regularized logistic models - Decision Trees introduction - Model explainability (SHAP, LIME)		
UNIT-IV	Forecasting Strategies and Causal Inference Models	9 Periods
Forecasting basics: trend, seasonality - Holt, Holt-Winters exponential smoothing - Forecasting using ML: Prophet, XGBoost - Evaluation: RMSE, MAE, MAPE - Causal inference basics - DAGs, Granger causality - Difference-in-Differences (DiD), Instrumental variables		
UNIT-V	ADVANCED TIME SERIES MODELING AND DEEP LEARNING	9 Periods
Time series components and stationarity - ACF/PACF analysis - AR, MA, ARMA, ARIMA - SARIMA for seasonality - Multivariate: VAR, VECM - Intro to deep learning: RNN, LSTM - Tools: statsmodels, pmdarima, Prophet, TensorFlow.		

TEXT BOOKS	1. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", John Wiley & Sons, 2014.
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	2. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulachi, "Introduction to Time Series Analysis and Forecasting", Wiley, 2015
REFERENCES	1. David Forsyth, 'Probability and Statistics for Computer Science', Springer; 2018 2. Michael J. Evans, Jeffrey S. Rosenthal, 'Probability and Statistics - The Science of Uncertainty'. W H Freeman & Co, 2010 3. Max Kuhn, Kjell Johnson, "Applied Predictive Modeling", Springer, 2014. 4. Ronald E. Walpole, Raymond H. Meyers, Sharon L. Meyers, "Probability and Statistics for Engineers and Scientists", Pearson Education, 2014. 5. Daniel T. Larose, Chantal D. Larose "Data Mining and Predictive Analytics", Wiley, 2015 6. Thomas W. Miller, "Modeling Techniques in Predictive Analytics with Python and R: A guide to Data Science", Pearson Education, 2014.
MOOC/Web Platforms:	1. https://www.edx.org/course/data-science-machine-learning 2. https://www.udemy.com/course/python-for-data-science-and-machine-learning-bootcamp/ 3. https://www.datacamp.com/courses/supervised-learning-with-scikit-learn 4. https://ocw.mit.edu/courses/18-335j-introduction-to-computational-thinking-and-data-science-fall-2018/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply regression techniques for predictive modeling.	Apply (BL 3)
CO2	Use visualization tools for exploratory analysis.	Apply (BL 3)
CO3	Evaluate classification models and metrics.	Analyze (BL 4)
CO4	Build forecasting and causal inference models.	Analyze (BL 4)
CO5	Analyze advanced time series and deep learning models.	Evaluate (BL 5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	1	2	1	-	-	-	1	-	-	1	3	1
CO-2	3	3	1	2	1	-	-	-	1	-	-	1	3	1
CO-3	3	3	1	2	1	-	-	-	1	-	-	1	3	1
CO-4	3	3	1	2	1	-	-	-	1	-	-	1	3	1
CO-5	3	3	1	2	1	-	-	-	1	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME57 CAD and CAE

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	2	0	2	3

II - Course Objectives

1	Applying the fundamental concepts of computer graphics and its tools in a generic framework.
2	Creating and manipulating geometric models using curves, surfaces, and solids.
3	Applying concept of 3D modeling, visual realism, and CAD standard practices in engineering
4	Developing mathematical models for Boundary Value Problems and their numerical solution.
5	Formulating solution techniques to solve non-linear problems

III - Course Content

Preamble: This course covers modern computer graphics, advanced geometric modeling, and finite element analysis with an emphasis on current tools, real-time rendering, and advanced simulation techniques for engineering applications.		
UNIT-I	Fundamentals of Computer Graphics	9 Periods
Updated CAD workflows, advanced coordinate systems, 2D/3D transformations with matrix libraries, optimized graphic primitives algorithms, modern clipping techniques, viewing pipeline in GPU, latest graphics standards (OpenGL 4.x, Vulkan)		
UNIT-II	Geometric Modeling	9 Periods
Parametric and non-parametric curve representations, NURBS, advanced surface modeling with subdivision surfaces, modern solid modeling including mesh-based models and CAD-to-3D printing pipeline		
UNIT-III	Visual Realism and CAD Standards	9 Periods
Real-time rendering techniques, advanced depth buffering, PBR shading, GPU shaders, animation pipelines, modern CAD standards, introduction to WebGL, data exchange with 3D XML, STEP AP242		
UNIT-IV	Finite Element Analysis	9 Periods
Advanced FEM with adaptive meshing, nonlinear materials, coupled physics simulations, software integration (ANSYS, Abaqus), extended shape functions, applications extended to fluid-structure interaction and multi-physics problems		
UNIT-V	Non-Linear Analysis	9 Periods
Advanced nonlinear solvers, computational plasticity, damage mechanics, contact algorithms in HPC environments, mesh quality metrics, error control with AI-assisted mesh optimization, introduction to open-source FEM software (FEniCS, CalculiX)		



TEXT BOOKS	1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007 2. Seshu.P, "Textbook of Finite Element Analysis", PHI Learning Pvt. Ltd., NewDelhi, 2012
REFERENCES	1. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989. 2. Donald Hearn and M. Pauline Baker "Computer Graphics". Prentice Hall, Inc, 1992. 3. Foley, Wan Dam, Feiner and Hughes – "Computer graphics principles & practice", Pearson Education - 2003 4. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, ButterworthHeinemann,2018. 5. Reddy,J.N. "Introduction to the Finite Element Method", 4thEdition, Tata McGrawHill,2018.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/106/105/106105607/ 2. https://nptel.ac.in/courses/112/107/112107086/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Use modern CAD tools and graphics techniques in design work.	Apply (BL 3)
CO2	Create 3D models using curves, surfaces, and solid modeling for CAD and printing.	Create (BL 6)
CO3	Apply rendering and animation tools to improve visual quality in CAD models.	Apply (BL 3)
CO4	Build FEM models for real-world engineering simulations using software tools.	Create (BL 6)
CO5	Analyze complex engineering problems using nonlinear FEM and modern tools.	Analyze (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	1	1	1	2				1	3		2	2	1



CO-2	1	1	1	1	2				1	3		2	2	1
CO-3	1	1	1	1	2				1	3		2	2	1
CO-4	3	3	2	2	2				1	3		2	2	1
CO-5	3	3	2	2	2				1	3		2	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME58 Machine Learning for Intelligent Systems

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To introduce basic machine learning techniques such as regression, classification
2	To learn about introduction of clustering, types and segmentation methods
3	To learn about fuzzy logic, fuzzification and defuzzification
4	To learn about basics of neural networks and neuro fuzzy networks.
5	To learn about Recurrent neural networks and Reinforcement learning

III - Course Content

Preamble: This course introduces fundamental and advanced machine learning techniques with a focus on their applications in robotics. Students will learn key concepts and algorithms such as clustering, fuzzy logic, neural networks, and reinforcement learning, alongside practical case studies to develop intelligent robotic systems.		
UNIT-I	Fundamentals of Machine Learning	9 Periods
Fundamentals of Machine Learning - Supervised vs. Unsupervised Learning - Regression and Classification techniques overview - Accuracy, Precision, Recall, RMSE - Real-world AI-Robotics integration examples		
UNIT-II	Clustering and Dimensionality Reduction Techniques	9 Periods
Overview of Clustering Techniques - K-means, Agglomerative, DBSCAN (Added) - KNN Classifier & Real-life Robotics Case - PCA for Dimensionality Reduction - PCA use in Sensor Data Processing		
UNIT-III	Fuzzy Logic for Intelligent Systems	9 Periods
Fundamentals of Fuzzy Logic - Fuzzy Sets and Membership - Rule-Based System Design - Fuzzification and Defuzzification - Case Study: Fuzzy-based Path Planning		
UNIT-IV	Artificial Neural Networks and Hybrid Systems	9 Periods
Basics of Neural Networks - ANN with Backpropagation - MLP Implementation - Neuro-Fuzzy Hybrid Systems - Application: Robotic Arm Control using ANN		
UNIT-V	Recurrent Neural Networks and Reinforcement Learning	9 Periods
Introduction to RNNs and LSTMs (Added) - Real-time RNN Use in Robotics - Reinforcement Learning Concepts - MDP and Policy Learning - Q-learning Algorithm - Application: RL in Robotic Navigation		

TEXT BOOKS	1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addison Wesley, England, 2011
REFERENCES	1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2016 2nd Edition, Springer



	2. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, delhi 2016. 3. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, Chichester, 2011, Sussex Wiley.
MOC/Web Platforms:	https://nptel.ac.in/courses/106106139?utm_source https://onlinecourses.nptel.ac.in/noc25_bt16/preview?utm_source https://onlinecourses.nptel.ac.in/noc22_ee21/preview?utm_source https://nptel.ac.in/courses/117105084?utm_source https://nptel.ac.in/courses/106106143?utm_source

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand ML basics, supervised vs. unsupervised learning, and regression/classification for robotics.	Understand (BL 2)
CO2	Analyze clustering methods and apply PCA for robotic sensor data.	Analyze (BL 4)
CO3	Apply fuzzy logic principles for intelligent robotic control.	Apply (BL 3)
CO4	Implement ANN and neuro-fuzzy systems for robotic applications.	Apply (BL 3)
CO5	Analyze RNNs and use reinforcement learning for robotic navigation.	Analyze (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	3	2	1	-	-	-	-	-	-	3	3	2
CO-2	3	2	3	2	1	-	-	-	-	-	-	3	3	2
CO-3	3	2	3	2	1	-	-	-	-	-	-	3	3	2
CO-4	3	2	3	2	1	-	-	-	-	-	-	3	3	2
CO-5	3	2	3	2	1	-	-	-	-	-	-	3	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME59 Automobile Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To study the construction and working principle of various parts of an automobile
2.	To study the construction and working principle of engine auxiliary system.
3.	To study various transmission systems of automobile.
4.	To study about steering, brakes and suspension systems.
5.	To study about battery, Auto- electrical, alternative energy sources and Emission control systems

III - Course Content**Preamble:**

Automobile Engineering is a key branch of Mechanical Engineering focusing on vehicle design, development, and maintenance. The course covers essential systems such as transmission, suspension, steering, and braking. It also explores modern trends like electric and hybrid vehicles. Emphasis is placed on emission control, safety features, and autonomous technologies. Students gain skills to innovate and contribute to the evolving automotive industry.

Unit – I	Vehicle Structure and Engines	9 Periods
Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).		
Unit – II	Engine Auxiliary Systems	9 Periods
Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Battery coil ignition system, Magneto coil ignition system, Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Lubrication system and Cooling system		
Unit – III	Transmission Systems	9 Periods
Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.		
Unit – IV	Steering, Brakes and Suspension Systems	9 Periods
Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.		
Unit – V	Electrical Equipment & Alternative Energy Sources	9 Periods
Battery -Construction, Rating, Charging, testing, Starting circuit, construction and operation of starter motor, Alternator, Dynamo. Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric		



and Hybrid Vehicles, Fuel Cell. Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

Text Books:	1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002. Grewal B.S., "Higher Engineering Mathematics", 42 nd Edition, Khanna Publishers, Delhi, 2012. 2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014
Reference Books:	1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012. 2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998. 3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999. 4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978. 5. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 1989.
MOOC/Web Platforms:	nptel.ac.in/noc .

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Recognize the various parts of the automobile and their functions and materials	Apply (BL 3)
CO2	Discuss the engine auxiliary systems and engine emission control.	Apply (BL 3)
CO3	Distinguish the working of different types of transmission systems..	Apply (BL 3)
CO4	Explain the Steering, Brakes and Suspension Systems.	Understand (BL 2)
CO5	Predict possible alternate sources of energy for IC Engines	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	2	1	-	-	-	-	1	-	-	1	2	2
CO-2	2	1	2	1	-	-	-	-	1	-	-	1	2	2
CO-3	2	1	2	1	-	-	-	-	1	-	-	1	2	2



CO-4	2	1	2	1	-	-	-	-	1	-	-	1	2	2
CO-5	2	1	2	1	-	-	-	-	1	-	-		2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓	✓	✓		✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME60 Measurements and Controls

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To Identify measurement parameters and analyze errors of measurements.
2.	To Select and apply suitable transducer for a particular measurement.
3.	To identify measurement parameters and select the appropriate sensor for it.
4.	To Explain the working of various types of control systems of apply for specific applications. 5
5.	To apply the principle of automatic control systems to control various parameter(s).

III - Course Content

Preamble: Measurements and Control is fundamental for accurate monitoring and regulation of engineering processes. It deals with the principles and methods of measuring physical quantities. The subject covers sensors, transducers, instrumentation, and control systems. Emphasis is placed on precision, reliability, and automation in industrial applications. It equips students with skills to design and manage efficient control systems.

Unit – I	Measurements and Error Analysis	9 Periods
General concepts – Units and standards – Measuring instruments –sensitivity, readability, range, accuracy, precision – static and dynamic response – repeatability hysteresis – systematic and random errors – Statistical analysis of experimental data – Regression analysis – Curve fitting - calibration and Uncertainty.		
Unit – II	Instruments	9 Periods
Transducer, modifying (intermediate) and Terminal stages – Mechanical and electrical transducers, preamplifiers – charge amplifiers – filters – attenuators – D’ Arsonval – CRO – Oscillographs – recorders – microprocessor based data logging, processing and output. Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures		
Unit – III	Parameters for Measurement	9 Periods
Dimension, displacement, velocity, acceleration, Impact – Force, torque, power- Pressure, Temperature, Heat Flux, Heat Transfer Coefficients, Humidity – Flow – Velocity - Time, frequency and phase angle – noise and sound level. Diaphragm gauges. Low-pressure measurement – Thermal conductivity gauges – ionization pressure gauges, McLeod pressure gauge		
Unit – IV	Control System	9 Periods
Basic elements – feedback principle, implication of measurements – Error detectors – final actuating elements – Two position, multi-position, floating, proportional controls – relays – servo amplifiers – servo motors – Electrical, magnetic, electronic control systems		
Unit – V	Application of Control Systems	9 Periods
Governing of speed, kinetic and process control – pressure, temperature, fluid level, flow-thrust and flight control – photo electric controls – designing of measurement and control systems for different applications. Examples with block diagrams–Temperature, speed & position control systems		



Text Books:	1. Beckwith, Marangoni and Lienhard, Mechanical Measurements, Pearson, 2013. 2. Ernest Doebelin and DhaneshManik, Measurement Systems, McGraw Hill International Edition, 2017. 3. Holman J P, "Experimental Methods for Engineers", McGraw Hill Int. Edition, 7th Ed., 2017. 4. Nagrath I J, "Control Systems Engineering", New Age International Publishers, 2018. 5. 5. Nakra B.C, and Chaudhry K.K, Instrumentation, Measurement, and Analysis, Tata McGraw Hill, 4th Edition, 2016.
Reference Books:	1. "Materials and Processes in Manufacturing" by E. Paul DeGarmo, J.T. Black, and Ronald A. Kohser 4th Edition, 2022. 2. "Manufacturing Processes for Engineering Materials" by Serope Kalpakjian and Steven Schmid, 9 th Edition, 2021 3. "Manufacturing Processes and Materials: Exercises" by R. K. Jain -Pearson India, 15th Edition 2023.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/105/1121052126/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify measurement parameters and analyze errors of measurements.	Applying (BL 2)
CO2	Select and apply suitable transducer for a particular measurement.	Applying (BL 2)
CO3	Identify measurement parameters and select the appropriate sensor for it.	Applying (BL 2)
CO4	Explain the working of various types of control systems of apply for specific applications.	Applying (BL 2)
CO5	Apply the principle of automatic control systems to control various parameter(s).	Applying (BL 2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	-	-	1	-	-	-	-	2	3	1
CO-2	3	3	2	1	-	-	1	-	-	-	-	2	3	1
CO-3	3	3	2	1	-	-	1	-	-	-	-	2	3	1
CO-4	3	3	2	1	-	-	1	-	-	-	-	2	3	1
CO-5	3	3	2	1	-	-	1	-	-	-	-	2	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓		✓		✓	✓	✓

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



**Chairperson - Board of Studies,
Department of Mechanical Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul 624401**

I – Course Code & Name: 23PME61 Design Concepts in Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To study the various design requirements and get acquainted with the processes involved in product development.
2.	To study the design processes to develop a successful product
3.	To learn scientific approaches to provide design solutions
4.	Designing solution through relate the human needs and provide a solution.
5.	To study the principles of material selection, costing and manufacturing in design.

III - Course Content

Preamble: Design Concepts in Engineering introduces the fundamentals of creating efficient and innovative solutions to engineering problems. It focuses on design principles, creativity, and systematic problem-solving approaches. The subject covers material selection, safety, sustainability, and cost-effectiveness. Emphasis is placed on modern tools, techniques, and collaborative design processes. It prepares students to develop practical and reliable engineering designs.

Unit – I	Design Terminology	9 Periods
Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.		
Unit – II	Introduction to Design Processes	9 Periods
Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering - customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation		
Unit – III	Creativity in Design	9 Periods
Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks. Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.		
Unit – IV	Human and Societal aspects in Product Development	9 Periods
Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects		



Unit – V	Material and Processes in Design	9 Periods
Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).		

Text Books:	1. Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co., 1998. 2. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, 3. "Integrated Product and Process Design and Development", CRC Press, 2009. 4. James Garratt, "Design and Technology", Cambridge University Press, 1996. 5. Joseph E. Shigley, Charles R. Mische, and Richard G. Budynas, "Mechanical Engineering Design", McGraw Hill Professional, 2003. 6. 5. Sumesh Krishnan and Mukul Sukla, Concepts in Engineering Design, Notion Press, 2016.
Reference Books:	1. Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420. 3. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/105/1121052116/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyze the various design requirements and get acquainted with the processes involved in product development.	Applying (BL 2)
CO2	Apply the design processes to develop a successful product.	Applying (BL 2)
CO3	Apply scientific approaches to provide design solutions	Applying (BL 2)
CO4	Design solution through relate the human needs and provide a solution.	Applying (BL 2)
CO5	Apply the principles of material selection, costing and manufacturing in design.	Applying (BL 2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	1	-	-	1	2	3	1

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-2	3	3	2	1	-	-	1	1	-	-	1	2	3	1
CO-3	3	3	2	1	-	-	1	1	-	-	1	2	3	1
CO-4	3	3	2	1	-	-	1	1	-	-	1	2	3	1
CO-5	3	3	2	1	-	-	1	1	-	-	1	2	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓		✓		✓	✓	✓

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



(Signature)

I – Course Code & Name: 23PME62 Composite Materials and Mechanics

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the need for composite materials and their advantages over conventional materials.
2.	Study different types of fibers (glass, carbon, aramid, natural fibers) and their properties.
3.	Derive and apply rules of mixtures for mechanical and thermal properties.
4.	Understand stress-strain relationships in anisotropic and orthotropic materials.
5.	Understand about the laminated flat plate composites

III - Course Content

Preamble: Composite Materials and Mechanics focuses on the study and application of advanced materials made by combining two or more distinct constituents to achieve superior properties. This subject explores the behavior, design, and manufacturing of composites, emphasizing their strength-to-weight advantages. It covers micromechanics, macromechanics, and failure theories specific to composites. The course equips students with analytical and practical tools for engineering applications. It is vital for innovations in aerospace, automotive, marine, and structural engineering.

Unit – I	Introduction, Lamina Constitutive Equations & Manufacturing	9 Periods
Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes		
Unit – II	Flat plate laminate constitute equations	9 Periods
Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.		
Unit – III	Lamina Strength Analysis	9 Periods
Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure		
Unit – IV	Thermal Analysis	9 Periods
Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi- Isotropic Laminates		
Unit – V	Analysis of Laminated Flat Plates	9 Periods



Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations
- Natural Frequencies

Text Books:	1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990. 2. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984. 3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
Reference Books:	1. Mallick, P.K., Fiber, "Reinforced Composites: Materials, Manufacturing and Design", Manel Dekker Inc, 1993. 2. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munich, 1990. 3. R.M. Jones, "Mechanics of Composite Materials", 2nd Edition, Taylor & Francis, 1999 4. L.R. Calcote, "Analysis of laminated structures", Van Nostrand Reinhold Co., 1989. 5. Autar K. Kaw, Mechanics of Composite Materials, CRC Press LLC, 1997 6. G.Lubin, "Hand Book on Fibre glass and advanced plastic composites", Van Nostrand Co., New York, 1989.
MOOC/Web Platforms:	NPTel Videos: https://nptel/courses/video/112105126/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Summarize the various types of Fibers, Equations and manufacturing methods for Composite materials	Understanding (BL 2)
CO2	Derive Flat plate Laminate equations	Applying (BL 3)
CO3	Analyze Lamina strength	Applying (BL 3)
CO4	Analyze the thermal behavior of Composite laminates	Applying (BL 3)
CO5	Analyze Laminate flat plates	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	1	1	-	-	2	1	1	1	-	-	1	1	2
CO-2	3	1	1	-	-	2	1	1	1	-	-	1	1	2



CO-3	3	1	1	-	-	2	1	1	1	-	-	1	1	2
CO-4	3	1	1	-	-	2	1	1	1	-	-	1	1	2
CO-5	3	1	1	-	-	2	1	1	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓							✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME63 Electrical Drives and Controls

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To learn the basic concepts of different types of electrical machines and their performance
2.	To study the different methods of starting D.C motors and induction motors
3.	To study the conventional and solid-state drives
4.	To study the conventional and solid-state speed control of D.C. drives
5.	To study the conventional and solid-state speed control of A.C. drives

III - Course Content

Preamble: The subject Electrical Drives and Control focuses on the study of electrical machines, power electronics, and control systems used for motion control in industrial applications. It provides fundamental knowledge of various types of drives, their operating principles, characteristics, and performance analysis. The course emphasizes speed control, torque management, and selection of appropriate drives for different mechanical loads. It also covers modern control techniques and automation concepts to improve efficiency and reliability. This subject prepares students to design, operate, and maintain efficient drive systems for sustainable industrial growth.

Unit – I	Introduction	9 Periods
Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors		
Unit – II	Drive motor characteristics	9 Periods
Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors and its application.		
Unit – III	Starting Methods	9 Periods
Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors		
Unit – IV	Conventional and Solid-State Speed Control of D.C. Drives	9 Periods
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers – applications.		
Unit – V	Conventional and Solid-State Speed Control of A.C. Drives	9 Periods
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.		

Text Books:	1. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2006 2. Vedam Subrahmaniam, “Electric Drives (Concepts and Applications)”, Tata McGraw-Hill, 2010 3. Partab. H., “Art and Science and Utilisation of Electrical Energy”, Dhanpat Rai and Sons, 2017
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Reference Books:	1. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2012 2. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.
MOOC/Web Platforms:	1. NPTEL Videos: https://nptel/courses/video/112105126/L01.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Discuss the basic concepts of different types of electrical machines and their performance.	Understanding (BL 2)
C02	Explain the different methods of starting D.C motors and induction motors	Applying (BL 3)
C03	Discuss the conventional and solid-state drives	Applying (BL 3)
C04	Describe the conventional and solid-state speed control of D.C. drives	Applying (BL 3)
C05	Explain the conventional and solid-state speed control of A.C. drives	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	1	1	-	-	2	1	1	1	-	-	1	1	-
CO-2	3	1	1	-	-	2	1	1	1	-	-	1	1	-
CO-3	3	1	1	-	-	2	1	1	1	-	-	1	1	-
CO-4	3	1	1	-	-	2	1	1	1	-	-	1	1	-
CO-5	3	1	1	-	-	2	1	1	1	-	-	1	1	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓						✓	✓

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME64 Power Plant Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To study the coal based thermal power plants.
2.	To study the diesel, gas turbine and combined cycle power plants.
3.	To learn the basic of nuclear engineering and power plants.
4.	To learn the power from renewable energy
5.	To study the alternative energy power systems.

III - Course Content

Preamble: This course introduces the principles, components, and operations of various power generation systems including thermal, diesel, gas turbine, nuclear, renewable, and alternative energy plants. Emphasis is placed on system layout, site selection, efficiency, and environmental considerations, preparing students for the evolving energy sector.

Unit – I	Thermal Power Plants	9 Periods
Layout of modern coal power plant - site selection criteria, Super Critical Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Binary Cycles and Cogeneration systems. Pollution control technologies including Waste Disposal.		
Unit – II	Diesel, Gas Turbine and Combined Cycle Power Plants	9 Periods
Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.		
Unit – III	Nuclear Power Plants	9 Periods
Layout and subsystems of Nuclear Power Plants- site selection criteria, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants - Pollution control technologies.		
Unit – IV	Renewable Energy System	9 Periods
Hydro Electric Power Plants – site selection criteria - Classification, Typical Layout and associated components including Turbines. Principle, Construction, site selection criteria, and working of: Wind Energy Systems, Tidal Energy Systems, Solar Energy Systems, Solar Photo Voltaic (SPV), Solar Thermal		
Unit – V	Alternative Energy Power Systems	9 Periods
Principle, Construction, site selection criteria, and working of: Geothermal Power Systems - Biogas Power Systems - Fuel Cell Power Systems		



Text Books:	1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2018.
Reference Books:	1. A Textbook of Power Plant Engineering by R.K. Rajput 1 January 2016 2. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar 1 November 2019
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/105/112105212/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Explain the layout, construction and working of the components inside a thermal power plant.	Applying (BL 2)
C02	Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants	Applying (BL 2)
C03	Explain the layout, construction and working of the components inside nuclear power plants.	Applying (BL 2)
C04	Explain the layout, construction and working of the components inside Renewable energy power plants.	Applying (BL 2)
C05	Explain the layout, construction and working of the alternative energy power systems	Applying (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	1	-	-	1	-	-	-	-	2	3	-
CO-2	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-3	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-4	3	3	2	1	-	-	1	-	-	-	-	2	3	-
CO-5	3	3	2	1	-	-	1	-	-	-	-	2	3	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓	✓	✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME65 Refrigeration and Air- Conditioning

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1.	To learn Quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally
2.	To Analyzing factors behind energy billing and applying the concept of demand side management for lowering energy costs
3.	To learn Computing the stoichiometric air requirement for any given fuel and quantifying the energy losses associated with thermal utilities of industries
4.	To Diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency
5.	To Applying CUSUM and other financial evaluation techniques to estimating the accruable energy savings/monetary benefits for any energy efficiency project

III - Course Content

Preamble: Refrigeration and Air Conditioning is essential for preserving goods, providing comfort and supporting industrial processes. It focuses on thermodynamic principles, heat transfer, and the operation of cooling systems. The subject covers the design, analysis, and maintenance of refrigeration and HVAC systems. Emphasis is placed on energy efficiency, eco-friendly refrigerants, and sustainability. It prepares students for modern challenges in cooling and environmental control technologies..

Unit – I	Introduction	9 Periods
Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP		
Unit – II	Vapour Compression Refrigeration System	9 Periods
Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system - low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators		
Unit – III	Other Refrigeration Systems	9 Periods
Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic- Vortex and Pulse tube refrigeration systems		
Unit – IV	Psychrometric Properties and Processes	9 Periods
Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature		



Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

Unit – V	Air Conditioning Systems and Load Estimation	9 Periods
Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.		

Text Books:	1.Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010. 2. ASHRAE Hand book, Fundamentals, 2010 3.Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007 4. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009
Reference Books:	1.Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986. 2.Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/112/105/112105212/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the basic concepts of Refrigeration	Applying (BL 2)
CO2	Explain the Vapor compression Refrigeration systems and to solve problems	Applying (BL 2)
CO3	Discuss the various types of Refrigeration systems	Applying (BL 2)
CO4	Calculate the Psychrometric properties and its use in psychrometric processes	Applying (BL 2)
CO5	Explain the concepts of Air conditioning and to solve problems	Applying (BL 2)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	2	2	1	-	-	1	-	-	-	-	2	3	1



COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-2	3	3	2	1	-	-	1	-	-	-	-	2	3	1
CO-3	3	3	2	1	-	-	1	-	-	-	-	2	3	1
CO-4	3	3	2	1	-	-	1	-	-	-	-	2	3	1
CO-5	3	3	2	1	-	-	1	-	-	-	-	2	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	✓	✓		✓		✓	✓	✓

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



[Signature]

Chairperson - Board of Studies,
Department of Mechanical Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul 624401

I – Course Code & Name: 23PME66 Turbo Machines

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To study the energy transfer in rotor and stator parts of the turbo machines.
2	To study the function of various elements of centrifugal fans and blowers.
3	To evaluating the working and performance of centrifugal compressor
4	To analyzing flow behavior and flow losses in axial flow compressor
5	To study the types and working of axial and radial flow turbines.

III - Course Content

Preamble: This course provides an overview of Introduction to Turbo machineries, Centrifugal Fans and Blowers, Centrifugal Compressor, Axial Flow Compressor, Axial and Radial Flow Turbines.		
UNIT-I	Working Principles	9 Periods
Introduction to Turbo machineries: turbines, pumps and compressors, fans and blowers, compressible flow machines, incompressible flow machines Energy transfer between fluid and rotor-classification of fluid machinery, dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.		
UNIT -II	Centrifugal Fans and Blowers	9 Periods
Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.		
UNIT-III	Centrifugal Compressor	9 Periods
Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.		
UNIT-IV	Axial Flow Compressor	9 Periods
Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.		
UNIT-V	Axial and Radial Flow Turbines	9 Periods
Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.		

TEXT BOOKS	1. Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011. . 2. Yahya, S.M., "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2011.
REFERENCES	1. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.



	2. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7th Edition, ButterworthHeinemann, 2014.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc21_me127/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the energy transfer in rotor and stator parts of the turbo machines.	Understand (BL 2)
CO2	Explain the function of various elements of centrifugal fans and blowers	Understand (BL 2)
CO3	Evaluate the working and performance of centrifugal compressor.	Evaluate (BL 5)
CO4	Analyze flow behavior and flow losses in axial flow compressor.	Analyze (BL 4)
CO5	Explain the types and working of axial and radial flow turbines	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	1	-	-	-	-	1	-	-	1	3	2
CO-2	2	1	1	1	-	-	-	-	1	-	-	1	3	2
CO-3	2	1	1	1	-	-	-	-	1	-	-	1	3	2
CO-4	2	1	1	1	-	-	-	-	1	-	-	1	3	2
CO-5	2	1	1	1	-	-	-	-	1	-	-	1	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME67 Non-Traditional Machining Processes

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To classify non-traditional machining processes and describe mechanical energy based nontraditional machining processes.
2	To differentiate chemical and electro chemical energy-based processes.
3	To describe thermo-electric energy-based processes.
4	To explain nano finishing processes.
5	To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

III - Course Content

Preamble: This course introduces Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring, EDM, WEDM, EBM, Nano Finishing Processes, High Energy Machining Processes.

UNIT-I	Introduction and Mechanical Energy Based Processes	9 Periods
Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT-II	Chemical and Electro Chemical Energy Based Processes	9 Periods
Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.		
UNIT-III	Thermoelectric Energy Based Methods	9 Periods
Electrical Discharge Machining (EDM) - Principle, Equipment, dielectric fluid, electrode, process parameters, capabilities, design considerations and summary. Wire cut Electrical Discharge Machining (WEDM) – Working principle, Equipment, process parameters, capabilities and applications. Electron Beam Machining (EBM) - Principle, Equipment, process parameters & capabilities, Comparison, Selection of suitable method based on the requirement.		
UNIT-IV	Nano Finishing Processes	9 Periods
Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.		
UNIT-V	High Energy Machining Processes	9 Periods
Laser Beam Machining (LBM) - Working principle, Equipment, process parameters & capabilities. Ion Beam Machining (IBM) - Principle, Equipment, process parameters & capabilities. Plasma Beam Machining (PBM) - Principle, Equipment, process parameters & capabilities. Comparison, Selection of suitable method based on the requirement.		



TEXT BOOKS	1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458 2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.
REFERENCES	1. Jagadeesha T., "", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2020, ISBN-13: 978-9385909122. 2. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2019, ISBN-13: 978-1575373256.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc21_me05/preview 2. https://www.udemy.com/course/non-traditional-manufacturing/?srsltid=AfmBOooOHFGdUKSMoINDwkvuONmgBSaFRsOic9WKxGVs8soEtntAFXiE

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes..	Apply (BL 3)
CO2	Illustrate chemical and electro chemical energy based processes.	Understand (BL 2)
CO3	Evaluate thermo-electric energy based processes.	Evaluate (BL 5)
CO4	Interpret nano finishing processes.	Understand (BL 2)
CO5	Analyse hybrid non-traditional machining processes and differentiate non-traditional machining processes.	Analyze (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	-	1	-	1	-	1	-	1	1	-	1	2	2
CO-2	3	-	1	-	1	-	1	-	1	1	-	1	2	2
CO-3	3	-	1	-	1	-	1	-	1	1	-	1	2	2
CO-4	3	-	2	-	1	-	1	-	1	1	-	1	2	2
CO-5	3	-	3	-	3	-	1	-	1	1	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)




 Chairperson - Board of Studies,
 Department of Mechanical Engineering,
 NPR College of Engineering & Technology
 (Autonomous),
 Natham, Dindigul 624401

I – Course Code & Name: 23PME68 Thermal Power Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To study the fuel properties and arrive at proximate and ultimate analysis of fuels.
2	To study the different types of boilers and compute their performance parameters.
3	To study the performance parameters of an air compressor
4	To study the working principles of various refrigeration systems and perform cop calculations.
5	To study the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads

III - Course Content

Preamble: This course introduces fuel properties, different types of boilers and compute their performance parameters, performance of air compressor, principles of refrigeration systems, psychrometric properties

UNIT-I	Fuels and Combustion	9 Periods
Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis – Proximate and Ultimate Analysis - Moisture Determination - Calorific Value -Gross & Net Calorific Values		
UNIT-II	Boilers	9 Periods
Types and comparison, Mountings and Accessories. Performance calculations, Boiler trial.		
UNIT-III	Air Compressors	9 Periods
Brayton cycle - Open cycle gas turbine - Closed cycle gas turbine - Regeneration - Inter cooling and reheating between stages		
UNIT-IV	Refrigeration Systems	9 Periods
Refrigeration Cycles - Vapour compression cycles - Cascade system – Vapour absorption cycles - GAX Cycle		
UNIT-V	Psychrometry and Air-Conditioning	9 Periods
Psychrometric properties – Property calculations using Psychrometric chart and expressions. Psychrometric processes – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing Air conditioning systems, concept of RSHP, GSHP and ESHP, Cooling load calculations. Cooling towers – concept and types		
TEXT BOOKS	1. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010. 2. Ballaney. P, “ Thermal Engineering”, 25th Edition, Khanna Publishers, 2017	



[Signature]
 Chairperson - Board of Studies,
 Department of Mechanical Engineering,
 NPR College of Engineering & Technology
 (Autonomous),
 Natham, Dindigul 624401

REFERENCES	1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2018 2. Arora, "Refrigeration and Air-Conditioning", 2nd Edition, Prentice Hall of India, 2019. 3. Nag P.K, "Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill, 2015 4. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2016
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc23_me31/preview 2. https://www.edx.org/learn/engineering/massachusetts-institute-of-technology-thermal-fluids-1 3. https://www.coursera.org/courses?query=thermodynamics

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Evaluate the fuel properties and arrive at proximate and ultimate analysis of fuels	Evaluate (BL 5)
CO2	Analyze different types of boilers and compute their performance parameters.	Analyse (BL 4)
CO3	Evaluate the performance parameters of an air compressor	Evaluate (BL 5)
CO4	Apply the working principles of various refrigeration systems and perform cop calculations	Apply (BL 3)
CO5	Analyze the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads.	Analyse (BL 4)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	1	1	1	-	-	-	-	1	-	-	1	2	1
CO-2	3	2	1	1	-	-	-	-	1	-	-	1	2	1
CO-3	3	1	1	1	-	-	-	-	1	-	-	1	2	1
CO-4	3	2	1	1	-	-	-	-	1	-	-	1	2	1
CO-5	3	1	1	1	-	-	-	-	1	-	-	1	2	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



Chairperson - Board of Studies,
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Natham, Dindigul - 624401

I – Course Code & Name: 23PME69 Design for Manufacturing

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
2	To learn design consideration principles of forming in the design of extruded, stamped, and forged products.
3	To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
4	To learn design consideration principles of welding in the design of welded products.
5	To learn design consideration principles of assembly in the design of assembled products.

III - Course Content

Preamble: This course introduces design of cast products, design of extruded, stamped, and forged products, design of turned, drilled, milled, planed, shaped, slotted, and ground products, design of welded products, design of assembled products.		
UNIT-I	Introduction	9 Periods
Tolerance Analysis: Process capability, process capability metrics, Tolerance – cost aspects, feature tolerances, geometric tolerances, relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerances – sure fit law, normal law and truncated normal law.		
UNIT-II	Casting	9 Periods
Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.		
UNIT-III	Forming and Machining	9 Periods
Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts. Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.		
UNIT-IV	Welding	9 Periods
Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.		
UNIT-V	Assembly	9 Periods
Principles of Design for Assembly, Minimize Part Count, Standardization and Minimize Part Variety, Design guidelines for manual assembly, DFA analysis, DFA index, Design for Automated Assembly. Introduction to usage of DFMA software.		



TEXT BOOKS	1. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill, 1986. 2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.
REFERENCES	1. CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001. 2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004. 3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014. 4. Henry Peck, "Designing for Manufacture", Sir Isaac Pitman & Sons Ltd., 1973. 5. Matousek, "Engineering Design", Blackie & Sons, 1956.
MOOC/Web Platforms:	1. https://nptel.ac.in/courses/107103012 2. https://www.udemy.com/course/manufacturing-process-selection-and-design-for-manufacturing/

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.	Understand (BL 2)
CO2	Explain design consideration principles of forming in the design of extruded, stamped, and forged products.	Understand (BL 2)
CO3	Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.	Understand (BL 2)
CO4	Explain design consideration principles of welding in the design of welded products.	Understand (BL 2)
CO5	Explain design consideration principles of assembly in the design of assembled products.	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	3	1	-	-	-	-	-	-	-	1	2	2
CO-2	3	3	3	1	-	-	-	-	-	-	-	1	2	2
CO-3	3	3	3	1	-	-	-	-	-	-	-	1	2	2
CO-4	3	3	3	1	-	-	-	-	-	-	-	1	2	2
CO-5	3	3	3	1	-	-	-	-	-	-	-	1	2	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



Chairperson - Board of Studies,
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I – Course Code & Name: 23PME70 Power Generation Equipment Design

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To introduce the power generation equipments types layouts working cycles.
2	To learn the fuels, combustion and burning methods of combustion system.
3	To study the various boilers and its boilers parts of steam power plant.
4	To study the basics of nuclear fuels and reactor classification.
5	To study of techno economics and operating cost and safety of power plant.

III - Course Content

Preamble: A comprehensive course designed to provide updated knowledge and practical insights into steam power plant, fuels and combustion, solar energy, gas turbine power plant, power plant economics.

UNIT-I	Steam Power Plant	9 Periods
Layout, Working, coal handling, fuel firing, grate firing and pulverized fuel firing, Modeling of thermal equipment - heat exchangers, evaporators, condensers, turbomachines, distillation equipment. Absorber, generator.		
UNIT-II	Fuels and Combustion	9 Periods
Fuels, combustion and burning methods - Fuel classification - Solid, liquid and gaseous - Compositions and heating values - Classification of coal - Combustion process, atmosphere and control - ESP Furnace construction - Stokers - suspension firing - pulverised fuel firing - oil and gas burners and systems - Fuel control - Burner management system.		
UNIT-III	Solar Energy	9 Periods
Solar Radiations and solar angles - latitude angle, declination angle, hour angle, zenith angle - Solar flat plate and concentrating type collectors performance analysis. Solar pond, Solar Still. Solar Thermal Power Plant, Photo Voltaic Cell.		
UNIT-IV	Gas Turbine Power Plant	9 Periods
Layout of open and closed cycle plants- working, components and accessories Fuels and combustion chamber Performance analysis with reheating and regeneration working of combined gas turbine and steam power plants.		
UNIT-V	Power Plant Economics	9 Periods
Load curve - Average and Peak load Plant capacity factor and utilization factor - Cost of power generation - Selection of peak and base load power plant - Emission Regulations.		



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TEXT BOOKS	1. Power Plant Engineering - PK Nag 2. A Textbook of Power Plant Engineering - Rajput
REFERENCES	1. Basics of Boiler and HRSG Design - Brad Buecker 2. Steam Plant Operation-Everett B. Woodruff, Herbert B. Lammers, Thomas F. Lammers 3. Nuclear Power Plant Design and Analysis Codes Development Validation and Application 2020 Edition by Jun Wang, Xin Li, Chris Allison, Judy Hohorst, Elsevier 4. A Techno-Economic Analysis of Solar Thermal Power Plant by Malik Monu and Saini R P 8 November 2012 5. Power Plant Engineering by Dilip Vairagkar 1 January 2019
MOOC/Web Platforms:	1. https://www.coursera.org/learn/electrical-power-generation-an-industrial-outlook 2. https://www.udemy.com/course/power-generation-power-plants-and-turbines/

IV – Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss the power generation equipments types layouts working cycles.	Understand (BL 2)
CO2	Explain the fuels, combustion and burning methods of combustion system.	Understand (BL 2)
CO3	Discuss the various boilers and its boilers parts of steam power plant.	Understand (BL 2)
CO4	Explain the basics of nuclear fuels and reactor classification.	Understand (BL 2)
CO5	Discuss of techno economics and operating cost and safety of power plant	Understand (BL 2)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	1	-	-	2	-	1	-	-	1	1	2
CO-2	2	1	1	1	-	-	2	-	1	-	-	1	1	2
CO-3	2	1	1	1	-	-	2	-	1	-	-	1	1	2
CO-4	2	1	1	1	-	-	2	-	1	-	-	1	1	2
CO-5	2	1	1	1	-	-	2	-	1	-	-	1	1	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME71 Dynamics of Ground Vehicles

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To Develop physical and mathematical models
2	To predict the the dynamic response of vehicles
3	To understand Tire Mechanics and Modeling
4	To understand Vertical Dynamics and NVH
5	To understand Lateral and Vehicle Handling Dynamics

III - Course Content

Preamble: This course covers Vehicle motion dynamics, Vibration measuring instruments, Rubber properties, Vertical Dynamics and NVH, Lateral and Vehicle Handling Dynamics.

UNIT-I	Introduction to Vehicle Dynamics	9 Periods
Vehicle motion dynamics -Power source, chassis, and powertrain overview - Subsystems and driver interaction - Ride comfort, braking, and turning safety - Fundamentals of mathematical modeling		
UNIT-II	Concept of Vibration	9 Periods
Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Base excitation. Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed		
UNIT-III	Tire Mechanics and Modeling	9 Periods
Rubber properties: slip, grip, and rolling resistance - Tire construction and force development - Contact patch and pressure distribution - Lateral force generation - Ply steer, conicity, and classification of tire models - Magic Formula and combined slip modeling		
UNIT-IV	Vertical Dynamics and NVH	9 Periods
Rollover prevention - Half car and quarter car models - Noise, vibration, and harshness (NVH) in vehicles		
UNIT-V	Lateral and Vehicle Handling Dynamics	9 Periods
Bicycle model and stability - Understeer gradient and state-space approach - Mimuro plot and lateral transient response - Parameters affecting vehicle handling - Subjective and objective evaluation of handling		

TEXT BOOKS	1. J. Y. Wong, "Theory of Ground Vehicles", Fourth Edition, Wiley-Interscience, 2008 2. Singiresu S. Rao, "Mechanical Vibrations," Fifth Edition, Prentice Hall, 2010
REFERENCES	1. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013
MOOC/Web Platforms:	1. https://legacy.sae.org/learn/content/c0414/



2. <https://www.udemy.com/course/fundamental-concepts-of-vehicle-dynamics/>

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Develop physical and mathematical models to predict the dynamic response of vehicles.	Apply (BL 3)
C02	Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response.	Apply (BL 3)
C03	Use dynamic analyses in the design of vehicles.	Analyse (BL 4)
C04	Understand the principle behind the lateral dynamics.	Understand (BL 2)
C05	Evaluate the longitudinal dynamics and control in an automobile.	Evaluate (BL 5)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	3	3	3	3	-	2	2	3	-	3	2	3
CO-2	3	3	3	3	3	3	-	2	2	3	-	3	2	3
CO-3	3	3	3	3	3	3	-	2	2	3	-	3	2	3
CO-4	3	2	2	2	2	2	-	2	1	3	-	3	2	3
CO-5	3	3	3	3	3	3	-	2	2	3	-	3	2	3

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓	✓	-	-	-	-	✓	✓	✓	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



B. N. N.
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I – Course Code & Name: 23PME72 Operational Research

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To learn Selecting the constraints on the availability of resources and developing a model
2	To study Appraising the challenges in the transportation and production problems and
3	To learn Planning the purchase/ manufacturing policies, managing the spares/ stocks and
4	To Analysing the queue discipline and exploring the avenues for better customer service
5	To Investigating the nature of the project and offering methodical assistance towards

III - Course Content

Preamble: This course covers foundational concepts in evolution of Operations Research, CPM and PERT networks, EOQ models, Queueing models.		
UNIT-I	Introduction	9 Periods
Historical evolution of Operations Research, Importance of OR in decision making Processes. Linear programming – Introduction to Linear Programming and Its applications. Graphical Method – Simplex algorithm – Step-by-Step Procedure for solving LP problems Using Simplex. Duality formulation – Economic Interpretation of dual variables. Sensitivity analysis.		
UNIT-II	Transportation and Assignment Models	9 Periods
Transportation Models: Applications in Supply Chain and Logistics, Mathematical Formulation of Transportation Problems, Methods for Solving Transportation Problems. Assignment models: Mathematical formulation, solution methods Traveling Salesman problem – Networks models – Shortest route – Minimal spanning tree - CPM and PERT networks – Critical path scheduling.		
UNIT-III	Inventory Models	9 Periods
Types of Inventories – Economic order quantity (EOQ) models – EOQ models with and without shortage - Quantity discount models – Stochastic inventory models – Multi product models.		
UNIT-IV	Queueing Theory	9 Periods
Queueing models – Single server and multi-server models. Poisson input – Exponential service – Constant rate service - Infinite population.		
UNIT-V	Project Management and Replacement Models	9 Periods
Project Management: Introduction; Guidelines for Networking AOA Diagrams – Problems in Critical Path Method (CPM) & Program Evaluation Review Technique (PERT) – Differences of CPM & PERT. Replacement Problems: Types – Problems in: Determination of Economic Life of an Asset – Problems in: Individual and Group Replacement Policies , Apply OR software.		

TEXT BOOKS	1. Pannerselvam R, "Operations Research", 2nd Edition, PHI, 2009. 2. Hamdy A. Taha, "Operations Research an Introduction", 10th Edition, PHI/Pearson Education, 2017.
REFERENCES	1. Ravindran, Phillips and Solberg, "Operations Research Principles and Practice", 2nd Edition, Wiley India, 2007.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc19_ma29/preview



2. <https://www.udemy.com/course/quantitative-techniques-qt-or-operation-research-or/>

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand basics of mathematical theory and proofs.	Understand (BL 2)
CO2	Apply concepts of finite automata and regular languages.	Apply (BL 3)
CO3	Explain context-free grammar and pushdown automata.	Understand (BL 2)
CO4	Understand principles of information visualization.	Understand (BL 2)
CO5	Design effective visualizations using tools and principles.	Apply (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-2	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-3	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-4	3	2	1	1	-	-	-	-	1	-	-	1	3	2
CO-5	3	2	1	1	-	-	-	-	1	-	-	1	3	2

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
√	√	√	-	-	-	-	√	√	√	-

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



Buy

Chairperson - Board of Studies,
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Natham Dindigul 624401

I – Course Code & Name: 23PME73 Advanced Vehicle Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To provide knowledge on electric vehicle architectures, energy storage technologies, and their performance characteristics.
2	To familiarize students with electric propulsion systems and different types of electric motors used in vehicles.
3	To introduce the concepts of autonomous and connected vehicles, including sensing, communication, and control technologies.
4	To develop understanding of automotive networking systems, bus architectures, and global regulatory requirements.

III - Course Content

Preamble: This course provides an overview of advanced concepts in vehicle design, dynamics, powertrains, and safety systems. It prepares students to understand modern automotive technologies and sustainable mobility solutions.		
Unit – I	Electric Vehicles	9 Periods
EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, social and environmental importance of electric vehicles, impact of modern drive- trains on energy supplies.		
Unit – II	Electric Vehicle Motors	9 Periods
Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, BLDC motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives.		
Unit – III	Autonomous and Connected Vehicles	9 Periods
Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System.		
Unit – IV	Automotive Networking	9 Periods
Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, International regulatory requirements and standards		
Unit – V	On-Board Testing	9 Periods
Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring, Introduction to Cyber-physical system		



Text Books:	1. John G Hayes and G Abaas Goodarzi, Electric Powertrain -, 1st Edition, John Wiley & Sons Ltd., 2-18 2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities, CRC Press, 1st Edition, 2-2-. 3. Dominique Paret, Multiplexed Networks for Embedded Systems, John Wiley & Sons Ltd., 2--7. 4. Hong Cheng, —Autonomous Intelligent Vehicles: Theory, Algorithms & Implementation , Springer, 2-11 Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science, Engineering and Technology: Congressional Policies, Practices and Procedures) by Andrew M Wright and Harrison R Scott 5 September 2-12
Reference Books:	1. Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT 17 July 2--2 2. Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey 1 September 2-11
MOOC/Web Platforms:	1. NPTEL: https://www.youtube.com/playlist?list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr 2. NPTEL: https://digimat.in/nptel/courses/video/1-81-2121/L-1.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Acquire an overview of electric vehicles and their importance in automotive.	Applying (BL 3)
CO2	Discuss the characteristics and the selection of traction motor	Applying (BL 3)
CO3	Comprehend the vehicle-to-vehicle and autonomous technology	Applying (BL 3)
CO4	Explain the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems	Applying (BL 3)
CO5	Be familiar with on-board diagnostics systems.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	-	-	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	-	1	1	-	-	-	-	-	-	-	1	3	1
CO-4	3	2	1	1	-	-	-	-	-	-	-	1	3	1

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME74 Advanced Internal Combustion Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To impart knowledge on the working principles, combustion process, and performance aspects of spark ignition and compression ignition engines.
2	To understand fuel injection systems, combustion chambers, and factors influencing abnormal combustion and knocking.
3	To study emission formation mechanisms, control techniques, and emission regulations for modern engines.
4	To familiarize students with the properties, utilization methods, and engine modifications required for alternative fuels.
5	To introduce advanced combustion concepts and modern powertrain systems including HCCI, RCCI, hybrid and fuel cell vehicles.

III - Course Content

Preamble: This course provides an overview of advanced concepts in vehicle design, dynamics, powertrains, and safety systems. It prepares students to understand modern automotive technologies and sustainable mobility solutions.		
Unit – I	Spark Ignition Engines	9 Periods
Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.		
Unit – II	Compression Ignition Engines	9 Periods
Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviors – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.		
Unit – III	Emission Formation and Control	9 Periods
Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles		
Unit – IV	Alternative Fuels	9 Periods
Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.		



Unit – V	Alternate Combustion and Power Train System	9 Periods
Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles – Fuel Cells.		

Text Books:	1. V. Ganesan, "Internal Combustion Engines", V Edition, Tata McGraw Hill, 2-12. 2. John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill, 1988. 3. B.P. Pundir, "IC Engines Combustion & Emission", Narosa Publishing House, 2-14. 4. Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, Inc., 2-3.
Reference Books:	1. K.K. Ramalingam, "Internal Combustion Engine Fundamentals", SciTech Publications, 2-11. 2. R.B. Mathur and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai & Sons, 2--7 3. Eran Sher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Academic Press, 1998.
MOOC/Web Platforms:	1. NPTEL: https://www.youtube.com/watch?v=VnGH2EScMDE 2. NPTEL: https://www.digimat.in/nptel/courses/video/1121-3262/L16.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the working of Gasoline fuel injection systems and SI combustion.	Applying (BL 3)
CO2	Explain the working of Diesel fuel injection systems and CI combustion	Applying (BL 3)
CO3	Identify the source and measure it; explain the mechanism of emission formation and control methods.	Applying (BL 3)
CO4	Select alternative fuel resources and its utilization techniques in IC engines.	Applying (BL 3)
CO5	Explain advanced combustion modes and future power train systems	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	-	-	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	-	1	1	-	-	-	-	-	-	-	1	3	1
CO-4	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME75 Casting and Welding Processes

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To provide knowledge on solidification behavior, microstructural development, and properties of ferrous cast alloys.
2	To understand the composition, melting practices, grain refinement, and heat treatment of non-ferrous cast alloys.
3	To study the physical metallurgy of welding, including microstructural transformations in weld and heat-affected zones of steels.
4	To impart knowledge on welding metallurgy of alloy steels, stainless steels, and cast irons with emphasis on defects and remedies.
5	To familiarize students with welding practices, challenges, and solutions for non-ferrous alloys such as aluminium, copper, nickel, and titanium.

III - Course Content

Preamble: This course provides fundamental knowledge of cast alloys and their metallurgical characteristics, along with welding metallurgy of ferrous and non-ferrous materials. It equips students with insights into composition control, microstructural evolution, and challenges in joining advanced alloys		
Unit – I	Ferrous Cast Alloys	9 Periods
Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size Super cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure- Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons-family & microstructures-Alloying effects- Malleable Iron, ADI, Charge calculations- Effect of normal elements and alloying elements in steels Compositional aspects and properties of alloy steels-melting procedure and composition control for carbon steels- low alloy steels - stainless steels-composition control- slag-metal reactions-desulphurization dephosphorization, specifications for carbon steels- low alloy steels and stainless steels.		
Unit – II	Non-Ferrous Cast Alloys	9 Periods
Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys- problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings		
Unit – III	Physical Metallurgy of Welding	9 Periods
Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold		



cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.		
Unit – IV	Welding of Alloy Steels and Non-Ferrous Metals	9 Periods
Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions		
Unit – V	Defects, Weldability and Standards	9 Periods
Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes.		

Text Books:	1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2-17. 2. K. Chakrabarthi, 'Casting Technology and Cast Alloys, Prentice Hall, 2--5. 3. ASM International. Handbook Committee, ASM Handbook: Casting. Volume 15, ASM International, 2--8. 4. Baldev Raj, Shankar V, Bhaduri A K, "Welding Technology for Engineers", Narosa Publications, 2--9.
Reference Books:	1. Beeley P, "Foundry Technology" Butterworth-Heinemann, 2--1. 2. R.S.Parmar, 'Welding Engineering and Technology', Khanna Publishers, 2-1- 3. John Campbell, "Casting", Butterworth-Heinemann, 2--3.
MOOC/Web Platforms:	1. NPTEL: https://www.digimat.in/nptel/courses/video/1131-7-92/L-1.html 2. NPTEL: https://onlinecourses.nptel.ac.in/noc25_me128/preview

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the ferrous casting metallurgy and its applications	Applying (BL 3)
CO2	Explain the non-ferrous casting metallurgy and its applications.	Applying (BL 3)
CO3	Explain the ferrous welding metallurgy and its applications.	Applying (BL 3)
CO4	Explain the welding metallurgy of alloy steels and non-ferrous metals and its applications.	Applying (BL 3)
CO5	Identify the causes and remedies of various welding defects; apply welding standards and codes.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	-	-	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	-	1	1	-	-	-	-	-	-	-	1	3	1
CO-4	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME76 Process Planning and Cost Estimation

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To provide knowledge on process planning methods, drawing interpretation, and material evaluation.
2	To familiarize students with selection of production equipment, tooling, jigs, fixtures, and quality assurance methods.
3	To introduce the concepts of cost estimation, elements of costing, and estimation procedures.
4	To develop the ability to estimate production costs for different manufacturing shops, including forging, welding, and foundry.
5	To enable students to calculate machining time for various operations such as turning, drilling, milling, shaping, and grinding.

III - Course Content

Preamble: This course introduces the principles and practices of process planning, production cost estimation, and machining time calculation. It equips students with the skills to plan manufacturing processes efficiently and estimate production costs accurately.		
Unit – I	Introduction to Process Planning	9 Periods
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection		
Unit – II	Process Planning Activities	9 Periods
Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies		
Unit – III	Introduction to Cost Estimation	9 Periods
Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost		
Unit – IV	Production Cost Estimation	9 Periods
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop		
Unit – V	Machining Time Calculation	9 Periods
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.		



Text Books:	1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2--2. 2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995. 3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2--2. 4. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley,1998. 5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", KhannaPublishers 199-.
Reference Books:	1. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2--3. 2. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2--1.
MOOC/Web Platforms:	1. NPTEL: https://www.youtube.com/playlist?list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr 2. NPTEL: https://digimat.in/nptel/courses/video/1-81-2121/L-1.html

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Discuss select the process, equipment and tools for various industrial products.	Applying (BL 3)
CO2	Discuss select the process, equipment and tools for various industrial products.	Applying (BL 3)
CO3	Explain the concept of cost estimation.	Applying (BL 3)
CO4	Compute the job order cost for different type of shop floor.	Applying (BL 3)
CO5	Calculate the machining time for various machining operations.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	-	-	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	-	1	1	-	-	-	-	-	-	-	1	3	1
CO-4	3	2	1	1	-	-	-	-	-	-	-	1	3	1

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME77 Surface Engineering

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	To provide knowledge on surface features, roughness parameters, and friction mechanisms in metals and nonmetals.
2	To study wear mechanisms, wear debris analysis, and theoretical wear models for various materials.
3	To introduce corrosion types, influencing factors, testing methods, and prevention techniques.
4	To familiarize students with surface engineering techniques including PVD, CVD, laser hardening, and advanced coatings.
5	To impart understanding of advanced engineering materials, including alloys, ceramics, polymers, biomaterials, and nanoengineered surfaces.

III - Course Content

Preamble: This course introduces the fundamentals of friction, wear, and corrosion, along with surface engineering techniques and advanced materials. It enables students to understand surface interactions, protective coatings, and material selection for enhanced performance and durability.		
Unit – I	Surfaces and Friction	9 Periods
Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact.		
Unit – II	Wear	9 Periods
Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements		
Unit – III	Corrosion	9 Periods
Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors		
Unit – IV	Surface Treatments	9 Periods
Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy –Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nanoengineered coatings – Other coatings, Corrosion resistant coatings		



Unit – V	Engineering Materials	9 Periods
Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology		

Text Books:	1. G.W.Stachowiak and A.W.Batchelor, "Engineering Tribology", Butterworth-Heinemann, 2--5. 2. S.K.Basu, S.N.Sengupta and B.B.Ahuja,"Fundamentals of Tribology", Prentice Hall of India, 2--5. 3. Fontana G., "Corrosion Engineering", McGraw Hill, 1985. 4. Halling, J. (Editor), "Principles of Tribology ", MacMillan, 1984.
Reference Books:	1. Rabinowicz.E., "Friction and Wear of materials", John Willey & Sons,1995. 2. Williams J.A., "Engineering Tribology", Oxford University Press, 1994. 3. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2--
MOOC/Web Platforms:	1. NPTEL: https://nptel.ac.in/courses/1121-7248 2. NPTEL: https://nptel.ac.in/courses/1131-51-5

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the fundamentals of surface features and different types of friction associated with metals and non-metals	Applying (BL 3)
CO2	Analyze the different types of wear mechanism and its standard measurement	Applying (BL 3)
CO3	Analyze the different types of corrosion and its preventive measures	Applying (BL 3)
CO4	Analyze the different types of surface properties and surface modification techniques	Applying (BL 3)
CO5	Analyze the various types of materials used in the friction and wear applications.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)



[Signature]

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V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	-	-	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	-	1	1	-	-	-	-	-	-	-	1	3	1
CO-4	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I – Course Code & Name: 23PME78 Precision Manufacturing

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	Understand the fundamentals of precision engineering and machining accuracy.
2	Explore conventional and non-conventional micro- and nano-machining techniques.
3	Learn the design principles of precision machines and ultra-precision machine elements.
4	Analyze mechanical and thermal errors in precision manufacturing systems.
5	Master advanced measurement and characterization methods for precision features.

III - Course Content

Preamble: This course delves into the principles and practices of precision engineering, emphasizing micro- and nano-machining techniques, machine design for high-precision manufacturing, error analysis, and advanced measurement methods. It aims to equip students with the knowledge to design and evaluate precision systems and components.

Unit – I	Precision Engineering	9 Periods
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Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.

Unit – II	Precision Machining	9 Periods
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Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micromilling, micro-grinding, Ultra-precision diamond turning, non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.

Unit – III	Machine Design for Precision Manufacturing	9 Periods
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Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.

Unit – IV	Mechanical and Thermal Errors	9 Periods
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Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

Unit – V	Measurement and Characterization	9 Periods
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Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nano features.

Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography

Text Books:	1. Jain, V.K., Introduction to micromachining, Narosa publishers, 2-18 2. Venkatesh V.C., Sudinlzman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2--7. 3. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2--8. 4. Jain, V.K., Micro manufacturing Processes, CRC Press, 2-12.
Reference Books:	1. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2--2. 2. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2-13. 3. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2-5
MOOC/Web Platforms:	1. NPTEL: https://onlinecourses.nptel.ac.in/noc25_me18-/preview 2. NPTEL: https://nptel.ac.in/courses/1121-5231

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Acquire an overview of electric vehicles and their importance in automotive.	Applying (BL 3)
CO2	Discuss the characteristics and the selection of traction motor	Applying (BL 3)
CO3	Comprehend the vehicle-to-vehicle and autonomous technology	Applying (BL 3)
CO4	Explain the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems	Applying (BL 3)
CO5	Be familiar with on-board diagnostics systems.	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-1	3	-	-	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	-	1	1	-	-	-	-	-	-	-	1	3	1



COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-4	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



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I – Course Code & Name: 23PME79 Gas Dynamics and Jet Propulsion

Prerequisites	Program Name	Sem	Category	L	T	P	C
Nil	B.E. – Mechanical Engineering	V / VI / VII	PEC	3	0	0	3

II - Course Objectives

1	Understand the fundamentals of compressible fluid flow, including energy and momentum equations.
2	Analyze isentropic flows through variable area ducts, such as nozzles and diffusers.
3	Examine the behavior of compressible flows through ducts with heat transfer and friction.
4	Study the formation and properties of normal and oblique shock waves.
5	Explore the principles and performance of jet and space propulsion systems.

III - Course Content

Preamble: This course delves into the principles of compressible fluid dynamics, focusing on isentropic flows, shock waves, and propulsion systems. It encompasses theoretical analyses and practical applications in jet and space propulsion technologies.		
Unit – I	Basic Concepts and Isentropic Flows	9 Periods
Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.		
Unit – II	Compressible Flow Through Ducts	9 Periods
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.		
Unit – III	Normal and Oblique Shocks	9 Periods
Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.		
Unit – IV	Jet Propulsion	9 Periods
Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.		
Unit – V	Space Propulsion	9 Periods
Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.		

Text Books:	1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2-3.
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	2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2-12 3. R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", 2nd edition, Wiley, 2-11. 4. Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", Prentice-Hall of India, 2--7.
Reference Books:	1. Radhakrishnan, E., "Gas Dynamics", Printice Hall of India, 2--6. 2. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965. 3. Babu, V., "Fundamentals of Compressible Flow", CRC Press, 1st Edition, 2--8
MOOC/Web Platforms:	1. https://www.youtube.com/playlist?list=PLwdnzlV3ogoWb_iTQza6Z8dYHR-1qhh- 2. https://www.youtube.com/playlist?list=PLwdnzlV3ogoWEYkr5o3OD4cv5v7ba1-Lm

IV - Course Outcome

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the fundamentals of compressible flow concepts and the use of gas tables.	Applying (BL 3)
CO2	Analyze the compressible flow behaviour in constant area ducts	Applying (BL 3)
CO3	Analyze the development of shock waves and its effects	Applying (BL 3)
CO4	Explain the types of jet engines and their performance parameters	Applying (BL 3)
CO5	Explain the types of rocket engines and their performance parameters	Applying (BL 3)

(Action verb of each CO to be matched with the next mapping table) (For example: if CO-1 uses the High Order Thinking Skills based action verb, then the corresponding PO must be mapped with High Correlation)

V - Mapping Table Mapping of COs with POs and PSOs

COs/ POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	-	-	1	-	-	-	-	-	-	-	1	3	1
CO-2	3	2	1	1	-	-	-	-	-	-	-	1	3	1
CO-3	3	-	1	1	-	-	-	-	-	-	-	1	3	1
CO-4	3	2	1	1	-	-	-	-	-	-	-	1	3	1

COs/ POs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
CO-5	3	-	1	1	-	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)

VI – Teaching Pedagogies (Select appropriate pedagogies)

Chalk & Talk Power Point	Smart Board/ Video	Demo Model	Case Study Video	Google Class room	Flipped Class rooms	Activity based	Tutorial	Project/ Problem based	Assignment/ Group Discussion	Simulation/ Trouble shooting
✓	✓			✓		✓	✓		✓	

(Usage of Teaching Pedagogies based on action verbs of each CO) (For Example: IF CO uses the higher order thinking skills action verbs, then the appropriate teaching methodology chosen for course delivery)



I - Course Name: 23OCS01 Artificial Intelligence and Machine Learning Fundamentals

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Python Programming	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamental concepts, history, and problem-solving strategies of Artificial Intelligence and Machine Learning, along with their real-world applications.
2.	To learn knowledge representation, logical inference, and probabilistic reasoning techniques for handling uncertainty in intelligent systems.
3.	To explore and apply various supervised machine learning algorithms for predictive modeling and data classification.
4.	To analyze and implement unsupervised learning techniques for clustering, dimensionality reduction, and anomaly detection.
5.	To examine real-world applications of AI and ML across domains and understand ethical, explainable, and operational aspects of intelligent systems.

III - Course Content

Unit - I	Introduction to AI and ML	10 Periods
Introduction to AI and ML – History and foundations of AI – Intelligent agents – Problem solving – Search strategies – Uninformed and informed search – Heuristic functions- Introduction to ML types (Supervised, Unsupervised, Reinforcement), Applications of AI in real-world domains.		
Unit - II	Probabilistic Reasoning	8 Periods
Knowledge representation and reasoning – Logic and inference – Propositional and predicate logic – Uncertainty – Bayes Theorem – Rule-based systems-Probabilistic graphical models (Bayesian networks), Fuzzy logic for reasoning.		
Unit - III	Supervised Learning	9 Periods
Machine Learning Algorithms – Linear regression, Logistic regression, KNN, Decision trees, Naive Bayes. Support Vector Machines, Ensemble methods (Bagging, Boosting)		
Unit - IV	Unsupervised Learning	9 Periods
Unsupervised Learning – Clustering techniques: K-means, Hierarchical, DBSCAN – Dimensionality reduction: PCA, LDA-Anomaly detection, Auto encoders.		
Unit - V	AI and ML Applications	9 Periods
AI and ML Applications – Natural Language Processing – Computer Vision – Robotics – Expert systems-AI ethics and governance, Explainable AI (XAI), ML Ops and deployment.		

TOTAL: 45 Periods

Text Books:	1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021. 2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
Reference Books:	1. Tom M. Mitchell, Machine Learning, McGraw Hill, 2022 2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2023 3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2021



	4. Michael Negnevitsky, AI: A Guide to Intelligent Systems, Pearson, 2020 5. Ankur Taly et al., Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, Springer, 2023
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106126/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the principles and history of Artificial Intelligence and Machine Learning.	Understand (K2)
CO2	Apply logic and probabilistic reasoning for knowledge representation.	Apply (K3)
CO3	Apply machine learning algorithms for classification and regression.	Apply (K3)
CO4	Analyze unsupervised learning methods and dimensionality reduction.	Analyze (K4)
CO5	Apply AI/ML techniques in real-world applications and understand responsible AI practices.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO2	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO4	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO5	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OCS02 Fundamentals of Augmented Reality/Virtual Reality

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Python	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental principles of Augmented Reality (AR) and Virtual Reality (VR).
2.	To understand the components, devices, and working mechanisms of immersive technologies.
3.	To gain basic knowledge of 3D visualization, modeling, and simulation concepts.
4.	To explore common toolkits, applications, and interaction techniques used in AR/VR.
5.	To study various applications, challenges, and future trends in AR/VR across engineering fields.

III - Course Content

Unit – I	Introduction to AR and VR Technologies	9 Periods
Overview of Virtual Reality (VR) and Augmented Reality (AR)-Concept of Immersion, Interaction, and Imagination-Difference between VR and 3D Computer Graphics-Benefits and Components of a VR System-Introduction to Immersive Technologies: AR, VR, MR, and XR-Basic Display Systems: Graphics Displays, 3D Trackers, and Sound Displays-Applications of AR/VR in Various Fields		
Unit – II	Basics of 3D Visualization and Modeling	9 Periods
Fundamentals of 3D Object Modeling-Transformation and Kinematics Basics-Overview of 3D Graphics and Game Engines-Object Hierarchies and Viewing the 3D World-Introduction to Physical Modeling and Collision Detection-Force Computation and Interaction Basics		
Unit – III	AR/VR Tools and Interaction Methods	9 Periods
Introduction to VR Programming and Toolkits-WorldToolKit and Java 3D Overview-Basics of Augmented Reality and Computer Vision Concepts-Interaction and Navigation in AR/VR Environments-Gesture Interfaces and Wearable Devices		
Unit – IV	Case Studies and Emerging Trends	9 Periods
Analysis of successful AR/VR applications in gaming, education, healthcare, and retail-Discussion on ethical considerations and challenges in AR/VR-Future directions and research opportunities in AR/VR		
Unit – V	Applications and Future Scope	9 Periods
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.		

TOTAL: 45 Periods

Text Books:	1. Grigore C. Burdea & Philippe Coiffet, <i>Virtual Reality Technology</i> , Wiley-IEEE Press, 2nd Edition, 2003. 2. Alan B. Craig, <i>Understanding Augmented Reality: Concepts and Applications</i> , Morgan Kaufmann, 2013
Reference Books:	1. Steven M. LaValle, <i>Virtual Reality</i> , Cambridge University Press, 2017. 2. Dieter Schmalstieg and Tobias Hollerer, <i>Augmented Reality: Principles and Practice</i> , Addison-Wesley, 2016. 3. Jason Jerald, <i>The VR Book: Human-Centered Design for Virtual Reality</i> , ACM Books, 2016
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106138 https://onlinecourses.nptel.ac.in/noc25_cs87

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamental concepts, principles, and scope of AR and VR technologies.	Understand (K2)
CO2	Identify and describe the key components, devices, and working mechanisms of AR/VR systems.	Apply (K3)
CO3	Explain the basics of 3D visualization, transformation, and object modeling in virtual environments.	Understand (K2)
CO4	Utilize AR/VR toolkits and interaction methods to explore immersive technologies and user interfaces.	Apply (K3)
CO5	Analyze real-world applications, ethical issues, and emerging trends of AR/VR across different engineering domains.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	1
CO2	3	3	2	-	3	-	-	-	-	-	-	-	-	1
CO3	3	2	2	2	3	-	-	-	-	-	-	-	-	1
CO4	3	2	3	2	3	-	-	-	-	-	-	-	-	1
CO5	3	3	3	2	3	2	-	-	2	2	-	2	-	1

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OCS03 Data Science Fundamentals

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basics of Databases	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II – Course Objectives

1.	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.
2.	Analyze and visualize data using statistical and graphical methods to derive insights.
3.	Develop machine learning models for classification, regression, and clustering tasks.
4.	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.
5.	Present analytical findings through dashboards, reports, and interactive visualizations

III – Course Content

Unit – I	Introduction	9 Periods
Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – data preparation – Exploratory Data analysis – build the model – presenting findings and building applications – Data Mining – Data Warehousing – Basic statistical descriptions of Data.		
Unit – II	Data Manipulation	9 Periods
Python Shell – Jupyter Notebook – NumPy Arrays – Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – Data cleaning pipelines – Introduction to Polars.		
Unit – III	Machine Learning	9 Periods
The modeling process – Types of machine learning – Supervised learning – Unsupervised learning – Semi-supervised learning – Classification – Regression – Clustering – Outliers and Outlier Analysis – Feature engineering and selection – Model evaluation metrics.		
Unit – IV	Data Visualization	9 Periods
Importing Matplotlib – Simple line plots – Scatter plots – Density and contour plots – Histograms – Legends – Colors – Subplots – Text and annotation – Customization – Three-dimensional plotting – Geographic visualization with Plotly – Visualization with Seaborn – Interactive dashboards with Plotly and Streamlit.		
Unit – V	Handling Large Data	9 Periods
Problems with large data – Techniques for handling large datasets – Programming tips for large data – Predicting malicious URLs (case study) – Recommender system (case study) – Tools and techniques needed – Research question – Data preparation – Model building – Model monitoring and automation – Scalable ML using PySpark – Working with cloud-based data platforms (e.g., AWS, BigQuery).		

TOTAL: 45 Periods

Text Books:	1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
Reference Books:	1. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III) 69 2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106179/

IV – Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.	Apply (K3)
C02	Analyze and visualize data using statistical and graphical methods to derive insights.	Analyze (K4)
C03	Apply machine learning models for classification, regression, and clustering tasks.	Apply (K3)
C04	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.	Apply (K3)
C05	Present analytical findings through dashboards, reports, and interactive visualizations	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C02	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C03	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C04	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C05	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High




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I – Course Name: 23OCS04 Introduction to Data Structures using Python

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic of Python	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II – Course Objectives

1.	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.
2.	Analyze and visualize data using statistical and graphical methods to derive insights.
3.	Develop machine learning models for classification, regression, and clustering tasks.
4.	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.
5.	Present analytical findings through dashboards, reports, and interactive visualizations

III – Course Content

Unit – I	Abstract Data Types	9 Periods
Data Abstraction: Data Representation – Types of Data Structures – Abstract Data Type ADTs and classes – introduction to OOP – classes in Python – inheritance – namespaces – shallow and deep copying Introduction to analysis of algorithms – asymptotic notations-The Big-O, Omega and Theta notation- Optimizing for optimistic scenarios – Trade- offs between Time and Space		
Unit – II	Linear Structures	9 Periods
Linear ADTs: List – Stack – Queue – Circular Queue – Linked List – Singly Linked List, Doubly Linked List, Circular Linked List -Applications- Expression evaluation, Scheduling Algorithms, Polynomial Evaluation, Josephus Problem		
Unit – III	Sorting and Searching	9 Periods
Bubble sort – selection sort – insertion sort – merge sort – quick sort- Radix sort, Bitonic sort, Cocktail sort, Medians and Order Statistics- Minimum and maximum, Selection in expected linear time, Selection in worst-case linear time, linear search, Interpolation search, Exponential search.		
Unit – IV	Tree Structures	9 Periods
Binary trees- Properties of Binary trees, B-tree, B-Tree definition- Operations on B-Tree: Searching a B-tree, Creating, Splitting, Inserting and Deleting, B+-tree. Threaded binary trees, Leftist trees, Tournament trees, 2-3 tree, Splay tree, Red-black trees, Range trees. Heaps as priority queues, Binary heaps, binomial and Fibonacci heaps, Heaps in Huffman coding, Extendible hashing.		
Unit – V	Graph Structures	9 Periods
Representation of graphs, Topological sorting, Shortest path algorithms- Dijkstra's algorithm, Floyd-Warshall algorithm, Minimum spanning trees – Reverse delete algorithm, Boruvka's algorithm.		

TOTAL: 45 Periods


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Text Books:	1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", An Indian Adaptation, John Wiley & Sons Inc., 2021
Reference Books:	1. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015 2. Rance D. Necaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011 3. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms", Pearson Education, 1983. 4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
MOOC/Web Platforms:	https://nptel.ac.in/courses/106106145/

IV – Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.	Apply (K3)
CO2	Analyze and visualize data using statistical and graphical methods to derive insights.	Analyze (K4)
CO3	Apply machine learning models for classification, regression, and clustering tasks.	Apply (K3)
CO4	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.	Apply (K3)
CO5	Present analytical findings through dashboards, reports, and interactive visualizations	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO2	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO4	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO5	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OCS05 IoT Concepts and Applications

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Electronics Knowledge	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand IoT fundamentals, ecosystem, and evolution.
2.	Understand IoT communication protocols, standards, and middleware.
3.	Learn about IoT network topologies, communication technologies, and cloud integration.
4.	Explore data analytics and AI in IoT applications.
5.	Understand security, ethics, and real-world IoT applications.

III - Course Content

Unit – I	Foundations of IoT History and Evolution of IoT	10 Periods
IoT Ecosystem & Layers: Perception, Network, Middleware, Application - IoT Design Goals, Challenges, and Future Directions - Architectures: oneM2M, IoT World Forum (IoTWF), Fog & Edge Computing - Functional Blocks of IoT Systems - Smart Objects: Sensors, Actuators, Embedded Systems Mini Project Idea: Build a "Thing" using basic sensors and Arduino to demonstrate environmental data collection.		
Unit – II	Protocols, Standards and Middleware	8 Periods
Need for Middleware in IoT - RFID, WSN, SCADA, M2M Middleware Architectures - IoT Access Technologies: IEEE 802.15.4, LoRaWAN, NB-IoT - Communication Protocols: MQTT, CoAP, HTTP vs CoAP - Protocol Stack Overview: 6LoWPAN, RPL, 6TiSCH - Interoperability and Resource Management		
Unit – III	Communication and Networking for IoT	9 Periods
IoT Network Topologies: Star, Mesh, Cluster - LPWAN vs WPAN: LoRa, Sigfox, Zigbee, BLE - IPv6, 6LoWPAN, and addressing in Constrained Devices - Routing in IoT: RPL, Mobility Support - Application Layer Communication: Data Aggregation, Dissemination - Cloud Platforms: AWS IoT Core, ThingSpeak Hackathon Task: Design a networked system for smart traffic control using simulated nodes.		
Unit – IV	Data Analytics and AI in IoT	9 Periods
Data Lifecycle in IoT: Collection to Visualization - Real-time Analytics and Edge AI - Data Cleaning, Storage (Cloud vs Edge), and Processing - Machine Learning in IoT: Supervised vs Unsupervised - AI Tools: TensorFlow Lite, TinyML - Big Data Tools: Apache Kafka, Spark Streaming Lab Task: Train a TinyML model on microcontroller to detect gestures or anomalies in sensor data.		
Unit – V	Security, Ethics and Applications	9 Periods
Cybersecurity Challenges in IoT - Secure Communication, Authentication, and Data Privacy - Legal, Ethical, and Environmental Concerns - Real-World Applications: - Smart Cities & Grids - Precision Agriculture - Healthcare Monitoring - Industrial IoT- Smart Retail		

TOTAL: 45 Periods

Text Books:	1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017 2. Samuel Greengard, The Internet of Things, The MIT Press, 2015
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Reference Books:	1. Pethuru Raj, "The Internet of Things: Enabling Technologies..." 2. Arshdeep Bahga, Vijay Madiseti, "IoT: A Hands-on Approach"
MOOC/Web Platforms:	Online tools: Blynk, Node-RED, Firebase, Azure IoT Hub Hardware: ESP32, NodeMCU, Raspberry Pi, DHT11, PIR sensors

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand IoT fundamentals, ecosystem, and evolution.	Understand (K2)
C02	Understand IoT communication protocols, standards, and middleware.	Understand (K2)
C03	Apply IoT network topologies, communication technologies, and cloud integration.	Apply (K3)
C04	Explore data analytics and AI in IoT applications.	Analyze (K4)
C05	Understand security, ethics, and real-world IoT applications.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C02	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C03	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C04	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C05	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High


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I - Course Name: 230CE01 Cartography and GIS

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamental elements of cartography including types of maps, map projections, coordinate systems, and their applications.
2.	To learn the principles of map design, symbolization, color usage, lettering, and the processes involved in map production and reproduction.
3.	To introduce the basic concepts, components, and data models of Geographic Information Systems (GIS), including spatial and attribute data structures.
4.	To explore the methods of spatial data input, georeferencing, coordinate transformations, and understand topological relationships in GIS.
5.	To assess data quality parameters, understand GIS standards and metadata, and learn about spatial data output through maps and graphical representations.

III - Course Content

Unit - I	Elements of Cartography	9 Periods
Definition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents – Map Projections – Shape, Distance, Area and Direction Properties – Perspective and mathematical Projections – Indian Maps and Projections – Map Co-ordinate System – UTM and UPS References.		
Unit - II	Map Design and Production	9 Periods
Map and Mapping concepts -Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.		
Unit - III	Basics of GIS	9 Periods
Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models.		
Unit - IV	Data Input and Topology	9 Periods
Scanner – Raster Data Input – Raster Data File Formats – Georeferencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology - Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.		



Unit - V	Data Quality and Output	9 Periods
Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.		
TOTAL: 45 Periods		

Text Books:	1. Arthur H. Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002. 2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017. 3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.
Reference Books:	1. John Campbell, "Introductory Cartography", Wm. C.Brown Publishers, 3rd Edition, 2004 2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883
MOOC/Web Platforms:	https://www.my-mooc.com/en/categorie/gis https://www.my-mooc.com/en/mooc/fundamentals-of-gis

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand map types, scales, projections, and coordinate systems used in cartography.	Understand (K2)
CO2	Apply map design principles, symbolization, and transformation techniques for map production.	Apply (K3)
CO3	Explain GIS components, data types, and spatial data models.	Understand (K2)
CO4	Perform data input, georeferencing, and establish topology in GIS.	Apply (K3)
CO5	Assess GIS data quality and generate spatial outputs using standards and metadata.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	-	-	3	-	-	-	-	2	-	1	-	-
CO2	3	1	-	-	3	-	-	-	-	2	-	1	-	-
CO3	3	1	-	-	3	-	-	-	-	2	-	1	-	-
CO4	3	1	-	-	3	-	-	-	-	2	-	1	-	-
CO5	3	1	-	-	3	-	-	-	-	2	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High



Blue
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I- Course Name: 23OCE02 Environment, Health and Safety

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the need for EHS systems in workplaces and interpret international and national EHS regulations, policies, and ergonomics principles
2.	To learn occupational health hazards, exposure pathways, and apply appropriate control measures including personal protective equipment.
3.	To understand safety features in workplace design and implement safety systems for physical, chemical, and construction-related hazards.
4.	To be familiarize with workplace hazards, conduct job safety analyses, and develop effective risk management and emergency response plans.
5.	To understand and apply the components of an EHS management system based on national and international standards like BIS and ISO 45001.

III - Course Content

Unit – I	Introduction	9 Periods
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives - Ergonomics.		
Unit – II	Occupational Health and Hygiene	9 Periods
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria.		
Unit – III	Workplace Safety and Safety Systems	9 Periods
Features of Satisfactory and Safe design of work premises – good housekeeping - Training methods and strategies -types of training. Evaluation and review of training -lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels.		
Unit – IV	Hazards and Risk Management	9 Periods
Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies.		
Unit – V	Environmental Health and Safety Management	9 Periods
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – Bureau of Indian standards on safety and health 14489 - 1998 and 15001 - ISO 45001-Strucure and Clauses-Case Studies.		

TOTAL: 45 Periods



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Text Books:	1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India 2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
Reference Books:	1. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007. 2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005. 3. Environmental and Health and Safety Management by Nicholas P.Chermisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
MOOC/Web Platforms:	https://www.coursera.org/courses?query=environmental%20health https://moocs.anuonline.ac.in/quality-health-safety-environment.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the need for EHS in industries and related Indian regulations.	Understand (K2)
C02	Identify workplace health hazards and apply assessment and control methods.	Understand (K2)
C03	Analyze safety systems used in industrial environments.	Apply (K3)
C04	Prepare emergency plans and conduct accident investigations.	Apply (K3)
C05	Understand EHS Management System and its key elements.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C02	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C03	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C04	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C05	3	-	-	-	1	2	3	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



I – Course Name: 23OCE03 Environmental Impact Assessment

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals, historical development, and legal aspects of Environmental Impact Assessment (EIA).
2.	To apply methodologies and analytical tools for environmental impact prediction and evaluation.
3.	To assess socio-economic impacts of developmental projects on individuals, families, and communities.
4.	To analyze and propose mitigation measures for impacts on natural, cultural, and economic environments.
5.	To gain practical insights into EIA through real-world industrial and infrastructure case studies.

III - Course Content

Unit – I	Introduction	9 Periods
	Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and Methods of categorization of industries for EIA limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation.–public hearing in EIA- EIA consultant accreditation.	
Unit – II	Components and Quality Analysis	9 Periods
	Matrices networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological -- cumulative impact assessment.	
Unit – III	Socio-Economic Impact Assessment	9 Periods
	Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts communities transition.	
Unit – IV	Prediction, Assessment and Mitigation	9 Periods
	Methods for Prediction and assessment of impacts on Air, Water, Soil and Noise - Biological, Cultural, Social and Economic environments - Standards and guidelines for evaluation - Options for mitigation of impacts - Policies for decision making.	
Unit – V	Case Studies	9 Periods
	Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.	

TOTAL: 45 Periods

Text Books:	1. Morris, P. and Therivel, R., Environmental Impact Assessment: Theory and Practice, 2nd Edition, Routledge, London, 2021. 2. Glasson, J., Therivel, R. and Chadwick, A., Introduction to Environmental Impact Assessment, 5th Edition, Routledge, London, 2019. 3. Fonseca, A. (Ed.), Handbook of Environmental Impact Assessment, Edward Elgar Publishing, Cheltenham, 2022. 4. Morris, P. and Therivel, R., Methods of Environmental Impact Assessment, 4th Edition, Routledge, London, 2020. 5. Gilpin, A. (Ed.), Environmental Impact Assessment: Cutting Edge for the 21st Century, Revised Reprint, Routledge, London, 2020.
Reference Books:	1. Canter, L.W., Environmental Impact Assessment, 2nd Edition, McGraw-Hill, New York, 1996. 2. Lawrence, D.P., Impact Assessment – Practical Solutions to Recurrent Problems and Contemporary Challenges, 2nd Edition, Wiley, New Jersey, 2014. 3. Kolluru, R., Bartell, S., Pitblado, R. and Stricoff, R., Risk Assessment and Management Handbook, McGraw-Hill Inc., New York, 1996.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_ar07/preview 2. https://www.futurelearn.com/courses/environmental-impact-assessment 3. https://cursos.iadb.org/en/topics/management-social-and-environmental-risk/principles-reviewing-environmental-impact-assessments

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the principles, process, and regulatory framework of Environmental Impact Assessment.	Understand (K2)
C02	Apply analytical methods and prediction tools for assessing environmental impacts.	Apply (K3)
C03	Evaluate socio-economic consequences of developmental projects on communities.	Apply (K3)
C04	Recommend suitable mitigation measures and policies for sustainable project development.	Apply (K3)
C05	Analyze real-world case studies to integrate theory with practical EIA applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	-	-	-	-	2	2	-	-	2	-	-	-	-
C02	3	2	3	3	2	-	-	-	-	-	-	2	-	-
C03	-	2	-	-	-	3	2	2	-	2	-	-	-	-
C04	-	-	3	-	-	3	3	3	-	3	2	-	-	-
C05	3	-	3	2	-	2	3	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I- Course Name: 23OCE04 Industrial Waste Water Management

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the sources, characteristics, and environmental impacts of industrial wastewater.
2.	To provide knowledge on regulatory requirements and the importance of pollution prevention and waste minimization in industries.
3.	To familiarize students with various physical, chemical, and biological treatment methods used in industrial wastewater management.
4.	To develop understanding on reuse strategies, residuals management, and zero discharge concepts.
5.	To enable students to analyze real-life case studies and recommend suitable wastewater treatment and pollution control strategies for specific industries.

III - Course Content

Unit – I	Industrial Wastewater Treatment Introduction	8 Periods
Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial		
Unit – II	Industrial Pollution Prevention & Waste Minimization	8 Periods
Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimization. Methods and materials changes – Waste minimization strategies – Zero discharge concept.		
Unit – III	Industrial Wastewater Treatment	10 Periods
Flow and Load Equalization – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation- Removal of Inorganic Constituents – Precipitation, Heavy metal removal, Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Difficulties and Remedial Measures, Rotating Biological Contactors. Suspended Growth Processes		
Unit – IV	Wastewater Reuse and Residual Management	9 Periods
Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse Industrial reuse, Present status and issues. Residuals of industrial wastewater treatments – Individual and common effluent treatment plants.		
Unit – V	Case Studies	10 Periods
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Sugar and Distilleries		

TOTAL: 45 Periods

Text Books:	1. Wastewater Treatment – Concepts and Design Approach, by G L Karia and R A Christian, Prentice Hall of India, 2006 2. Environmental Engineering by Gerard Kiely, McGraw Hill Education (India) Pvt Ltd, 2013 3. Environmental Engineering – A Design Approach by A. P. Sincero and G A Sincero, Prentice Hall of India, 2014
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Reference Books:	1. "Industrial wastewater management, Treatment & disposal, Water Environment" Federation Alexandria Virginia, Third Edition, 2008. 2. Lawrance K. Wang, Yung Tse Hung, Howard H. Lo and Constantine Yapijakis "Handbook of Industrial and Hazardous waste Treatment", Second Edition, 2004. 3. Metcalf & Eddy, Inc., George Tchobanoglous, Franklin L. Burton and H. David Stensel, Wastewater engineering, treatment and reuse, Fourth Edition, McGraw-Hill, 2017 4. Nelson Leonard Nemerow, "industrial waste Treatment", Elsevier, 2007. 5. Wesley Eckenfelder W., "Industrial Water Pollution Control", Second Edition, Mc Graw Hill, 2000. 6. Paul L. Bishop, Pollution Prevention: -Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000. 7. Waste water Treatment for pollution control and reuse by Soli. J. Arceivala, Shyam. R. Asolekar, Tata McGraw Hill, 2007
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc24_ce53/preview https://nptel.ac.in/courses/105105350 https://onlinecourses.nptel.ac.in/noc25_ce116/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Explain the source and types of industrial wastewater and their environmental impacts and choose the regulatory laws pertaining to environmental protection	Understand (K2)
C02	Apply industrial wastewater pollution and implement pollution prevention, waste minimization in industries	Apply (K3)
C03	Apply knowledge and skills to design industrial wastewater treatment schemes	Apply (K3)
C04	Analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques	Analyze (K4)
C05	Apply research to develop effective management systems for industrial wastewater that are technically sound, economically feasible and socially acceptable	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	3	2	2	-	-	-	2	-	-
CO2	3	2	3	2	2	2	2	-	-	-	-	2	-	-
CO3	3	3	3	3	2	3	-	-	-	-	-	3	-	-
CO4	3	2	3	3	3	3	2	-	-	-	-	3	-	-
CO5	3	3	3	3	3	3	2	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High



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I-Course Name: 23OCE05 Remote Sensing Concepts

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To help students understand the basic concepts and components of remote sensing, including the principles of radiation.
2.	To understand how electromagnetic radiation interacts with the Earth's surface and atmosphere.
3.	To learn about different satellite orbits, types of platforms, and the applications of nano-satellites.
4.	To understand how various remote sensors work and their characteristics.
5.	To learn how to use satellite data, interpret images, and apply cloud-based tools like Google Earth Engine for analysis.

III - Course Content

Unit - I	Remote Sensing and Electromagnetic Radiation	9 Periods
Definition – components of Remote Sensing – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods – Electromagnetic Spectrum – Radiation principles – Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive – Radiation Quantities		
Unit - II	EMR Interaction With Atmosphere and Earth Material	9 Periods
Standard atmospheric profile – Main atmospheric regions and their characteristics – Interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil, and water – Solid surface scattering in microwave region – Introduction to drone-based hyperspectral remote sensing and thermal mapping		
Unit - III	Orbits and Platforms	9 Periods
Motions of planets and satellites – Newton's law of gravitation – Gravitational field and potential – Escape velocity – Kepler's laws of planetary motion – Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms – Ground-based, airborne, and spaceborne platforms – Classification of satellites – Sun-synchronous and geosynchronous satellites – Lagrange orbit – Latest nano-satellite applications		
Unit - IV	Sensing Techniques	9 Periods
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites		



Unit - V	Data Products and Interpretation	9 Periods
Photographic and digital products – Types, levels and open source satellite data products – selection and procurement of data– Visual interpretation: basic elements and interpretation keys -Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification - Cloud-based access (Google Earth Engine), and real-time analytics tools		

TOTAL: 45 Periods

Text Books:	1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2015. 2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018
Reference Books:	1. Janza, F.Z., Blue H.M. and Johnson, J.E. Manual of Remote Sensing. Vol.I, American Society of Photogrammetry, Virginia, USA, 2002. 2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995 3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988. 4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2006 Edition II, Wiley Publication

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concepts, components, and radiation principles of remote sensing.	Understand (K2)
CO2	Understand how electromagnetic radiation interacts with the atmosphere and Earth's surface materials.	Understand (K2)
CO3	Understand satellite orbits, different types of platforms, and nano-satellite applications.	Understand (K2)
CO4	Understand the working of different remote sensors and their characteristics.	Understand (K2)
CO5	Understand satellite data types, interpretation methods, and use of cloud tools like Google Earth Engine.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO2	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO3	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO4	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO5	3	1	-	1	1	1	1	-	-	-	-	1	1	-

Mapping: 1-Low, 2-Medium, 3-High

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I - Course Name: 23OEC01 Antenna Fundamentals

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand and analyze key antenna parameters and matching techniques to evaluate antenna performance.
2.	Design and analyze linear and phased antenna arrays for directional radiation control
3.	Learn techniques for accurate measurement of antenna parameters and overcome practical limitations.
4.	Explore the principles and applications of frequency-independent and modern specialized antennas.
5.	Understand antenna requirements and designs for contemporary wireless, satellite, and radar systems.

III - Course Content

Unit - I	Antenna Fundamentals and Radiation	9 Periods
Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature.		
Unit - II	Antenna Arrays	9 Periods
N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased arrays, Adaptive array.		
Unit - III	Antenna Measurements	9 Periods
Drawbacks in measurement of antenna parameters – methods to overcome drawbacks in antenna measurements - measurement ranges - Impedance - Gain - Radiation pattern - Beam width, Radiation resistance - Antenna efficiency - Directivity - Polarization and phase Measurements.		
Unit - IV	Special Antennas	9 Periods
Principle of frequency independent antennas – Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Reflector Antenna, Patch Antenna.		
Unit - V	Antennas for Modern Wireless Communications	9 Periods
Antennas for Terrestrial mobile communication - mobile handsets and base stations. Antennas for Satellite Communication, Radar systems, RFID, MEMS antenna, MIMO antenna.		

TOTAL: 45 Periods

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Reference Books:	1. John D Kraus, "Antennas for all Applications", McGraw Hill, 5th Edition, 2005. R.E. Collin, "Antennas and Radio wave propagation", McGraw Hill, 1985. 2. Constantine. A. Balanis, "Antenna Theory Analysis and Design", Wiley student edition, 3rd Edition, 2009. 3. Annapurna Das and Sisir K Das, Microwave Engineering, Tata McGraw Hill Publishing Company Ltd., New Delhi, Second Edition, 2009 4. Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006 5. S. Drabowitch, "Modern Antennas", Springer Publications, 2nd Edition, 2007 6. Robert S. Elliott, "Antenna theory and Design", Wiley student edition, 2010. 7. H. Sizun, "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Comprehend antenna parameters and the radiation mechanism of simple antennas to complex antenna structures.	Understand (K2)
CO2	Design antennas for given specifications and perform array synthesis.	Apply (K3)
CO3	Elaborate the radiation mechanism of aperture antennas.	Understand (K2)
CO4	Acquire knowledge on the operation of antennas designed for specific applications and the measurement procedures.	Understand (K2)
CO5	Explain the selection of modern antennas for various applications.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High




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I - Course Name: 23OEC02 Consumer Electronics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To provide foundational knowledge of the consumer electronics industry, including classification of products, key components, ergonomic design principles, and power supply technologies.
2.	To understand the working principles and technologies behind modern audio and video systems, including analog/digital formats, display technologies, and streaming media platforms.
3.	To explore the internal architecture and control systems of household appliances, and introduce smart home integration with voice-controlled and energy-efficient technologies.
4.	To examine the role of IoT architecture, wireless communication protocols, and AI/ML in enhancing functionality, connectivity, and intelligence of modern consumer devices.
5.	To impart practical knowledge on safety standards, maintenance, fault diagnosis, and to introduce emerging innovations and sustainable practices in consumer electronics.

III - Course Content

Unit - I	Introduction to Consumer Electronics	9 Periods
Overview of consumer electronics industry- Classification: audio-video-communication-home appliances-Key components and block diagrams-Power supplies and batteries- Ergonomics and design aspects.		
Unit - II	Audio and Video Systems	9 Periods
Microphones-loudspeakers-amplifiers Analog and digital audio systems-Smart TVs-OLED-QLED-Set-top boxes, IPTV, streaming systems- Digital cameras, camcorders- imaging technologies.		
Unit - III	Home and Smart Appliances	9 Periods
Washing machines-microwave ovens- air conditioners-refrigerators-Embedded control systems in appliances-Energy efficiency and inverter technology-Introduction to Smart Homes and connected devices-Voice assistants-Amazon Alexa-Google Assistant.		
Unit - IV	IoT, AI and Communication in Consumer Electronics	9 Periods
IoT architecture and sensors in consumer devices-Wireless standards: Wi-Fi, Zigbee-Bluetooth-NFC AI and ML applications in consumer products- Smartphone technologies and wearable devices- Security-privacy and interoperability.		
Unit - V	Troubleshooting, Maintenance and Emerging Trends	9 Periods
Safety standards, regulations (BIS, IEC, RoHS)-Installation and maintenance practices-Fault diagnosis techniques-E-waste management and green electronics-Emerging trends: foldable tech- 8K- AR/VR- sustainable devices.		

TOTAL: 45 Periods

Reference Books:	1.S.P. Bali, "Consumer Electronics", Pearson Education, 2nd Edition, 2010. 2.R.G. Gupta, "Audio and Video Systems", Tata McGraw-Hill, 2nd Edition, 2010. 3.N.P. Bhatt, "Consumer Electronics: Servicing and Maintenance", McGraw Hill, 2nd Edition, 2010. 4.Robert Sobot, "Wireless Communication Electronics: Introduction to RF Circuits and Design", Springer, 2nd Edition, 2021. 5.Dogan Ibrahim, "Internet of Things with PIC Microcontrollers", Newnes, 1st Edition, 2020
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO 1	Understand the principles and features of audio and video systems used in consumer electronics.	Understand (K2)
CO 2	Explain the operation of home appliances and their subsystems.	Understand (K2)
CO 3	Demonstrate knowledge of digital and smart consumer devices, including IoT-enabled products.	Apply (K3)
CO 4	Apply safety, troubleshooting, and maintenance procedures for consumer electronics.	Apply (K3)
CO 5	Enumerate emerging trends and technologies such as AI, ML, and sustainability in consumer electronics.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



Chairperson - Board of Studies,
 Department of Mechanical Engineering,
 NPR College of Engineering & Technology
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I - Course Name: 230EC03 Display Devices Fundamentals

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamental principles of display systems, human visual perception, and key display parameters.
2.	To explore the structure, operation, and applications of transmissive and reflective displays including LCDs and e-paper.
3.	To study emissive and projection display technologies such as OLED, QLED, CRT, and various projection systems.
4.	To examine near-eye and wearable displays including AR/VR systems, holographic optics, and eye-tracking mechanisms.
5.	To analyze advanced and 3D display technologies including light field, volumetric, autostereoscopic, and touch screen displays.

III - Course Content

Unit - I	Display Fundamentals	9 Periods
Introduction to Displays, Requirements of Displays, Overview of Display Technologies: CRT, Flat Panel, Advanced Displays, Cathode Ray Tube (CRT), Flat Panel Displays, Human Visual System, Colorimetry, Depth Perception and Motion Perception Fundamentals, Fundamental Display Parameters.		
Unit - II	Transmissive and Reflective Displays	9 Periods
Introduction to transmissive Displays, Liquid Crystal Display (LCD), Types of LCD, LED Backlighting in LCDs, Reflective Displays, Electronic Paper (E-Ink), Digital Micromirror Device (DMD), Electrowetting and Electrofluidic Displays, Practical applications of Transmissive and Reflective Displays.		
Unit - III	Emissive and Projection Displays	9 Periods
Emissive Displays, Cathode Ray Tube (CRT), OLED and AMOLED Displays, Quantum Dot LEDs (QLED), Field Emission Displays, Projection Display, Types of Projectors, Holographic Projection, Common Applications of Emissive and Projection Displays.		
Unit - IV	Near-Eye and Wearable Displays	9 Periods
Near-Eye Displays (NED), Head-Mounted Displays (HMD), Combiner Mirrors and Basic Optical Principles, On-Axis and Off-Axis Near-Eye Displays, Smart NEDs and Augmented Reality, Light Field Displays and Holographic NEDs, Contact Lens Displays, Adaptive Displays, Eye Tracking:		
Unit - V	Advanced Display Types and 3D Displays	9 Periods
Introduction to 3D Displays and Their Significance, Spatial and Spectroscopic Displays, Autostereoscopic Displays, Parallax Barrier Displays, Volumetric Displays, Light Field Display, Computer-Generated Holograms (CGH), HDTV and LED Displays, Touch Screen Displays.		

TOTAL: 45 Periods

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Reference Books:	1. R G Gupta, Television Engineering and Video Systems, McGraw Hill, India, 2011 (Second Edition). 2. A Veeralakshmi and R Srivel, "Television and Video Engineering", Ane Books, 2013. 3. E.H. Stupp, M. S. Brennessoltz, "Projection Displays", Wiley, 2008 (Second Edition). 4. Joseph A. Castellano, "Handbook of Display Technology", Elsevier, 1992.
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO 1	Understand and explain the fundamental principles and requirements of various display technologies including CRT, flat panel, and advanced displays.	Understand (K2)
CO 2	Describe the human visual system and its impact on display design, including concepts of colorimetry, depth perception, and motion perception.	Understand (K2)
CO 3	Differentiate transmissive and reflective display technologies such as LCD, E-Ink, DMD, and their practical applications.	Understand (K2)
CO 4	Explain the working principles and applications of emissive and projection displays, including OLED, AMOLED, QLED, and holographic projectors.	Understand (K2)
CO 5	Understand near-eye and wearable displays, advanced 3D display technologies, and their significance in modern electronic systems.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OEC04 Basics of Embedded Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals of embedded systems and the architecture, programming, and features of the 8051 microcontroller.
2.	To understand ARM processor architecture, programming, exceptions, and performance analysis techniques.
3.	To study the architecture and functionalities of the MSP430 microcontroller and its peripheral interfaces.
4.	To explore real-time operating systems, task scheduling, interprocess communication, and multiprocessing in embedded systems.
5.	To analyze embedded system design through real-world applications like vending machines, digital cameras, and USB interfaces.

III - Course Content

Unit - I	Introduction to Embedded Systems and Microcontroller	9 Periods
Introduction to Embedded Systems –Structural units in Embedded processor - selection of processor –8/16 bit Microprocessors – Microcontroller for an Embedded System- 8051 Microcontroller – Architecture, Addressing Modes, Instruction Set.		
Unit - II	ARM Processor	9 Periods
ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.		
Unit - III	MSP430 Microcontroller	9 Periods
Functional Block diagram of MSP-EXP430F5529LP - Memory Mapped CPU, Exceptions, Architecture of MSP430 - Addressing Modes - Instruction Set, Interrupts, Digital in - outs, Timer, Communication interfaces.		
Unit - IV	Processes and Operating Systems	9 Periods
Structure of a real time system, Task Assignment and Scheduling, Multiple Tasks and Multiple Processes, Pre-emptive real time Operating systems, Priority based scheduling, Distributed Embedded Systems, MPSoCs and shared memory multiprocessors.		
Unit - V	Embedded System Applications	9 Periods
Embedded System Design Process – Model train controller, Chocolate Vending Machine, Digital camera, ATM machine and simple USB back channel.		

TOTAL: 45 Periods

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Reference Books:	1. The 8051 Microcontroller: Architecture, Programming, and Applications, Kenneth Ayala, West Publishing Company, 2007 (Unit – I) 2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, 3rd Edition, Morgan Kaufmann, 2012. (Unit – II, IV, V) 3. John H Davies, MSP430 Microcontroller Basics, Elsevier, 2008. Unit – III, V). 4. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013. 5. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education, 2013. 6. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the architecture and features of 8051.	Understand (K2)
CO2	Explain ARM processor architecture and programming concepts.	Understand (K2)
CO3	Explain MSP430 microcontroller's concepts.	Understand (K2)
CO4	Understand the principles of real-time operating systems.	Understand (K2)
CO5	Apply embedded systems programming, design, and development skills.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High




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I - Course Name: 23OEC05 Basics of Nano Electronics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental concepts of nanoelectronics, including quantum effects, nanostructures, and material properties.
2.	To explore bottom-up synthesis techniques for nanomaterials such as sol-gel, CVD, epitaxy, and self-assembly.
3.	To study top-down nanofabrication methods including lithography, ball milling, and vapor phase deposition techniques.
4.	To understand various characterization techniques for nanomaterials including microscopy and spectroscopy tools.
5.	To examine the applications of nanoelectronics in MEMS/NEMS, healthcare, energy, electronics, and transportation sectors.

III - Course Content

Unit - I	Introduction to Nano Electronics	9 Periods
Nano electronics in recent scenario - Crystal Structure -Semiconductors- Band theory- Donors - Acceptors and Deep traps, Mobility - Excitons, Electron confinement - Quantum dots, wires and well, 1D, 2D and 3D Nano structured materials, metal Oxides- Physical, Chemical and Optical properties		
Unit - II	Synthesis of Nano materials - Bottom-up Approaches	9 Periods
Sol-gel, Self-assembled monolayer, Physical and Chemical vapour deposition, thin films, epitaxy-Lithography Top-down Approaches-Grinding, high energy ball milling, Injection molding		
Unit - III	Nano materials - Top-down Approaches	9 Periods
Fundamentals of nano-thin film growth; Vapor phase deposition methods - Physical and chemical vapor phase methods; Langmuir-Blodgett Films; Electrochemical Deposition; laws of electrolysis and deposition		
Unit - IV	Nano materials Characterization	9 Periods
X-ray diffraction, Powder diffraction, Structural analysis, Scanning Electron Microscopy, FESEM, AFM, Transmission Electron Microscope, Spectroscopic techniques: UV-Visible, Infra-red Spectroscopy, rotational, vibrational photo luminescence (PL)		
Unit - V	Applications of Nano Electronics	9 Periods
Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS), Application in Electronics, Medical and Health Care, energy saving and for Transportation		

TOTAL: 45 Periods

Reference Books:	1.Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009 2.Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009 3.Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Understand the basics of nano electronics including quantum wires, dots and wells.	Understand (K2)
CO2	Explain the bottom-up approaches to synthesize the nano materials.	Understand (K2)
CO3	Explain the top-down approaches to synthesize the nano materials.	Understand (K2)
CO4	Identify the nano material characterization method.	Apply (K3)
CO5	Explain the use of nano devices for various applications.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High (Mapping value based on usage of Action verbs in each CO)



I - Course Name: 23OEC06 Fundamentals of Image Processing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic concepts, components, and fundamental steps in digital image processing including image acquisition and representation.
2.	To understand image enhancement techniques in the spatial domain using histogram operations and various spatial filters.
3.	To apply frequency domain techniques for image enhancement and restoration using Fourier transforms and noise reduction filters.
4.	To study color image processing, edge detection, and image segmentation methods for feature isolation and analysis.
5.	To explore image and video compression techniques and introduce basic feature extraction and pattern recognition methods.

III - Course Content

Unit - I	Introduction to Image Processing	9 Periods
Fundamental Steps in Digital Image Processing, Components of Image Processing System Image Acquisition and Sampling Quantization and Resolution. Digital Image Fundamentals - Image Representation (2D functions, pixels) Image Types (Binary, Grayscale, Color), Basic Relationships between Pixels, Neighbors, Connectivity, Distance Metrics. Image File Formats (JPEG, PNG, BMP, TIFF)		
Unit - II	Image Enhancement in the Spatial Domain	9 Periods
Histogram Processing, Histogram Equalization, Matching, Spatial Filtering Smoothing Filters (Mean, Gaussian), Sharpening Filters (Laplacian, Sobel)		
Unit - III	Image Enhancement in the Frequency Domain	9 Periods
Fourier Transform and its Properties, Discrete Fourier Transform (DFT), Filtering in Frequency Domain, Ideal, Butterworth, Gaussian Filters, High-pass and Low-pass Filtering. Image Restoration Model of Image Degradation/Restoration, Noise Models (Gaussian, Salt & Pepper, Speckle), Restoration Techniques, Inverse Filtering, Wiener Filtering.		
Unit - IV	Color Image Processing	9 Periods
Color Models (RGB, CMY, HSV, HSI), Color Transformations, Pseudocolor Image Processing, Full-color Image Processing Color Image Smoothing and Sharpening. Image Segmentation - Point, Line, and Edge Detection, Roberts, Prewitt, Sobel, Canny Thresholding (Global, Adaptive), Region-based Segmentation, Watershed Segmentation		
Unit - V	Image Compression	9 Periods
Need for Compression, Lossless Compression Techniques (Huffman, Run-length), Lossy Compression Techniques (JPEG, Transform Coding), Basics of Video Compression (MPEG) Feature Extraction (SIFT, SURF, HOG), Pattern Recognition Basics		

TOTAL: 45 Periods

Reference Books:	1.Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", Pearson Education, 4th Edition 2.Anil K. Jain, " Fundamentals of Digital Image Processing", Prentice Hall.
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Understand the fundamentals of digital images and image processing systems.	Understand (K2)
CO2	Apply spatial and frequency domain techniques for image enhancement.	Apply (K3)
CO3	Analyze and implement image restoration and noise reduction techniques.	Analyze (K4)
CO4	Perform color image processing and understand color model.	Apply (K3)
CO5	Understand and apply image compression methods.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



Chairperson - Board of Studies,
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I - Course Name: 23OEC07 Internet of Things

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the evolution, architectures, and core functional stack of the Internet of Things including fog, edge, and cloud computing.
2.	To explore the key components of an IoT ecosystem such as sensors, actuators, control units, and communication modules.
3.	To study IoT protocols, wireless sensor networks, and enabling technologies including big data and cloud computing.
4.	To learn IoT deployment and programming on platforms like Raspberry Pi and Arduino, including interfacing and cloud connectivity.
5.	To analyze various IoT applications across smart cities, industry, health, environment, agriculture, and home automation.

III - Course Content

Unit – I	Introduction to Internet of Things	9 Periods
Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT.		
Unit – II	Components in Internet of Things	9 Periods
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units – Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules).		
Unit – III	Protocols and Technologies behind IoT	9 Periods
IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing, Embedded Systems.		
Unit – IV	Open Platforms and Programming	9 Periods
IoT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		
Unit – V	IoT Applications	9 Periods
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture.		

TOTAL: 45 Periods


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Reference Books:	1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017 2. Samuel Greengard, The Internet of Things, The MIT Press, 2015. 3. Perry Lea, "Internet of things for architects", Packt, 2018. 4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012. 5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012. 6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011. 7. ArshdeepBahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO 1	Explain the concept of IoT.	Understand (K2)
CO 2	Understand the communication models and various protocols for IoT.	Understand (K2)
CO 3	Design portable IoT using Arduino/Raspberry Pi /open platform.	Understand (K2)
CO 4	Apply data analytics and use cloud offerings related to IoT.	Analyze (K4)
CO 5	Explain applications of IoT in real time scenario.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High




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I - Course Name: 223OEC08 Sensors and Actuators

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand sensor functions, classifications, calibration methods, and principles of transduction with error analysis.
2.	To study the principles, construction, and applications of variable resistance and inductance sensors like strain gauges and LVDTs.
3.	To explore variable capacitance sensors, piezoelectric, Hall effect, semiconductor sensors, and environmental sensors.
4.	To examine various automotive actuators including electromechanical and fluid-mechanical types and their machine ratings.
5.	To analyze different actuators used in automatic temperature control systems and their operational characteristics.

III - Course Content

Unit - I	Introduction to Measurements and Sensors	9 Periods
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error Propagation of error- Odds and uncertainty- principle of transduction-Classification.		
Unit - II	Variable Resistance and Inductance Sensors	9 Periods
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer and LVDT.		
Unit - III	Variable and other Special Sensors	9 Periods
Variable Resistance Sensors, Variable Capacitance and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.		
Unit - IV	Automotive Actuators	9 Periods
Electromechanical actuators - Fluid - mechanical actuators - Electrical machines - Direct - current machines - Three - phase machines - Single - phase alternating - current Machines - Duty - type ratings for electrical machines.		
Unit - V	Automatic Temperature Control Actuators	9 Periods
Different types of actuators used in automatic temperature control - Fixed and variable displacement temperature control		

TOTAL: 45 Periods


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Reference Books:	1. Ernest O. Doebelin, Dhanesh N.Manik Doebelin's Measurement Systems: 7th Edition (SIE), McGraw Hill Publishers, 2019.
	2. Robert Brandy, "Automotive Electronics and Computer System", Prentice Hall, 2001
	3. William Kimberley, "Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004.
	4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978 - 3 - 658 - 01783 - 5.
	5. James D Halderman, "Automotive Electrical and Electronics", Prentice Hall, USA, 2013
	6. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.
	7. Patranabis.D, "Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd, 2003
	8. William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective", 7th Edition, Elsevier Butterworth - Heinemann Publishers, 2012.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	List common types of sensor and actuators used in vehicles.	Understand (K2)
CO2	Design measuring equipment's for the measurement of pressure force, temperature and flow.	Apply (K3)
CO3	Generate new ideas in designing the sensors and actuators for automotive application.	Apply (K3)
CO4	Understand the operation of the sensors, actuators and electronic control.	Understand (K2)
CO5	Explain temperature control actuators for vehicles.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High




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I - Course Name: 23OEC09 Fundamentals of Wearable Devices

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce wearable devices, their evolution, types, sensors, applications, and industry trends.
2.	To understand physiological and motion data, basic wearable sensors, biological signals, and user interaction techniques.
3.	To explore wireless health systems, body area networks, integration with smartphones/cloud, and security concerns.
4.	To study wearable applications in healthcare, fitness, rehabilitation, and assistive technologies for special needs.
5.	To examine wearable technology in defense, environmental monitoring, smart lifestyles, and advanced wearable robotics.

III - Course Content

Unit - I	Introduction to Wearable Devices	9 Periods
Introduction to wearable devices – Evolution of wearable computing – Types of wearable devices: Smart watches, Fitness trackers, Smart garments, AR/VR devices – Basic classification of wearable sensors – Applications in healthcare, sports, education, safety, and entertainment – Overview of industry trends and future scope.		
Unit - II	Wearable Data and User Interface	9 Periods
Physiological and motion data: heart rate, steps, sleep, temperature – Introduction to basic sensors: Accelerometers, Gyroscopes – Overview of biological signals: ECG, EEG, EMG – Data visualization techniques – User interaction: Haptic feedback, Gesture and Voice control – Mobile app interfaces and feedback system.		
Unit - III	Wireless Health Systems	9 Periods
Wireless technologies: Bluetooth, Wi-Fi, NFC – Overview of Body Area Networks (BAN) – Integration with smartphones and cloud platforms – Wearable system components: Processing units, batteries, displays – Data synchronization and storage – Privacy and security in wearable systems – Popular wearable platforms		
Unit - IV	Healthcare, Fitness and Assistive Applications	9 Periods
Wearable devices in healthcare – ECG, EEG, EMG monitoring – Chronic disease and elderly care – Smart patches and glucose monitoring – Fitness tracking: step count, heart rate, calorie burn – Gait and posture analysis – Physiotherapy and rehabilitation – Assistive wearables for visually and hearing-impaired – Industrial wearables: fatigue sensors, gas detectors, smart helmets.		
Unit - V	Defense, Environment and Smart Lifestyle Applications	9 Periods
Wearables in military and defense – Smart uniforms – Soldier health monitoring – Wearable GPS and tracking – Body-worn cameras – Exosuits and wearable robotics – Environmental monitoring: UV, gas, and pollution – Smart textiles and LED garments – Haptic wearables for VR and gaming – Navigation aids and safety devices for visually impaired, children, and elderly.		

TOTAL: 45 Periods

Reference Books:	1.Ramfis Nieto, "Designing Wearable Systems: Concepts and Implementation", McGraw-Hill, 2019. 2.John A. Rogers and Roozbeh Ghaffari, "Bio-integrated Electronics: Materials, Systems, and Applications", Cambridge University Press, 2019.
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Understand the fundamentals and evolution of wearable technology.	Understand (K2)
CO2	Explain the types of data and sensors used in wearable systems.	Understand (K2)
CO3	Explain the system components and connectivity of wearable devices.	Understand (K2)
CO4	Recognize smart textile concepts and user-centered wearable designs.	Understand (K2)
CO5	Analyze real-world applications and future developments in wearables.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High




 Chairperson - Board of Studies,
 Department of Mechanical Engineering,
 NPR College of Engineering & Technology
 (Autonomous),
 Natham, Dindigul 624401

I - Course Name: 23OEC10 Wireless Sensor Networks

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce wireless sensor networks, their architectures, node components, topologies, and short-range wireless standards.
2.	To study MAC and routing protocols tailored for wireless sensor networks with an emphasis on energy efficiency and performance trade-offs.
3.	To understand the 6LoWPAN architecture and integration of IPv6 in low power and lossy networks including routing and mobility support.
4.	To explore application design issues, QoS requirements, energy management, and middleware protocols in WSNs.
5.	To learn simulation tools and programming frameworks such as TinyOS, NesC, Contiki OS, and their use in WSN development and testing.

III - Course Content

Unit - I	Introduction to Wireless Sensor Networks	9 Periods
Introduction to Wireless Sensor Networks – Motivation, Applications, and Challenges, Comparison with Ad Hoc Networks, Node Architecture – Sensor Node Components, Network Architecture – Types of Topologies, Design Principles, Service Interfaces, and Gateway Concepts, Short Range Wireless Communication Standards: IEEE 802.15.4, Zigbee, Bluetooth, Physical Layer and Transceiver Design Considerations.		
Unit - II	MAC and Routing Protocols	9 Periods
MAC Protocols – Fundamentals, Low Duty Cycle Protocols, Wakeup Concepts Contention and Schedule-Based Protocols – SMAC, BMAC, TRAMA Routing Protocols – Design Requirements, Classification SPIN, Directed Diffusion, LEACH, PEGASIS Routing Metrics and Performance Trade-offs.		
Unit - III	6LoWPAN and IPv6 Integration	9 Periods
6LoWPAN Architecture – Protocol Stack and Adaptation Layer Link Layer Addressing and Routing (Mesh-Under, Route-Over) Header Compression – Stateless & Context-Based Fragmentation and Reassembly Mobility Support: Mobile IPv6, Proxy Mobile IPv6, Proxy Home Agent Routing for Low Power and Lossy Networks – ROLL, Border Routing, MANET Integration		
Unit - IV	Application Design Issues	9 Periods
Application Design Issues – End-to-End, Real-Time Streaming, Publish/Subscribe Web Services and Middleware Protocol Paradigms Common Protocols – MQTT-S, ZigBee CAP, SNMP.		
Unit - V	QoS/Energy Management	9 Periods
Real-time Transport QoS Requirements – Delay, Reliability, Throughput Energy Management – Power-aware MAC and Routing, Battery and Transmission Management Trade-offs Between QoS and Energy Efficiency.		

TOTAL: 45 Periods

Reference Books:	1. Holger Karl, Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2006. 2. Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017. 3. Zach Shelby Sensinode and Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet" John Wiley and Sons, Ltd, Publication, 2009. 4. Philip Levis, "TinyOS Programming", 2006 -www.tinyos.net. 5. The Contiki Operating System. http://www.sics.se/contiki .
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO 1	Design solutions for WSNs applications.	Apply (K3)
CO 2	Develop efficient MAC and Routing Protocols.	Analyze (K4)
CO 3	Design solutions for 6LOWPAN applications.	Apply (K3)
CO 4	Develop efficient layered protocols in 6LOWPAN.	Analyze (K4)
CO 5	Use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High




 Chairperson - Board of Studies,
 Department of Mechanical Engineering,
 NPR College of Engineering & Technology
 (Autonomous),
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I- Course Name: 23OEE01 AI with MATLAB

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To introduce the fundamentals of Artificial Intelligence and its real-world applications.
2.	To familiarize students with the MATLAB environment for AI development.
3.	To develop the ability to implement AI algorithms such as search methods, knowledge representation, and reasoning.
4.	To apply machine learning techniques using MATLAB toolboxes.
5.	To enable students to design and simulate AI-based systems using MATLAB.

III-Course Content

Unit-I	Introduction to AI and MATLAB	9 Periods
Basics of Artificial Intelligence – History, Applications, and Challenges- Overview of MATLAB – Environment, Scripts, Functions - Data handling and visualization in MATLAB - Introduction to MATLAB toolboxes for AI - Simple AI programs using MATLAB.		
Unit-II	Problem Solving and Search Techniques	9 Periods
Uninformed Search: BFS, DFS, Depth-Limited Search - Informed Search: A*, Best-First Search, Heuristic Functions - Constraint Satisfaction Problems - Implementation of search strategies in MATLAB - Case studies using AI search in MATLAB.		
Unit-III	Knowledge Representation and Reasoning	9 Periods
Propositional and Predicate Logic - Rule-Based Systems and Inference Mechanisms - Forward and Backward Chaining - Uncertainty and Probabilistic Reasoning - MATLAB implementation of logical reasoning systems.		
Unit-IV	Machine Learning with MATLAB	9 Periods
Supervised Learning: Regression, Classification - Unsupervised Learning: Clustering Techniques - Dimensionality Reduction and Data Preprocessing - Introduction to MATLAB Machine Learning Toolbox - Case studies: Fault detection, Image classification.		
Unit-V	Neural Networks and Fuzzy Logic Systems	9 Periods
Basics of Artificial Neural Networks (ANNs) - Designing and Training Neural Networks in MATLAB - Introduction to Fuzzy Logic and Fuzzy Inference Systems - Building Fuzzy systems using MATLAB Fuzzy Logic Toolbox - Applications in control systems, prediction, and decision-making.		

TOTAL: 45 Periods

Text Books:	1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach, 4th US edition", Pearson Education, 2022. 2. Phil Kim, MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence: A practical guide for AI and deep learning with MATLAB, Apress, 2017.
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MOOC/Web Platforms:	1. MATLAB Official Documentation (AI & ML Toolboxes) https://www.mathworks.com/products/artificial-intelligence.html 2. MATLAB Tutorials and Examples (MathWorks) https://www.mathworks.com/learn/tutorials/matlab-onramp.html 3. AI Projects in MATLAB – File Exchange https://www.mathworks.com/matlabcentral/fileexchange/ 4. Coursera – Introduction to AI with MATLAB https://www.coursera.org/learn/ai-for-everyone 5. MATLAB and Simulink Training – MathWorks https://www.mathworks.com/services/training.html
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IV-Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO 1	Understand and explain key concepts of Artificial Intelligence and their applications.	Understand (K2)
CO 2	Implement AI techniques including search algorithms and knowledge-based systems using MATLAB.	Apply (K3)
CO 3	Apply machine learning models in MATLAB for classification, clustering, and regression tasks.	Apply (K3)
CO 4	Develop intelligent systems using neural networks and fuzzy logic in MATLAB.	Apply (K3)
CO 5	Simulate and analyze AI-driven solutions for practical engineering problems.	Apply (K3)

V-Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	1	-	-	1	1
CO2	3	3	3	2	1	-	-	-	-	1	-	-	1	1
CO3	3	3	3	2	1	-	-	-	-	1	-	-	1	1
CO4	3	3	2	2	2	-	-	-	-	1	-	-	1	1
CO5	3	3	2	2	2	-	-	-	-	1	-	-	1	1

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEE02 Applied Soft Computing

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Programming	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic principles and scope of soft computing techniques such as fuzzy logic, neural networks, and genetic algorithms.
2.	To impart knowledge on fuzzy set theory and fuzzy logic controllers, including their application in electrical engineering.
3.	To explore the structure, learning methods, and practical applications of neural networks.
4.	To understand the functioning of genetic algorithms and how they are applied to electrical engineering problems.
5.	To train students in using MATLAB toolboxes for implementing fuzzy logic, neural networks, and genetic algorithms in real-world electrical problems.

III - Course Content

Unit - I	Introduction	9 Periods
Introduction to soft computing - Fuzzy logic, Neural Network and Genetic algorithm.		
Unit - II	Fuzzy Logic	9 Periods
Fuzzy sets, logic operations, and relations; Fuzzy decision-making; fuzzy inference systems; design steps in fuzzy logic controller; application of fuzzy logic controller in Electrical engineering.		
Unit - III	Neural Networks	9 Periods
Basic concepts and major classes of neural networks, supervised and unsupervised learning, Single-layer perceptron, multi-layer perceptron, Back Propagation Neural network, RBF networks. Application of neural network modelling / control problems in Electrical engineering.		
Unit - IV	Genetic Algorithms	9 Periods
Introduction - genetic algorithm steps-Selection, Crossover and Mutation; Application of GA to Electrical engineering problems.		
Unit - V	Application	9 Periods
Use of MATLAB Fuzzy logic, Neural network and GA toolboxes to solve electrical engineering problems.		

TOTAL: 45 Periods

Text Books:	1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd., 2nd Edition, 2011. 2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley, 4th Edition, 2020.
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Reference Books:	1. Simon Haykin, Neural Networks and Learning Machines, Pearson Education, 3rd Edition, 2008. 2. David E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education, 1989. 3. Satish Kumar, Neural Networks: A Classroom Approach ,McGraw-Hill Education, 2nd Edition, 2017. 4. J.S.R. Jang, C.T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Pearson Education, 2004.
MO OC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_cs54/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamental concepts and components of soft computing.	Understand (K2)
CO2	Design and apply fuzzy logic systems in electrical engineering contexts.	Apply (K3)
CO3	Construct and use neural network models for analysis and control tasks in electrical systems.	Analyze (K4)
CO4	Implement genetic algorithm procedures for solving electrical engineering optimization problems.	Apply (K3)
CO5	Apply MATLAB tools to model and solve real-time electrical engineering problems using soft computing techniques.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	1	-	-	-	1
CO2	3	3	3	2	1	-	-	-	-	1	-	-	-	1
CO3	3	3	3	2	1	-	-	-	-	1	-	-	-	1
CO4	3	3	2	2	2	-	-	-	-	1	-	-	-	1
CO5	3	3	2	2	2	-	-	-	-	1	-	-	-	1

Mapping: 1-Low, 2-Medium, 3-High



Chairperson - Board of Studies,
Department of Mechanical Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul 624401

I - Course Name: 230EE03 Electric Vehicle Technology

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Programming	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the principles of electromechanical energy conversion and the characteristics of various electrical machines used in electric and hybrid electric vehicles.
2.	To analyze the operation and characteristics of different types of power electronic converters and their applications in motor drive systems.
3.	To study the control strategies for DC and AC motor drives including advanced techniques used in electric vehicle propulsion systems.
4.	To explore the architecture, powertrain components, and energy storage systems used in hybrid and electric vehicles.
5.	To apply the fundamentals of vehicle mechanics for analyzing drive cycles, powertrain sizing, and implementing control and energy management strategies in hybrid electric vehicles.

III - Course Content

Unit - I	Rotating Power Converters	9 Periods
Magnetic Circuits and Electromechanical Energy Conversion- DC Machines- AC Machines- Special Electrical Machines (BLDC, PMSM & SRM)- Power Electronic Converters for Motor Drives- Applications in Electric Vehicles and Renewable Energy Systems		
Unit - II	Static Power Converters	9 Periods
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and three phase), DC choppers, single and three phase inverters, Multilevel inverters, and Matrix Converters.		
Unit - III	Control of DC and AC Motor Drives	9 Periods
Fundamentals of Electric Drive Dynamics-DC Motor Drive Control (Chopper, four quadrant) - Induction Motor Drives (v/f, Inverter - fed) - Vector Control of AC Motors (IM, PMSM)-BLDC -SRM - Advanced Control and Implementation Techniques.		
Unit - IV	Hybrid Electric Vehicle Architecture and Power Train Components	9 Periods
Evolution and Classification of Electrified Vehicles – Comparison – Powertrain Components and Energy Storage – Mechanical Subsystems of Powertrain - Advanced Technologies and Trends.		
Unit - V	Mechanics of Hybrid Electric Vehicles and Control of Vehicles	9 Periods
Fundamentals of Vehicle Mechanics - Drive Cycle Analysis and Powertrain Sizing - Hybrid Electric Vehicle Architectures – supervisory Control and Energy Management – Advanced Control Strategies – Intelligent Vehicle Control and Integration		

TOTAL: 45 Periods

Text Books	1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020. 2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011
Reference Books	1. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013. 2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021. 3. Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021. 4. Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017 5. James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, Wiley, 2012

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the operating principles and characteristics special machines used in electric mobility.	Understand (K2)
C02	Analyze the structure and functionality of power semiconductor devices in electric vehicle applications.	Analyze (K4)
C03	Analyze the control strategies for DC and AC electric drives.	Analyze (K4)
C04	Clarify the architecture of electric and hybrid electric vehicles and inverters.	Analyze (K4)
C05	Apply the fundamentals of vehicle mechanics to evaluate energy requirements and hybrid electric vehicles.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	-	-	-	-	3	3	-	-	-	-	-	1	-
C02	3	3	-	-	-	3	3	-	-	-	-	-	1	-
C03	3	3	-	2	-	3	3	-	-	-	-	-	1	-
C04	3	3	2	2	-	3	3	-	-	-	-	-	1	-
C05	3	2	-	-	-	3	3	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High



I- Course Name: 230EE04 Electrical Safety

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental concepts of electrical safety, including the nature of electrical shocks and preventive measures.
2.	To familiarize students with national and international electrical safety standards, codes, and statutory requirements.
3.	To provide knowledge on electrical protection methods, maintenance procedures, and first aid techniques for electrical hazards.
4.	To equip students with the skills to conduct energy audits for various electrical systems and recommend energy-saving techniques.
5.	To develop an understanding of safety management practices, policies, and motivation strategies to foster a safety-oriented workplace.

III - Course Content

Unit - I	Introduction to Electrical Safety, Shocks and their Prevention	9 Periods
Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation – Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity.		
Unit - II	Standards and Requirements	9 Periods
National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and Classification of electrical equipment for hazardous areas (IS, NFPA, API and OSHA standards).		
Unit - III	Electrical Protection and Maintenance	9 Periods
Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-Cardio Pulmonary Resuscitation (CPR).		
Unit - IV	Energy Audit of Electrical Systems	9 Periods
Instruments for energy audit - energy audit of heating, ventilation and air conditioning systems - energy audit of compressed air systems - energy audit of buildings - energy audit of electric drive utilities-energy efficient electrical systems- types and tips for improvement in industry.		
Unit - V	Safety Management of Electrical Systems	9 Periods
Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees towards safety.		

TOTAL: 45 Periods

Text Books	1. John Codick, "Electrical safety handbook", 4th Edition, McGraw Hill Professional, 2012, New Delhi. 2. C.S. Raju, "A Practical Book on domestic safety", Sri Sai Publisher, Chennai - 2003. 3. Power Engg. Hand book, TNEB Engineers officers, Chennai-2002.
Reference Books	1. Rao - R.C, Khanna, "Electrical safety, Fire safety engineering and safety management", 2nd Edition, Khanna Publisher, 2012, New Delhi. 2. Trivedi P.R., Jolka B.R., "Energy Management", Common Wealth Publishers, New Delhi, 1997.



3. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Identify various electrical hazards and explain methods for preventing electrical shocks and fire incidents.	Understand (K2)
C02	Interpret and apply national and international electrical safety standards and statutory requirements in real-world scenarios.	Apply (K3)
C03	Demonstrate appropriate electrical protection techniques and perform basic preventive maintenance and emergency first aid (CPR).	Apply (K3)
C04	Conduct energy audits in electrical systems and recommend measures for improving energy efficiency in industrial and building applications.	Analyze (K4)
C05	Implement principles of electrical safety management and develop safety policies, audit strategies, and motivation techniques in organizations.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	-	-	-	-	3	3	-	-	-	-	-	1	-
C02	3	3	-	-	-	3	3	-	-	-	-	-	1	-
C03	3	3	-	2	-	3	3	-	-	-	-	-	1	-
C04	3	3	2	2	-	3	3	-	-	-	-	-	1	-
C05	3	2	-	-	-	3	3	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High



Chairperson - Board of Studies,
Department of Mechanical Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul 624401

I - Course Name: 230EE05 E-waste Management

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Gaining knowledge about the current state of e-waste generation, collection, and disposal, both globally and in specific regions.
2.	Learning about the potential risks associated with e-waste, including the release of hazardous materials and their impact on ecosystems and human health.
3.	Studying national and international laws and regulations governing e-waste management, such as the E-Waste (Management) Rules.
4.	Learning about the emerging technologies and green chemistry
5.	Exploring various methods for reducing, reusing, recycling, and responsibly disposing of e-waste, including techniques for material recovery and waste minimization.

III - Course Content

Unit – I	General Concepts to E Waste and E-Waste Management	9 Periods
Introduction and general concepts to e-waste and e-waste management; Principle and standards for the disposal; Life cycle and Performance assessment and understanding		
Unit – II	Health Effects of E-Waste Pollution	9 Periods
Health Effects of E-waste Pollution; Global Trends of E-waste Pollution and Its Impact on Environment		
Unit – III	Material Recycling and Processing Techniques	9 Periods
E-waste: Global Scenario, Constituents, and Biological Strategies for Remediation Materials Recycling Considerations Processing Techniques.		
Unit – IV	Green Chemistry	9 Periods
Emerging Technologies Bioremediation Approaches e-factor concept in green chemistry Case studies: implementation of e-waste recycling		
Unit – V	Recycling Process	9 Periods
Recycling Processes and Plastic in e-waste is an emerging problem for India: Implications for Future Prospect		

TOTAL: 45 Periods

Text Books	1. Hugo Marcelo Veit and Andréa Moura Bernardes, "Electronic Waste: Recycling Techniques" Springer 2015. 2. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi
Reference Books	1. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009 2. Muammer Kaya, "Electronic Waste and Printed Circuit Board Recycling Technologies", Springer 2019. 3. Muhammad Zaffar Hashmi and Ajit Varma, "Electronic Waste Pollution: Environmental Occurrence and Treatment Technologies", Springer 2019.



	4. Lifeng Zhang and Gregory K. Krumdick, "Recycling of Electronic Waste II", Wiley 2011. 5. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017Elsevier
MOOC/Web Platforms:	https://news.mit.edu/2013/ewaste-mit

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the environmental impacts of e-waste.	Understand (K2)
CO2	Apply concepts of e-waste management hierarchy.	Apply (K3)
CO3	Distinguish the role of various national and internal act and laws applicable for e-waste management and handling.	Analyze (K4)
CO4	Analyze the e – waste management measures proposed under national and global legislations.	Analyze (K4)
CO5	To assess the overall sustainability of e-waste, considering the three pillars: environmental, economic, and energy.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	3	3	-	-	-	1	-	-	-
CO2	3	3	-	-	-	3	3	-	-	-	1	-	-	-
CO3	3	3	-	2	-	3	3	-	-	-	1	-	-	-
CO4	3	3	2	2	-	3	3	-	-	-	1	-	-	-
CO5	3	2	-	-	-	3	3	-	-	-	1	-	-	-

Mapping:1-Low,2-Medium,3-High



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Department of Mechanical Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul 624401

I-Course Name: 23OEE06 Industrial Automation

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals of industrial automation systems, including their architecture and essential communication protocols such as Modbus and Profibus.
2.	To familiarize students with key automation components like sensors, actuators, process control valves, and power electronic devices used in industrial systems.
3.	To impart knowledge on computer-aided measurement and control systems, including data acquisition, process interfaces, and industrial communication systems.
4.	To develop the ability to program, configure, and implement Programmable Logic Controllers (PLCs) in industrial process control and automation applications.
5.	To understand the structure and operation of Distributed Control Systems (DCS), including software configurations, communication protocols, and integration with other automation systems.

III - Course Content

Unit - I	Introduction	9 Periods
Basics of industrial automation, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA)- Flexible manufacturing system (FMS) - Industrial bus systems: Modbus & Profibus		
Unit - II	Automation Components	9 Periods
Measurement Systems Characteristics - Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.		
Unit - III	Computer Aided Measurement and Control Systems	9 Periods
Role of computers in measurement and control, Elements of computer aided measurement and control, man- machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms - Analysis of transfer lines without storage, Automated flow lines with storage buffers		
Unit - IV	Programmable Logic Controllers	9 Periods
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries		
Unit - V	Distributed Control System	9 Periods
introductions to computer based industrial automation - Direct Digital Control (DDC) - DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS - Transport Automation		

TOTAL: 45 Periods

Text Books	1. S.K.Singh, "Industrial Instrumentation", Tata McGraw Hill, 2nd edition companies, 2003. 2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India, 8th Edition, 2006.
Reference Books	1. E.A.Parr, Newness, New Delhi, "Industrial Control Handbook", 3 rd Edition, 2000.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the signal conditioning circuits for a variety of industrial and automation applications	Understand (K2)
CO2	Establish an in-depth understanding of data acquisition systems, interfacing techniques, and Distributed Control Systems (DCS).	Apply (K3)
CO3	Clarify the fundamentals and significance of communication buses used in applied automation engineering	Analyze (K4)
CO4	Understand the ladder logic and function block programs for PLCs using timers, counters, arithmetic, and logic instructions.	Analyze (K4)
CO5	Analyze the advanced PLC logic solutions for real-world industrial automation problems	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	3	3	-	-	-	-	-	1	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	1	-
CO3	3	3	-	2	-	3	3	-	-	-	-	-	1	-
CO4	3	3	2	2	-	3	3	-	-	-	-	-	1	-
CO5	3	2	-	-	-	3	3	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 230EE07 Power Plant Instrumentation

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand the methods and instruments used for measuring metal temperature in boilers.
2.	Understand different types of draught plants (natural, forced, induced, balanced) and their power requirements. Learn about fan drives, airflow control, and combustion control techniques.
3.	Understand automation concepts specific to thermal power plants. Learn about boiler automation systems including diagnostic functions and protection mechanisms.
4.	Understand the piping and instrumentation diagrams of different types of nuclear power plants.
5.	Gain an introduction to Industrial Internet of Things (IIoT) applications in power plants. Understand smart grid technologies and their impact on power plant instrumentation.

III - Course Content

Unit - I	Measurement in Boiler and Turbine	9 Periods
Metal temperature measurement in boilers, impulse-piping system for pressure measuring devices, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity measurement. Installation of non-contracting transducers for speed measurement, rotor and casing movement and expansion measurement.		
Unit - II	Controls in Boiler	9 Periods
Problems associated with control of multiple pulverizers. Draught plant: Introduction, natural draught, forced draught, induced draught, balanced draught, power requirements for draught systems. Fan drives and control, control of airflow. Combustion control: Fuel/Air ratio, oxygen, CO and CO ₂ trimming, combustion efficiency, excess air, parallel and cross limited combustion control, control of large systems.		
Unit - III	Automation	9 Periods
Automation: Thermal power plant, Boiler Automation - Diagnostic Functions and Protection - Digital Electro - Hydraulic Governor, Man-Machine Interface - Graphic Display of Automated Power plant.		
Unit - IV	Nuclear Power Plant Instrumentation	9 Periods
Piping and instrumentation diagram of different types of nuclear power plant, nuclear reactor control loops, reactor dynamics, excess reactivity, pulse channel and logarithmic instrumentation, control and safety instrumentation, reliability aspects.		
Unit - V	Emerging Trends and Applications	9 Periods
Introduction to the Industrial Internet of Things (IIoT) in power plants. Smart grid technologies and their impact on instrumentation. Simulation and modeling of power plant system.		

TOTAL: 45 Periods

Text Books	1. Philip Kiameh, Power Plant Instrumentation and Control Handbook 2. B. D. Taylor, 'Instrumentation for Engineers and Technicians' 3. Modern Power Station Practice – British Electricity International
Reference Books	1. Bela G. Liptak, Instrumentation in Industry 2. P.K. Nag, "Power Plant Engineering" 3. K.K. Ramalingam, "Power Plant Instrumentation"
MOOC/Web Platforms:	1. NPTEL (National Programme on Technology Enhanced Learning) 2. Coursera (e.g., Energy Production, Distribution & Safety) 3. edX (e.g., Smart Grids, Control Systems)

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Explain basic thermal power plant processes and layout	Understand (K2)
C02	Identify and describe the operation of instrumentation devices in power plants	Apply (K3)
C03	Analyze control strategies used in boiler and turbine operations	Analyze (K4)
C04	Select appropriate control systems for different power plant functions	Analyze (K4)
C05	Discuss advancements in combined cycle power generation	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	2	-	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	2	-	-	-	-	-	-	-	-	-	-	-
C03	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C04	3	3	3	2	-	-	-	-	-	-	-	-	-	-
C05	2	2	-	-	3	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



I-Course Name: 23OEE08 Principles of Robotics

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To introduce the fundamental components and mechanical structure of robotic systems.
2.	To impart knowledge on spatial descriptions, coordinate transformations, and kinematic modeling using D-H parameters.
3.	To analyze and design actuator and sensor systems for robotic control.
4.	To develop trajectory planning techniques and implement control strategies.
5.	To explore the integration of Artificial Intelligence and expert systems in robotics with real-world case studies.

III- Course Content

Unit - I	Fundamentals of Robot	9 Periods
Introduction: Fundamentals and robot - components, joints, degrees of freedom, coordinates. The mechanics & control of mechanical manipulators. Spatial Descriptions and Transformations: Descriptions – Positions, Orientations, and Frames, Mappings, Operators – Translations, Rotations, and Transformations, Transformation arithmetic and transform equations, transformation of free vectors, Representation & Orientation		
Unit - II	Representation And Kinematics of Robotic Structures	9 Periods
Representation and Transformation of joints, links Mechanical Structure notations, Coordinate frames, Description of objects in space, Transformation and fundamental rotation matrices, Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Kinematics: Forward kinematics of multi DOF manipulator - Inverse kinematics of 2DOF manipulator. Homogeneous transformation matrices, translation and rotation matrices		
Unit - III	Elements of Robots	9 Periods
Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.		
Unit - IV	Trajectory Planning and Robot Programming	9 Periods
Trajectory planning, joint space techniques, cartesian space formulation. Control of manipulator, PID control scheme, computed torque control, force control of robotic manipulators. Robot Programming Robot Programming: Manual programming – Teach Pendant, Offline Programming - Welding, Online programming – Deburring, Palletizing and Inspection.		
Unit - V	AI and Robotics	9 Periods
Artificial Intelligence in Robotics Expert systems, Artificial Intelligence- Knowledge Representation, AI in Robotics, Case studies		



TOTAL: 45 Periods

Text Books:	1. John J. Craig, <i>Introduction to Robotics: Mechanics and Control</i> , 4th Edition, Pearson Education, Boston, Massachusetts, 2022. ISBN: 978-0-13-784874-4. 2. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, <i>Robot Modeling and Control</i> , 2nd Edition, Wiley, Hoboken, New Jersey, 2020. ISBN: 978-1-119-52404-5.
Reference Books:	1. Stuart Russell and Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i> , 4th Edition, Pearson, Hoboken, New Jersey, 2020. ISBN: 978-0-13-461099-3. 2. Robert J. Schilling, <i>Fundamentals of Robotics: Analysis and Control</i> , 1st Edition, Pearson Education, Upper Saddle River, New Jersey, 1990. 3. Stuart Russell and Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i> , 4th Edition, Pearson, Hoboken, New Jersey, 2020.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/104/112104298/ 2. Introduction to Robotics IIT Kanpur Prof. T.Asokan

IV-Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify and describe the fundamental components, joint types, and degrees of freedom in robotic systems.	Understand (K2)
CO2	Apply spatial transformation techniques to represent positions and orientations of robotic links and end-effectors.	Apply (K3)
CO3	Model robotic joints and links using Denavit-Hartenberg (D-H) parameters and solve forward and inverse kinematics problems.	Apply (K3)
CO4	Analyze and select appropriate actuators and sensors for robotic applications based on functionality and requirements.	Analyse (K4)
CO5	Design and implement trajectory planning and control schemes for robotic manipulators in both joint and Cartesian spaces.	Analyse (K4)

V-Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	3	2	2	-	-	-	-	1	-	1	-	1	-
CO3	3	3	3	2	1	-	-	-	1	-	1	-	1	-
CO4	3	2	3	2	-	-	-	-	1	-	1	-	1	-
CO5	3	2	2	3	2	-	-	-	2	-	2	-	1	-

Mapping:1-Low,2-Medium,3-High



I- Course Name:23OEE09 Sensors and Transducers

P rerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To understand the concepts of measurement technology.
2.	To learn the various sensors used to measure various physical parameters.
3.	To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

III-Course Content

Unit-I	Introduction to Measurements and Sensors	9 Periods
Basics of Measurements – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types- Performance measures of sensors.		
Unit-II	Variable Resistance and Inductance Sensors	9 Periods
Motion Proximity Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, Linear Variable transducer (LVDT) – Rotary Variable transducer RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)		
Unit-III	Variable and Other Special Sensors	9 Periods
Types of Strain Guage, Load Cell, Magnetic Sensors –principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.		
Unit-IV	Automotive Actuators	9 Periods
Photo resistive, Photo conductive cell, photo voltaic, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.		
Unit-V	Automatic Temperature Control Actuators	9 Periods
Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring		

TOTAL:45 Periods

Text Books:	1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009. 2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
Reference Books:	1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010. 2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.

Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook"
2nd edition, CRC Press, 2015.

IV- Course Outcomes

On Completion of the course, the students will be able to		Bloom's Level Mapped
C01	Expertise in various calibration techniques and signal types for sensors.	Understand (K2)
C02	Apply the various sensors in the Automotive and Mechatronics applications.	Apply (K3)
C03	Study the basic principles of various smart sensors.	Understand (K2)
C04	Implement the DAQ systems with different sensors for real time applications.	Analyze (K4)
C05	Analyze applications of advanced sensor technologies in smart systems.	Analyze (K4)

IV-Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	-	1	-	-	-	-	-	-	-	-	-	1	-
C02	2	2	3	-	-	-	-	-	-	-	-	-	1	-
C03	1	-	2	-	-	-	-	-	-	-	-	-	1	-
C04	2	2	3	2	1	-	-	-	-	-	-	-	1	-
C05	2	2	2	3	2	-	-	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High



I-Course Name: 230EE10 Solar and Wind Energy Resources

Pre Requisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To introduce the fundamentals of solar energy, its availability, and its role in the renewable energy landscape.
2.	To explain the working principles and performance characteristics of solar cells and photovoltaic technologies.
3.	To enable students to understand the design, components, and operation of photovoltaic (PV) systems.
4.	To provide foundational knowledge on wind energy, including wind resource assessment and conversion principles.
5.	To familiarize students with different types of wind turbines and their performance characteristics in energy generation.

III-Course Content

Unit-I	Introduction to Solar Energy	9 Periods
Basic characteristics of sunlight – solar spectrum – insolation specifics– irradiance and irradiation- pyranometer – Solar PV cell- Simplest equivalent circuit for a photovoltaic cell – Solar cells to modules, Solar cells to arrays I-V characteristics – P-V characteristics – fill factor.		
Unit-II	Performance of Solar Cells	9 Periods
Parameters of solar cells, solar cell technologies – Factors affecting electricity generated by a solar cell, Solar PV module, Standard PV module parameters, IV and PV characteristics of SPV module, Solar PV modules arrays – connection of modules in series and parallel		
Unit-III	Photovoltaic Systems	9 Periods
Introduction to Simplified grid connected PV systems, Current voltage curves for loads – DC motor IV curves - Battery IV curves – maximum power point trackers – hourly IV curves, grid connected systems		
Unit-IV	Introduction to Wind Energy	9 Periods
Nature of the wind – Types of wind turbines, power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment -wind power laws - velocity and power duration curves - Betz limit - site selection.		
Unit-V	Wind Energy Conversion Techniques	9 Periods
Wind energy conversion devices - classification, characteristics- Wind Turbine Generators Asynchronous (Induction) generator- Squirrel cage Induction generator, Wound rotor Induction generator- Optislip Induction generator- Doubly-fed Induction generator. Synchronous generator- Wound rotor generator- Permanent magnet generator, Indian standards		

TOTAL: 45 Periods

Text Books:	1. Rai. G.D. "Non-Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002. 2. Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies,
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	Applications' PHI Learning Publications, 2nd Edition, 2011.
References	1. Solanki, C.S. "Solar Photovoltaic Technology and Systems", PHI learning Pvt. Ltd., New Delhi, 2013. 2. Rai. G.D. "Non-Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002. 3. S N Bhadra, S Banerjee and D Kastha, 'Wind Electrical Systems', Oxford University Press, 1st Edition, 2005. 4. S. Sumathi, L. Ashok Kumar, P. Surekha, 'Solar PV and Wind Energy Conversion Systems', Springer 2015

IV-Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamental concepts and significance of solar energy.	Understand (K2)
CO2	Analyze the performance characteristics of solar cells under various conditions.	Analyze (K4)
CO3	Design and evaluate photovoltaic systems for practical applications.	Evaluate (K5)
CO4	Describe the basic principles and potential of wind energy as a renewable source.	Understand (K2)
CO5	Compare and assess different wind energy conversion devices.	Understand (K2)

V-Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	1	-	1	-	-
CO2	3	3	3	2	1	-	-	-	-	1	-	1	-	-
CO3	3	3	3	2	1	-	-	-	-	1	-	1	-	-
CO4	3	3	2	2	2	-	-	-	-	1	-	1	-	-
CO5	3	3	2	2	2	-	-	-	-	1	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High



I - Course Name: 23OHS01 English for Competitive Examinations

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II. Course Objectives

1.	To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defense) and the international level (GRE, TOEFL, IELTS).
2.	To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
3.	To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.

III. Course Content

Unit-I	Vocabulary and Verbal Ability	9 Periods
Orientation on different formats of competitive exams Vocabulary Verbal ability Verbal reasoning - Exploring the world of words - Essential words - Meaning and their usage - Synonyms-antonyms - Word substitution - Word analogy - Idioms and phrases Commonly confused words - Spellings - Word expansion - new words in use.		
Unit-II	Grammar and Sentence Construction	9 Periods
Grammar - Sentence Improvement-Sentence completion - Rearranging phrases into sentences. Error identification-Tenses - Prepositions - Adjectives - Adverbs - Subject-verb agreement - Voice - Reported speech - Articles - Clauses - Speech patterns.		
Unit-III	Reading and Comprehension Skills	9 Periods
Reading - Specific information and detail - Identifying main and supporting ideas - Speed reading techniques Improving global reading skills Linking ideas Summarizing -Understanding argument - Identifying opinion/attitude and making inferences - Critical reading.		
Unit-IV	Writing and Composition Skills	9 Periods
Writing - Pre-writing techniques - Mind-map - Describing pictures and facts - Paragraph structure organizing points - Rhetoric writing Improving an answer Drafting, writing and developing an argument - Focus on cohesion - Using cohesive devices -Analytic writing - Structure and types of essay Mind maps Structure of drafts, letters, memos, emails Statements of Purpose Structure, Content and Style- Technical writing.		
Unit-V	Listening and Speaking Skills	9 Periods
Listening and Speaking Contextual listening - Listening to instructions - Listening for specific information Identifying detail, main ideas Following signpost words Stress, rhythm and intonation - Speaking to respond and elicit ideas - Guided speaking - Opening phrases - Interactive communication -Sentence stress - Speaking on a topic - Giving opinions - Giving an oral presentation Telling a story or a personal anecdote - Talking about oneself Utterance Speech acts- Brainstorming ideas - Group discussion.		

TOTAL:45 Periods

Text Books	1. R.P.Bhatnagar General English for Competitive Examinations. Macmillan India Limited, 2009.
Reference Books	1. Educational Testing Service the Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
	2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.
	3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.
Web Source	http://www.examenglish.com/ , http://www.ets.org/ , http://www.bankxams.com/
	http://civilservicesmentor.com/ , http://www.educationobserver.com
	http://www.cambridgeenglish.org/in/
	http://www.examenglish.com/ , http://www.ets.org/ , http://www.bankxams.com/
	http://civilservicesmentor.com/ , http://www.educationobserver.com
	http://www.cambridgeenglish.org/in/

IV. Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required.	Understand (K2)
C02	Identify errors with precision and write with clarity and coherence.	Analyze (K4)
C03	Understand the importance of task fulfilment and the usage of task-appropriate vocabulary.	Understand (K2)
C04	Communicate effectively in group discussions, presentations and interviews.	Apply (K3)
C05	Write topic-based essays with precision and accuracy.	Apply (K3)

V. Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C02	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C03	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C04	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C05	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OHS02 Project Report Writing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand the essentials of project writing.
2.	Perceive the difference between general writing and technical writing
3.	Assimilate the fundamental features of report writing.
4.	Understand the essential differences that exist between general and technical writing.
5.	Learn the structure of a technical and project report

III - Course Content

Unit - I	Writing Skills	9 Periods
Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.		
Unit - II	Project Report	9 Periods
Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism– Report Writing in STEM fields – Experiment – Statistical Analysis.		
Unit - III	Structure of the Project Report: (Part 1)	9 Periods
Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.		
Unit - IV	Structure of the Project Report: (Part 2)	9 Periods
Literature Review, Research Design, Methods of Data Collection -Tools and Procedures - Data Analysis - Interpretation - Findings – Limitations - Recommendations – Conclusion – Bibliography		
Unit - V	Proof reading a report	9 Periods
Avoiding Typographical Errors – Bibliography in required Format – Font –Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques		
TOTAL:45 Periods		
Books for study & Reference:	- Gerson and Gerson-Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012) - Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012) - Daniel Riordan - Technical Report Writing Today (1998) - Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers	



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MOOC/Web Platforms:	https://devimpactinstitute.com/courses/project-management/training-on-report-writing/ https://glomacs.com/training-course/advanced-report-writing-and-presentation-skills https://www.indepthresearch.org/course/effective-report-writing-skills-
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Write effective project reports.	Analyze (K4)
CO2	Use statistical tools with confidence.	Apply (K3)
CO3	Explain the purpose and intension of the proposed project coherently and with clarity.	Understand (K2)
CO4	Create writing texts to suit achieve the intended purpose.	Evaluate (K5)
CO5	Master the art of writing winning proposals and project	Evaluate (K5)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High



I - Course Name: 23OMA01 Algebra and Number Theory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
2.	To examine the key questions in the Theory of Numbers.
3.	To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.
4.	To introduce the basic notions of congruences.
5.	To apply the concepts in the real time problems by using theorems.

III - Course Content

Unit I	Groups and Rings	9 Periods
Groups: Definition - Properties (Statements only) - Homomorphism - Isomorphism - Cyclic groups (Statements only) - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Ring homomorphism - Integral domain - Field - Integer modulo n .		
Unit II	Finite Fields and Polynomials	9 Periods
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.		
Unit III	Divisibility Theory and Canonical Decompositions	9 Periods
Division algorithm- Base- b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.		
Unit IV	Diophantine Equations and Congruences	9 Periods
Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2×2 linear systems.		
Unit V	Classical Theorems and Multiplicative Functions	9 Periods
Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2×2 linear systems.		

TOTAL:45 Periods


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Text Books:	[1]. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007. [2]. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.
Reference Books:	[1]. P. Sivaramakrishna das and C. Vijayalakshmi, "Algebra and Number Theory", Pearson Publications, 2019. [2]. Niven. I, Zuckerman's., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons, Singapore, 2004. [3]. Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition, 2006.
MOOC/ Web Platforms:	http://kcl.digimat.in/nptel/courses/video/111108609/L01.html https://archive.nptel.ac.in/courses/111/106/111106137/ https://nptel.ac.in/courses/111108413 https://www.youtube.com/watch?v=B1AMosLhHGU https://www.slideshare.net/slideshow/number-theory-lesson-1-introduction-to-number-theory/232368762

IV - Course Outcomes

On completion of the course, the students will be able to		Blooms Level Mapped
C01	Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.	Apply (K3)
C02	Demonstrate accurate and efficient use of advanced algebraic techniques.	Understand (K2)
C03	Demonstrate their mastery by solving non-trivial problems related to the concepts.	Understand (K2)
C04	Understand the concepts of congruences and their applications.	Understand (K2)
C05	Apply the classical Theorems to the real time problems.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	2	2	-	-	-	-	2	-	-	2	-	-
C02	2	2	2	2	-	-	-	-	2	-	-	2	-	-
C03	3	2	2	2	-	-	-	-	2	-	-	2	-	-
C04	2	2	2	2	-	-	-	-	2	-	-	2	-	-
C05	2	2	2	2	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

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I - Course Name: 23OMA02 Graph Theory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Impart mathematical modelling to describe and explore real-world phenomena and data.
2.	Provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models.
3.	Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations.

III - Course Content

Unit - I	Introduction	9 Periods
Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.		
Unit - II	Trees, Connectivity & Planarity	9 Periods
Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.		
Unit - III	Matrices, Colouring and Directed Graph	9 Periods
Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.		
Unit - IV	Permutations & Combinations	9 Periods
Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.		
Unit - V	Generating Functions	9 Periods
Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.		

TOTAL: 45 Periods

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Reference Books:	1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003. 2. Grimaldi R.P. Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994. 3. Clark. J and Holton D.A, A First look at Graph Theory. Allied Publishers, 1995 4. Rosen K.H, Discrete Mathematics and Its Applications, Mc Graw Hill, 2007.
MOOC/ Web Platforms:	https://www.youtube.com/watch?v=f1JTtMP6NGw https://www.youtube.com/watch?v=fZqfkj-cb28 https://www.youtube.com/results?search_query=MATRICES%2C+COLOURING+AND+DIRECTED+GRAPH+NPTEL+ https://www.youtube.com/watch?v=Dsi7x-A89Mw https://www.youtube.com/watch?v=QylihXazzD8

IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
C01	Write precise and accurate mathematical definitions of objects in graph theory.	Understand (K2)
C02	Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples	Apply (K3)
C03	Validate and critically assess a mathematical proof.	Apply (K3)
C04	Use a combination of theoretical knowledge and independent mathematics thinking in creative investigation of questions in graph theory.	Apply (K3)
C05	Reason from definitions to construct mathematical proofs.	Analyse (K4)

V - Mapping Table- Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	-	-	-	-	-	-	-	-	3	-	-
C02	3	3	3	-	-	-	-	-	-	-	-	3	-	-
C03	3	3	3	-	-	-	-	-	-	-	-	3	-	-
C04	3	3	3	-	-	-	-	-	-	-	-	3	-	-
C05	3	3	3	-	-	-	-	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High



I - Course Name: 23OMA03 Linear Algebra

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To test the consistency and solve system of linear equations.
2.	To find the basis and dimension of vector space.
3.	To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
4.	To find orthonormal basis of inner product space and find least square approximation.
5.	To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition

III - Course Content

Unit - I	Matrices and System of Linear Equations	9 Periods
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.		
Unit - II	Vector Spaces	9 Periods
Vector spaces over Real and Complex fields - Subspace - Linear space - Linear independence and dependence - Basis and dimension.		
Unit - III	Linear Transformation	9 Periods
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation diagonalization.		
Unit - IV	Inner Product Spaces	9 Periods
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.		
Unit - V	Eigen Value Problems and Matrix Decomposition	9 Periods
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition - QR decomposition.		

TOTAL: 45 Periods

Text Books	1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002. 2. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5th Edition, 2019.
Reference Books	1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8th Edition, 2009. 2. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7th Edition, 2007. 3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010. 4. Richard Branson, Matrix Operations, Schaum's outline series, 1989.



	5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4 th Edition, 2005. 6. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014.
M OOC/Web Platforms:	https://nptel.ac.in/courses/111106135 https://nptel.ac.in/courses/111102011 https://www.youtube.com/watch?v=ZLh4Ud_vjB8

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Test the consistency and solve system of linear equations.	Understand (K2)
C02	Find the basis and dimension of vector space.	Apply (K3)
C03	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.	Apply (K3)
C04	Find orthonormal basis of inner product space and find least square approximation.	Apply (K3)
C05	Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	3	2	2	2	1	1	1	1	3	-	-
C02	3	3	3	3	3	2	2	1	1	1	1	3	-	-
C03	3	3	3	3	3	2	2	1	1	1	1	3	-	-
C04	3	3	3	3	3	2	2	1	1	1	1	3	-	-
C05	3	3	3	3	3	2	2	1	1	1	1	3	-	-

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 230MA04 Operations Research

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To provide the concept and an understanding of basic concepts in Operations Research techniques for Analysis and Modeling in Computer Applications.
2.	To understand, develop and solve mathematical model of linear programming problems.
3.	To understand, develop and solve mathematical model of Transport and assignment problems.
4.	To Understand network modeling for planning and scheduling the project activities.

III - Course Content

Unit I	Linear Programming Models	9 Periods
Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables: big-M -Two Phase method, degeneracy and unbound solutions.		
Unit – II	Transportation and Assignment Models	9 Periods
Formulation - Methods for finding basic Feasible Solution - Optimality Test - MODI method Degeneracy in Transportation Problem -Unbalanced Transportation Problem. Assignment Method: Mathematical formulation of assignment models – Hungarian Algorithm – Variants of the Assignment problem		
Unit – III	Scheduling by PERT and CPM	9 Periods
Introduction - Rules to frame a Network - Fulkerson's Rule to numbering of events - Activity, Times - Critical Path Computation. - Slack and Float - PERT- Steps and computing variance, Merits and demerits of PERT, CPM- Time estimating & Limitations, Comparison between PERT & CPM.		
Unit – IV	Queueing Models	9 Periods
Characteristics of Queueing Models-Poisson Queues-(M /M/1): (FIFO/∞/∞), (M / M / 1): (FIFO / N / ∞), (M / M / C): (FIFO / ∞ / ∞), (M / M / C): (FIFO / N / ∞) models.		
Unit – V	Game Theory	9 Periods
Competitive game, rectangular game, saddle point, minimax (maximin) method of optimal strategies- value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games		

TOTAL: 45 Periods

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Reference Books:	1. Taha H.A., "Operations Research: An Introduction", 10th Edition, Prentice Hall of India, New Delhi, 2017 2. Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research", 15th Revised Edition, S. Chand & Sons Education Publications, New Delhi, 2017 3. Ronald L Rardin, Optimization in Operations Research, 2nd Edition, Pearson Education, India, 2018 4. Jatinder Kumar, Optimization Techniques in Operations Research, LAP LAMBERT Academic Publishing, 2015 5. D.S. Hira and P.K. Gupta, Operations Research, 5th Edition, S. Chand & Sons, 2015.
MOOC/Web Platforms:	1. www.digimat.in/nptel/courses/video/111104027/L01.html?utm_source=chatgpt.com 2. https://www.youtube.com/watch?v=Q31jKiEXxdc&utm_source=chatgpt.com 3. www.digimat.in/nptel/courses/video/110104073/L21.html?utm_source=chatgpt.com 4. https://nptel.ac.in/courses/117103017?utm_source=chatgpt.com 5. https://onlinecourses.nptel.ac.in/noc19_ge32/preview?utm_source=chatgpt.com

IV - Course Outcomes

	Upon Completion of the course, the students will be able to	Bloom's Level Mapped
C01	Understand and apply linear programming to solve operational problem with constraints.	Apply (K3)
C02	Apply transportation and assignment models to find optimal solution.	Apply (K3)
C03	To prepare project scheduling using PERT and CPM.	Apply (K3)
C04	Identify and analyze appropriate queuing model to reduce the waiting time in queue.	Apply (K3)
C05	To choose the best strategy using decision making methods under game theory.	Analyse (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	2	-	-	-	-	-	-	-	-	-	-
C02	3	3	3	3	2	-	-	-	-	-	-	-	-	-
C03	3	3	2	2	-	-	-	-	-	-	-	-	-	-
C04	3	3	2	2	-	1	-	-	-	-	-	-	-	-
C05	3	3	2	2	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OMA05 Queueing and Reliability Modelling

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
2.	To understand the concept of queueing models and apply in engineering.
3.	To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
4.	To study the system reliability and hazard function for series and parallel systems.
5.	To implement Markovian Techniques for availability and maintainability which opens up new avenues for research

III - Course Content

Unit - I	Random Processes	9 Periods
Classification – Stationary process – Markov process – Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		
Unit - II	Markovian Queueing Models	9 Periods
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula – Queues with finite waiting rooms.		
Unit - III	Advanced Queueing Models	9 Periods
M/G/1 queue – Pollaczek Khinchin formula – M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.		
Unit - IV	System Reliability	9 Periods
Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.		
Unit - V	Maintainability and Availability	9 Periods
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems		

TOTAL: 45 Periods

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Reference Books:	1. Medhi J, "Stochastic models of Queueing Theory", Academic Press, Elsevier, Amsterdam, 2003. 2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016. 3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002. 4. Govil A.K., "Reliability Engineering", Tata-McGraw Hill Publishing Company Ltd., New Delhi, 1983.
MOOC/Web Platforms:	1. https://www.classcentral.com/course/youtube-electronics-probability-random-variables-47668?utm_source=chatgpt.com 2. https://onlinecourses.nptel.ac.in/noc21_ee93/preview?utm_source=chatgpt.com 3. https://onlinecourses.nptel.ac.in/noc21_ee93/preview?utm_source=chatgpt.com 4. https://onlinecourses.nptel.ac.in/noc21_ce58/preview?utm_source 5. https://onlinecourses.nptel.ac.in/noc21_ce58/preview?utm_source

IV - Course Outcomes

Upon Completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Enable the students to apply the concept of random processes in engineering disciplines.	Apply (K3)
CO2	Students acquire skills in analyzing various queueing models.	Apply (K3)
CO3	Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.	Apply (K3)
CO4	Students can analyze reliability of the systems for various probability distributions.	Apply (K3)
CO5	Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach	Analyse (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	2	-	-	2	-	-
CO2	3	3	2	-	-	-	-	-	2	-	-	2	-	-
CO3	3	3	-	2	-	-	-	-	2	-	-	2	-	-
CO4	3	3	2	-	-	-	-	-	2	-	-	2	-	-
CO5	3	3	3	2	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OMA06 Resource Management Techniques

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OE	3	0	0	3

II - Course Objectives

1.	To formulate linear programming problems and solve LPP using simple algorithm.
2.	To solve networking problems.
3.	To formulate and solve integer programming problems.
4.	To solve Non-Linear programming problems.
5.	To understand and solve project management problems.

III - Course Content

Unit - I	Linear Programming	9 Periods
Principal components of decision problem – Modeling phases – LP formulation and graphic solution – Resource allocation problems – simplex method – sensitivity analysis.		
Unit - II	Duality and Networks	9 Periods
Definition of dual problems – primal – Dual relationships – Dual simplex method –post optimality analysis – Transportation and assignment model – Shortest route problem		
Unit - III	Integer Programming	9 Periods
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming		
Unit - IV	Classical Optimization Theory	9 Periods
Unconstrained external problems, Newton – Raphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems		
Unit - V	Object Scheduling	9 Periods
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.		

TOTAL:45 Periods

Text Books:	1.H.A. Taha, "Operation Research", Prentice Hall of India, 2002.
Reference Books:	1.Pancer selvam, 'Operations Research' Prentice Hall of India, 2002. 2.Anderson 'Quantitative Methods for Business', 8 th Edition, Thomson Learning, 2002. 3.Winston 'Operations Research for Business', Thomson Learning, 2003. 4.Vohra, 'Quantitative Techniques in Management', Tata Mc Graw Hill, 2002. 5.Anand sarma, 'Operation Research' Himalaya Publishing House, 2003.
MOOC/Web Platforms:	https://share.google/uasnB9X2KP7TbVhjU https://share.google/G2pLV43yVjIHIPWCO https://share.google/OddZC1NWcgQyv6bds



IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO 1	Understand to formulate linear programming problems and solve LPP using simple algorithm.	Understand (K2)
CO 2	Understand to solve networking problems.	Understand (K2)
CO 3	Understand to formulate and solve integer programming problems.	Apply (K3)
CO 4	Understand to solve Non-Linear programming problems.	Understand (K2)
CO 5	Understand to solve project management problems.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	2	-	-	-	-	-	-	-	-	-	-
CO5	-	3	3	2	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



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