KPR Institute of Engineering and Technology

Learn Beyond (Autonomous, NAAC "A")

Avinashi Road, Arasur, Coimbatore.

Great Place To Work. Certified MAR 2022 - MAR 2023 INDIA

B.E. – Mechanical Engineering

Curriculum and Syllabi

Regulations – 2019

KPRIET

I. Vision and Mission of the Institute`

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of the industry, society, the nation and the world at large.

Mission

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning process through scholarly activities
- Enriching research and innovation activities in collaboration with industry and institute of repute
- Ensuring the academic process to uphold culture, ethics and social responsibility

II. Vision and Mission of the Department

Vision

To produce globally competent mechanical engineers to meet the changing needs of industries through innovative academic processes, research and value-based education

Mission

The Department of Mechanical Engineering is committed to

- Provide fundamental and skill-based education in mechanical engineering through innovative practices in teaching and learning.
- Collaborate with reputed industries, professional bodies and research laboratories for establishing Centre of Excellence.
- Imbibe ethical behavior and morality for social upliftment to uphold human values.

III. Program Educational Objectives (PEOs)

The graduates of mechanical engineering will

PEO1: have a successful professional career in their related field of engineering to meet the changing needs of various stakeholders.

PEO2: involve in technology advancements through continuing education.

PEO3: practice their profession with good leadership skills and ethical values.

IV. Program Outcomes (POs)

Graduates of Mechanical Engineering will be able to

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

PO 2 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.

PO 3 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.

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PO 4 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.

PO 5 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.

PO 6 The engineer and society: Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7 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.

PO 8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10 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.

PO 11 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.

PO 12 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.

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V. Program Specific Outcomes (PSOs)

A graduate of Mechanical Engineering should

PSO 1: Apply mechanical engineering principles to design, develop and implement advanced machine/mechanical systems or process for better performance and less human effort.

PSO 2: Ensure quality by applying quality tools, maintenance principles and managerial skills to comprehend the mechanical engineering processes, products and services.

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VII. Mapping of Course Outcomes with Program Outcomes

SEM	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
SEM I	Language Elective – I	-	-	-	-	-	✓	✓	-	✓	✓	-	-	-	-
	Calculus and Differential Equations	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	-
	Engineering Physics	✓	✓	-	-	✓	✓	-	-	✓	✓	-	✓	-	-
	Engineering Chemistry - I	✓	✓	-	-	-	-	✓	-	✓	✓	-	✓	-	-
	Basics of Electrical Engineering	✓	✓	✓	✓	-	-	✓	✓	-	-	-	✓	✓	-
	Engineering Graphics	✓	✓	-	-	✓	-	-	-	-	✓		✓	✓	
	Workshop (Mechanical)	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	✓
SEM II	Language Elective – II	-	-	-	-	-	✓	✓	✓	✓	✓	-	✓	-	-
	Complex Variables and Laplace Transforms	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
	Physics for Mechanical Engineers	✓	✓	-	-	✓	✓	-	-	-	✓	-	✓	✓	✓
	Chemistry for Mechanical Engineers	✓	✓	-	-	-	-	✓	-	✓	✓	-	✓	-	-
	Basics of Electronics Engineering	✓	✓	-	-	-	-	-	✓	✓	✓	-	✓	-	-
	Problem Solving Using Python Programming	✓	✓	✓	-	-	-	-	✓	✓	✓	-	✓	-	-
	Engineering Mechanics	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
SEM III	Fourier Analysis and Partial Differential Equations	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
	Engineering Thermodynamics	✓	✓	✓	✓	-	-	✓	-	-	-	-	-	✓	-
	Fluid Mechanics and Applications	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-
	Manufacturing Technology - I	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-

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	Material Science and Engineering	✓	-	-	-	-	-	-	✓	-	-	-	✓	✓	-
	Machine Drawing	✓	✓	-	-	✓	-	-	-	-	-	-	✓	✓	-
	Fluid Mechanics Laboratory	✓	✓	✓	✓	✓	-	-	-	✓	-	-	✓	✓	-
	Manufacturing Technology Laboratory - I	✓	✓	-	-	✓	-	-	-	✓	-	-	✓	✓	-
SEM IV	Statistics and Numerical Methods	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-	-
	Kinematics of Machinery	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Mechanics of Solids	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Manufacturing Technology - II	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-
	Engineering Metrology and Measurements	✓	✓	-	-	✓	-	-	-	-	-	-	-	✓	-
	Thermal Engineering	✓	✓	✓	-	-	✓	✓	-	-	-	-	-	✓	-
	Numerical Aptitude and Verbal Ability - I	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
	Mechanics of Solids Laboratory	✓	✓	-	✓	✓	-	-	✓	-	-	-	✓	✓	-
	Manufacturing Technology Laboratory - II	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	✓	-
SEM V	Design of Machine Elements	✓	✓	✓	-	-	-	-	✓	-	-	-	-	✓	-
	Dynamics of Machines	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	-
	Fundamentals of Automation	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓	-
	Numerical Aptitude and Verbal Ability -II	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
	Mechatronics Laboratory	✓	✓	-	✓	✓	-	-	-	-	-	-	✓	✓	-
	Technical Seminar	✓	✓	✓	✓	-	-	-	-	✓	✓	-	✓	✓	-
SEM VI	Design of Transmission System	✓	✓	✓	-	-	-	-	✓	-	-	-	-	✓	-
	Heat and Mass Transfer	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-

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	Finite Element Analysis	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Simulation and Analysis Laboratory	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	-
	Thermal Engineering Laboratory	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	-
	Mini Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM VII	Total Quality Management	✓	✓	-	-	-	-	✓	-	-	-	✓	-	-	✓	✓
	Operations Research	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	✓	✓
	Automobile Engineering	✓	-	-	-	-	-	-	-	-	-	-	-	✓	✓	-
	Computer Aided Modelling and Machining Laboratory	✓	✓	✓	-	✓	-	-	-	✓	✓	-	-	✓	-	-
SEM VIII	Project work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TRACK I	Design for Manufacture and Assembly	✓	✓	✓	-	✓	✓	✓	-	✓	-	-	-	✓	-	-
	Computer Aided Design	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
	Machine Tool Design	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
	Tool and Die Design	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-
	Product Life Cycle Management	✓	✓	✓	-	-	✓	-	✓	✓	✓	✓	-	✓	-	-
	FMEA and Prototyping	✓	✓	-	-	✓	-	-	-	-	-	-	✓	✓	✓	✓
	Product Development and Reverse Engineering	✓	✓	✓	-	✓	-	✓	✓	-	✓	✓	✓	✓	✓	✓
TRACK II	Non-Destructive Testing of Materials	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-	-
	Smart Materials	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
	Bio Materials and Ceramics	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
	Mechanics of Composite Materials	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-	-

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	Non-Traditional Machining Processes	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
	Welding Technology	✓	-	-	-	-	✓	-	-	-	-	-	✓	✓	-	
	Foundry Practices and Management	✓	✓	-	-	-	✓	-	-	-	-	-	-	✓	-	
	Additive Manufacturing	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-	
TRACK III	Project Management	✓	✓	✓	-	✓	-	-	-	-	✓	✓	✓	-	-	
	Maintenance and Erection Engineering	✓	-	-	-	✓	✓	✓	-	-	-	✓	-	-	✓	
	Process Planning and Cost Estimation	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	
	Plant Layout and Materials Handling	✓	✓	-	-	✓	-	-	-	-	-	-	-	✓	✓	
	Statistical Process Control	✓	✓	✓	✓	✓	-	-	✓	-	-	✓	✓	-	✓	
	Computer Integrated Manufacturing	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	✓	
	Lean Supply Chain Management	✓	✓	✓	-	-	-	-	-	-	-	✓	-	✓	✓	
TRACK IV	Gas Dynamics and Jet Propulsion	✓	✓	✓	✓	✓	-	-	-	✓	-	-	✓	-	✓	
	Heating, Ventilation and Air Conditioning	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-	
	Cogeneration and Waste Heat Recovery	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	
	Energy Management and Equipment Design	✓	✓	✓	✓	-	-	✓	-	✓	-	-	-	✓	-	
	Refrigeration and Air Conditioning	✓	✓	✓	✓	-	✓	✓	-	-	-	-	-	✓	-	
	Computational Fluid Dynamics	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-	
	Power Plant Engineering	✓	-	-	-	-	✓	✓	-	-	-	-	-	✓	-	
	Renewable Energy Resources and Systems	✓	-	-	-	-	✓	✓	-	-	-	-	-	✓	-	
TRACK	Microcontrollers and PLC	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-	

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	Industrial Robotics	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-
	Industrial Internet of Things	✓	-	-	-	-	-	-	-	-	-	-	-	✓	✓
	Robot Sensor and Language	✓	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	-
	MEMS and NEMS	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓	✓	-
	Industry 4.0	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓
	Artificial Intelligence for Robotics	✓	✓	✓	-	✓	-	-	-	✓	-	-	-	✓	-
	Machine Vision	✓	-	-	-	✓	-	-	-	-	-	-	-	-	✓
TRACK VI	Two and Three Wheelers Engineering	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	Automatic Transmission	✓	✓	✓	-	✓	-	-	-	✓	-	-	-	✓	-
	Automotive Engine and Subsystems	✓	✓	-	✓	✓	-	-	-	-	-	-	✓	-	✓
	Automotive Electrical and Electronics Systems	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-
	Autotronics	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-
	Vehicle Body Engineering	✓	✓	-	-	✓	-	-	-	-	-	-	-	✓	-
	Electric and Hybrid Vehicles	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓	-
TRACK VII	Small Business Management	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓
	Entrepreneurship and Business Models	✓	-	-	-	-	✓	✓	-	✓	✓	✓	✓	-	-
	Business Idea Generation and Support Institutions	-	-	-	-	-	✓	-	✓	✓	✓	✓	-	-	-
	Intellectual Property Rights	-	-	-	-	-	-	-	✓	✓	-	✓	✓	-	-
TRACK VIII	Comprehension - I	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-
	Comprehension - II	✓	✓	✓	-	✓	-	-	-	-	-	-	✓	✓	✓

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B.E. MECHANICAL ENGINEERING

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I - VIII SEMESTERS

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1		Language Elective I*	HSM	1	0	2	2
2	U19MA101	Calculus and Differential Equations	BS	3	1	0	4
3	U19PH101	Engineering Physics	BS	2	0	2	3
4	U19CY101	Engineering Chemistry I	BS	2	0	2	3
5	U19EEG04	Basics of Electrical Engineering	ES	3	0	0	3
PRACTICALS							
6	U19MEG01	Engineering Graphics	ES	1	0	4	3
7	U19ME101	Workshop (Mechanical)	ES	0	0	4	2
			TOTAL	12	1	14	20

* U19LE102-Communicative English / U19LE101-Basic English

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1		Language Elective II**	HSM	1	0	2	2
2	U19MA201	Complex Variables and Laplace Transforms	BS	3	1	0	4
3	U19PH205	Physics for Mechanical Engineers	BS	3	0	0	3
4	U19CY205	Chemistry for Mechanical Engineers	BS	2	0	2	3
5	U19ECG03	Basics of Electronics Engineering	ES	2	0	2	3
6	U19CSG01	Problem Solving Using Python Programming	ES	2	0	2	3
7	U19ME201	Engineering Mechanics	ES	3	0	0	3
			TOTAL	16	1	8	21

** U19LE201- Advanced Communicative English/ U19LE20X - Other languages

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SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19MA303	Fourier Analysis and Partial Differential Equations	BS	3	1	0	4
2	U19ME301	Engineering Thermodynamics	ES	3	1	0	4
3	U19ME302	Fluid Mechanics and Applications	PC	3	0	0	3
4	U19ME303	Manufacturing Technology - I	PC	3	0	0	3
5	U19ME304	Material Science and Engineering	ES	3	0	0	3
6	U19ME305	Machine Drawing	PC	2	0	2	3
PRACTICALS							
7	U19ME306	Fluid Mechanics Laboratory	PC	0	0	2	1
8	U19ME307	Manufacturing Technology Laboratory - I	PC	0	0	2	1
			TOTAL	17	2	6	22

SEMESTER IV

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19MA405	Statistics and Numerical Methods	BS	3	0	0	3
2	U19ME401	Kinematics of Machinery	PC	3	0	0	3
3	U19ME402	Mechanics of Solids	PC	3	0	0	3
4	U19ME403	Manufacturing Technology - II	PC	3	0	0	3
5	U19ME404	Engineering Metrology and Measurements	PC	2	0	2	3
6	U19ME405	Thermal Engineering	PC	3	0	0	3
7	U19CA001	Numerical Aptitude and Verbal Ability - I	EEC	1	0	0	1
PRACTICALS							
8	U19ME406	Mechanics of Solids Laboratory	PC	0	0	2	1
9	U19ME407	Manufacturing Technology Laboratory - II	PC	0	0	2	1
			TOTAL	18	0	6	21

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SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	U19ME501	Design of Machine Elements	PC	3	0	0	3
2	U19ME502	Dynamics of Machines	PC	2	1	1	4
3	U19ME503	Fundamentals of Automation	PC	3	0	0	3
4	-	Professional Elective I	PE	3	0	0	3
5	-	Open Elective I	OE	3	0	0	3
6	-	Open Elective II	OE	3	0	0	3
7	U19CA002	Numerical Aptitude and Verbal Ability II	EEC	1	0	0	1
		PRACTICALS					
8	U19ME504	Mechatronics Laboratory	PC	0	0	2	1
9	U19ME505	Technical Seminar	EEC	0	0	2	1
			TOTAL	18	1	5	22

SEMESTER VI

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	U19ME601	Design of Transmission System	PC	3	0	0	3
2	U19ME602	Heat and Mass Transfer	PC	3	0	0	3
3	U19ME603	Finite Element Analysis	PC	3	0	0	3
4	-	Professional Elective II	PE	3	0	0	3
5	-	Open Elective III	OE	3	0	0	3
6	-	Open Elective IV	OE	3	0	0	3
		PRACTICALS					
7	U19ME604	Simulation and Analysis Laboratory	PC	0	0	2	1
8	U19ME605	Thermal Engineering Laboratory	PC	0	0	2	1
9	U19ME606	Mini Project	EEC	0	0	2	1
			TOTAL	18	0	6	21

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SEMESTER VII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	U19ME701	Total Quality Management	HSM	3	0	0	3
2	U19ME702	Operations Research	HSM	3	1	0	4
3	U19ME703	Automobile Engineering	PC	2	0	2	3
4	-	Professional Elective III	PE	3	0	0	3
5	-	Professional Elective IV	PE	3	0	0	3
6	-	Open Elective V	OE	3	0	0	3
PRACTICALS							
7	U19ME704	Computer Aided Modelling and Machining Laboratory	PC	0	0	2	1
			TOTAL	17	1	4	20

SEMESTER VIII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	-	Professional Elective – V	PE	3	0	0	3
2	-	Professional Elective - VI	PE	3	0	0	3
PRACTICALS							
3	U19ME801	Project work	EEC	0	0	20	10
			TOTAL	6	0	20	16

INDUSTRIAL INTERNSHIP

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19CEI01	Industrial Training / Internship * (4 Weeks)	EEC	0	0	0	2
			TOTAL	0	0	0	2

*Four Weeks during any semester vacation from III to VI Semester

TOTAL CREDITS: 165

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PROFESSIONAL ELECTIVE COURSES (PE)

TRACK I – ENGINEERING DESIGN

Sl.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP01	Design for Manufacture and Assembly	3	0	0	3
2	U19MEP02	Computer Aided Design	3	0	0	3
3	U19MEP10	Machine Tool Design	3	0	0	3
4	U19MEP20	Tool and Die Design	3	0	0	3
5	U19MEP30	Product Life Cycle Management	3	0	0	3
6	U19MEP31	FMEA and Prototyping	3	0	0	3
7	U19MEP38	Product Development and Reverse Engineering	3	0	0	3

TRACK II – MATERIALS AND MANUFACTURING

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP03	Non-Destructive Testing of Materials	3	0	0	3
2	U19MEP11	Smart Materials	3	0	0	3
3	U19MEP12	Bio Materials and Ceramics	3	0	0	3
4	U19MEP21	Mechanics of Composite Materials	3	0	0	3
5	U19MEP22	Non-Traditional Machining Processes	3	0	0	3
6	U19MEP32	Welding Technology	3	0	0	3
7	U19MEP39	Foundry Practices and Management	3	0	0	3
8	U19MEP46	Additive Manufacturing	3	0	0	3

TRACK III – INDUSTRIAL ENGINEERING

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP04	Project Management	3	0	0	3
2	U19MEP05	Maintenance and Erection Engineering	3	0	0	3
3	U19MEP13	Process Planning and Cost Estimation	3	0	0	3
4	U19MEP23	Plant Layout and Materials Handling	3	0	0	3
5	U19MEP24	Statistical Process Control	3	0	0	3
6	U19MEP33	Computer Integrated Manufacturing	3	0	0	3
7	U19MEP40	Lean Supply Chain Management	3	0	0	3
8	U19MEP47	Lean Six Sigma	3	0	0	3

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TRACK IV – THERMAL ENGINEERING

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP06	Gas Dynamics and Jet Propulsion	3	0	0	3
2	U19MEP14	Heating, Ventilation and Air Conditioning	3	0	0	3
3	U19MEP15	Cogeneration and Waste Heat Recovery	3	0	0	3
4	U19MEP25	Energy Management and Equipment Design	3	0	0	3
5	U19MEP26	Refrigeration and Air Conditioning	3	0	0	3
6	U19MEP34	Computational Fluid Dynamics	3	0	0	3
7	U19MEP41	Power Plant Engineering	3	0	0	3
8	U19MEP48	Renewable Energy Resources and Systems	3	0	0	3

TRACK V – ROBOTICS AND AUTOMATION

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP07	Microcontrollers and PLC	3	0	0	3
2	U19MEP08	Industrial Robotics	3	0	0	3
3	U19MEP16	Industrial Internet of Things	3	0	0	3
4	U19MEP17	Robot Sensor and Language	3	0	0	3
5	U19MEP27	MEMS and NEMS	3	0	0	3
6	U19MEP35	Industry 4.0	3	0	0	3
7	U19MEP42	Artificial Intelligence for Robotics	3	0	0	3
8	U19MEP49	Machine Vision	3	0	0	3

TRACK VI – AUTOMOBILE ENGINEERING

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP09	Two and Three Wheelers Engineering	3	0	0	3
2	U19MEP18	Automatic Transmission	3	0	0	3
3	U19MEP28	Automotive Engine and Subsystems	3	0	0	3
4	U19MEP36	Automotive Electrical and Electronics Systems	3	0	0	3
5	U19MEP37	Autotronics	3	0	0	3
6	U19MEP43	Vehicle Body Engineering	3	0	0	3
7	U19MEP50	Electric and Hybrid Vehicles	3	0	0	3

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ENTREPRENEURSHIP TRACK

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP44	Small Business Management	3	0	0	3
2	U19MEP45	Entrepreneurship and Business Models	3	0	0	3
3	U19MEP51	Business Idea Generation and Support Institutions	3	0	0	3
4	U19MEP52	Intellectual Property Rights	3	0	0	3
5	U19MEP52	Design Thinking	2	0	2	3

COMPREHENSIVE COURSES

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19MEP19	Comprehension - I	3	0	0	3
2	U19MEP29	Comprehension - II	3	0	0	3

HUMANITIES AND SCIENCES (HSM)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19LE101	Basic English	HSM	1	0	2	2
2	U19LE102	Communicative English	HSM	1	0	2	2
3	U19LE201	Advanced Communicative English	HSM	1	0	2	2
4	U19ME701	Total Quality Management	HSM	3	0	0	3
5	U19CE701	Construction Project Management	HSM	3	0	0	3

BASIC SCIENCE COURSES (BS)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MA101	Calculus and Differential Equations	BS	3	1	0	4
2	U19PH101	Engineering Physics	BS	2	0	2	3
3	U19CY101	Engineering Chemistry – I	BS	2	0	2	3
4	U19MA201	Complex Variables and Laplace Transforms	BS	3	1	0	4
5	U19PH205	Physics for Mechanical Engineers	BS	3	0	0	3
6	U19CY205	Chemistry for Mechanical Engineers	BS	3	1	0	4
7	U19MA303	Fourier Analysis and Partial Differential Equations	BS	3	0	0	3
8	U19MA405	Statistics and Numerical Methods	BS	3	0	0	3

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ENGINEERING SCIENCE COURSES (ES)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19EEG04	Basics of Electrical Engineering	ES	3	0	0	3
2	U19MEG01	Engineering Graphics	ES	1	0	4	3
3	U19ME101	Workshop (Mechanical)	ES	0	0	4	2
4	U19ECG03	Basics of Electronics Engineering	ES	2	0	2	3
5	U19ME201	Engineering Mechanics	ES	3	0	0	3
6	U19CSG01	Problem Solving Using Python Programming	ES	2	0	2	3
7	U19ME301	Engineering Thermodynamics	ES	3	1	0	4
8	U19ME304	Material Science and Engineering	ES	3	0	0	3

PROFESSIONAL CORE COURSES (PC)

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19ME302	Fluid Mechanics and Applications	PC	3	0	0	3
2	U19ME303	Manufacturing Technology - I	PC	3	0	0	3
3	U19ME305	Machine Drawing	PC	2	0	2	3
4	U19ME306	Fluid Mechanics Laboratory	PC	0	0	2	1
5	U19ME307	Manufacturing Technology Laboratory - I	PC	0	0	2	1
6	U19ME401	Kinematics of Machinery	PC	3	0	0	3
7	U19ME402	Mechanics of Solids	PC	3	0	0	3
8	U19ME403	Manufacturing Technology - II	PC	3	0	0	3
9	U19ME404	Engineering Metrology and Measurements	PC	2	0	2	3
10	U19ME405	Thermal Engineering	PC	3	0	0	3
11	U19ME406	Mechanics of Solids Laboratory	PC	0	0	2	1
12	U19ME407	Manufacturing Technology Laboratory - II	PC	0	0	2	1
13	U19ME501	Design of Machine Elements	PC	3	0	0	3
14	U19ME502	Dynamics of Machines	PC	2	1	1	4
15	U19ME503	Fundamentals of Automation	PC	3	0	0	3
16	U19ME504	Mechatronics Laboratory	PC	0	0	2	1
17	U19ME601	Design of Transmission Systems	PC	3	0	0	3
18	U19ME602	Heat and Mass Transfer	PC	3	0	0	3
19	U19ME603	Finite Element Analysis	PC	3	0	0	3
20	U19ME604	Simulation and Analysis Laboratory	PC	0	0	2	1
21	U19ME606	Thermal Engineering Laboratory	PC	0	0	2	1
22	U19ME702	Automobile Engineering	PC	3	0	0	3
23	U19ME703	Computer Aided Modelling and Machining Laboratory	PC	2	0	2	3

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PROFESSIONAL ELECTIVES I

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MEP01	Design for Manufacture and Assembly	PE	3	0	0	3
2	U19MEP02	Computer Aided Design	PE	3	0	0	3
3	U19MEP03	Non-Destructive Testing of Materials	PE	3	0	0	3
4	U19MEP04	Project Management	PE	3	0	0	3
5	U19MEP05	Maintenance and Erection Engineering	PE	3	0	0	3
6	U19MEP06	Gas Dynamics and Jet Propulsion	PE	3	0	0	3
7	U19MEP07	Microcontrollers and PLC	PE	3	0	0	3
8	U19MEP08	Industrial Robotics	PE	3	0	0	3
9	U19MEP09	Two and Three-Wheeler Engineering	PE	3	0	0	3

PROFESSIONAL ELECTIVES II

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MEP10	Machine Tool Design	PE	3	0	0	3
2	U19MEP11	Smart Materials	PE	3	0	0	3
3	U19MEP12	Bio Materials and Implant Materials	PE	3	0	0	3
4	U19MEP13	Process Planning and Cost Estimation	PE	3	0	0	3
5	U19MEP14	Heating, Ventilation and Air Conditioning	PE	3	0	0	3
6	U19MEP15	Cogeneration and Waste Heat Recovery	PE	3	0	0	3
7	U19MEP16	Industrial internet of Things	PE	3	0	0	3
8	U19MEP17	Robot Sensor and Language	PE	3	0	0	3
9	U19MEP18	Automatic Transmission	PE	3	0	0	3
10	U19MEP19	Comprehension - I	PE	3	0	0	3

PROFESSIONAL ELECTIVES III

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MEP20	Tool and Die Design	PE	3	0	0	3
2	U19MEP21	Composite Materials and Mechanics	PE	3	0	0	3
3	U19MEP22	Non-Traditional Machining Process	PE	3	0	0	3
4	U19MEP23	Plant Layout and Materials Handling	PE	3	0	0	3
5	U19MEP24	Statistical Process Control	PE	3	0	0	3
6	U19MEP25	Energy Management and Equipment Design	PE	3	0	0	3
7	U19MEP26	Refrigeration and Air Conditioning	PE	3	0	0	3
8	U19MEP27	MEMS and NEMS	PE	3	0	0	3
9	U19MEP28	Automotive Engine and Subsystems	PE	3	0	0	3
10	U19MEP29	Comprehension - II	PE	3	0	0	3

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PROFESSIONAL ELECTIVES IV

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MEP30	Product Life Cycle Management	PE	3	0	0	3
2	U19MEP31	FMEA and Prototyping	PE	3	0	0	3
3	U19MEP32	Welding Technology	PE	3	0	0	3
4	U19MEP33	Computer Integrated Manufacturing	PE	3	0	0	3
5	U19MEP34	Computational Fluid Dynamics	PE	3	0	0	3
6	U19MEP35	Industry 4.0	PE	3	0	0	3
7	U19MEP36	Automotive Electrical and Electronics System	PE	3	0	0	3
8	U19MEP37	Autotronics	PE	3	0	0	3

PROFESSIONAL ELECTIVES V

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MEP38	Product Development and Reverse Engineering	PE	3	0	0	3
2	U19MEP39	Foundry Practices and Management	PE	3	0	0	3
3	U19MEP40	Lean Supply Chain Management	PE	3	0	0	3
4	U19MEP41	Power Plant Engineering	PE	3	0	0	3
5	U19MEP42	Artificial Intelligence for Robotics	PE	3	0	0	3
6	U19MEP43	Vehicle Body Engineering	PE	3	0	0	3
7	U19MEP44	Small Business Management	PE	3	0	0	3
8	U19MEP45	Entrepreneurship and Business Models	PE	3	0	0	3

PROFESSIONAL ELECTIVES VI

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	U19MEP46	Additive Manufacturing	PE	3	0	0	3
2	U19MEP47	Lean Six Sigma	PE	3	0	0	3
3	U19MEP48	Renewable Energy Resources and Systems	PE	3	0	0	3
4	U19MEP49	Machine Vision	PE	3	0	0	3
5	U19MEP50	Electric and Hybrid Vehicles	PE	3	0	0	3
6	U19MEP51	Business Idea Generation and Support Institutions	PE	3	0	0	3
7	U19MEP52	Intellectual Property Rights	PE	3	0	0	3
8	U19MEP53	Design Thinking	PE	2	0	2	3

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	U19ME505	Technical Seminar	0	0	2	1
2	U19ME605	Mini Project	0	0	2	1
3	U19ME801	Project work	0	0	20	10
4	U19CA001	Numerical Aptitude and Verbal Ability - I	0	0	2	1
5	U19CA002	Numerical Aptitude and Verbal Ability - II	0	0	2	1

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VIII. Scheme of Credit distribution – Summary

Sl.No	Stream	Credits/Semester								Credits	%	Suggested by AICTE
		I	II	III	IV	V	VI	VII	VIII			
1.	Humanities and Social Sciences including Management (HSM)	2	2	-	-	-	-	7	-	11	7%	12
2.	Basic Sciences (BS)	10	10	4	3	-	-	-	-	27	16%	25
3.	Engineering Sciences(ES)	8	9	7	-	-	-	-	-	24	14%	24
4.	Professional Core (PC)	-	-	11	17	11	11	4	-	54	33%	48
5.	Professional Elective (PE)	-	-	-	-	3	3	6	6	18	11%	18
6.	Open Electives (OE)	-	-	-	-	6	6	3		15	9%	18
7.	Employability Enhancement Courses (EEC)	-	-	-	1	2	1	-	10	14	10%	15
8.	Industrial Training/ Internship	-	-	-	-	-	-	-	-	2		
9.	Mandatory Non-Credit Course (MNC)	-	-	-	-	-	-	-	-	-	-	-
Total		20	21	22	21	22	21	20	16	165	100	160

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SEMESTER I

U19LE101	BASIC ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE-REQUISITES

- Nil

COURSE OBJECTIVE

- Read the text, understand and write the meaning under Technical, Business, Social and Academic contexts.
- Listen and comprehend monologues, dialogues and discussions.
- Speak effectively with appropriate use of words and participate in discussions.

UNIT I BASICS FOR COMMUNICATION 9

Regular & Irregular Verbs - Modal Verbs - Prepositions - Tenses - Subject Verb Agreement - Spotting Errors - Homonyms & Homophones - Phrasal Verbs – Single word Substitute - Word formation – Reported Speech

UNIT II LISTENING 9

Listening for Specific Information - Listening to short texts - Listening to Product description and Process - Listening to Formal and Informal Conversations - Listening to Announcements - Listening Comprehension

UNIT III SPEAKING 9

Introducing Oneself - Seeking and Sharing Information - JAM – Enquiring - asking for clarification - Describing a Place, Person, Process, Product and Experience - Current Affairs- Making Presentation

UNIT IV READING 9

Reading for Information - Skimming - Scanning – Predicting the Content - Reading Comprehension - Reading short texts - Proof Reading (Editing)

UNIT V WRITING 9

Memo - Email - Letter Writing (Formal & Informal) - Dialogue Writing -Descriptive Writing - Instructions - Filling forms of Application – Paraphrasing.

LIST OF EXPERIMENTS

1 Listening for information
2 Listening to announcements
3 Listening to stories
4 Song based listening
5 Listening to conversation
6 Self-Introduction
7 Just a Minute
8 Story Narration
9 Picture description
10 Movie Review

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Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: 30 Periods Total: 45 Periods

TEXT BOOKS

1 Mindscapes: English for Technologists and Engineers", Orient Black Swan, 2014.

2 Sudharshana N.P & Savitha C."English for Technical Communication". Cambridge University Press 2016

REFERENCE

1 Murphy, Raymond. "Intermediate English Grammar". Cambridge University Press. 2009.

2 Means, Thomas L. "English and Communication for Colleges". Cengage, 2017.

3 Using English: A Course book for Undergraduate Engineers and Technologists". Orient Black Swan, 2017.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Outcome	K-Level
CO1	Use appropriate vocabulary required for spoken and written communication.	Remember
CO2	Comprehend and answer questions and take part in conversations.	Understand
CO3	Participate in discussions and presentations.	Apply
CO4	Understand the meaning of the content present in letters, reports and newspaper.	Understand
CO5	Draft letters, emails and make notes with appropriate use of words.	Apply

COURSE ARTICULATION MATRIX

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO2	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO3	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO4	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO5	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO	-	-	-	-	-	2	1	-	3	3	-	-	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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U19LE102	COMMUNICATIVE ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE-REQUISITES

Nil

COURSE OBJECTIVE

- Develop the ability to read, write and comprehend various texts.
- Enhance the listening skills to understand conversations and deliberations on diverse contexts.
- Make effective presentations and demonstrate concepts within a team

UNIT I BASICS FOR COMMUNICATION 9

Active & Passive - Conditionals - Reported Speech - Degrees of Comparison- Phrases and Clauses - Idioms-Kinds of Sentences - Connectives & Discourse markers - Idioms - Purpose Statement.

UNIT II LISTENING 9

Listening to TED Talks - Listening to Product Description - Listening to Orations - Listening to News - Radio Based Listening

UNIT III SPEAKING 9

Group Discussion - Extempore - Technical Seminars-Product & Process Description - Role Play - Conversation and Etiquettes - Short group conversation - Narrating a story - Formal and Informal Discussions

UNIT IV READING 9

Pre - Reading &Post - Reading -Intensive Reading - Extensive Reading - Newspaper Reading - Reading Longer texts - Reviewing Company Profile - Reading Strategies - Interpreting Visual Graphics

UNIT V WRITING 9

Interpreting Charts and Graphs – Recommendations - Minutes of Meeting - Job Application and Cover Letter - Report Writing - Drafting Circulars (Business Context)

LIST OF EXPERIMENTS

1 Listening to TED talks
2 Listening to Product Description
3 Listening to News
4 Radio based listening
5 Listening to Oration
6 Self-Introduction
7 Role Play
8 Extempore
9 Presentation
10 Group Discussion

Contact Periods:

Lecture: 15 Periods Tutorial: - Periods Practical: 30 Periods Total: 45 Periods

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Learn Beyond

TEXT BOOKS

1 Mindscapes: English for Technologists and Engineers", Orient Black Swan, 2014.

2 Sudharshana NP & Savitha C. "English for Technical Communication". Cambridge University Press, 2016

REFERENCE

1 Murphy, Raymond. "Intermediate English Grammar". Cambridge University Press. 2009.

2 Means, Thomas L. "English and Communication for Colleges". Cengage, 2017.

3 Using English: A Course book for Undergraduate Engineers and Technologists". Orient BlackSwan, 2017.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Outcome	K-Level
CO1	Make use of relevant vocabulary in formal and informal contexts.	Apply
CO2	Infer and exhibit the ability to listen various professional interactions.	Understand
CO3	Express views and perceptions in a technical forum.	Understand
CO4	Interpret a given text and relate the content effectively.	Understand
CO5	Frame coherent and cohesive sentences in select contexts.	Understand

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO2	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO3	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO4	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO5	-	-	-	-	-	2	1	-	3	3	-	-	-	-
CO	-	-	-	-	-	2	1	-	3	3	-	-	-	-
Correlation levels:	1: Slight (Low)					2: Moderate (Medium)				3: Substantial (High)				

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SEMESTER I

U19MA101	CALCULUS AND DIFFERENTIAL EQUATIONS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE-REQUISITES

- Nil

COURSE OBJECTIVE

- Understand the concepts of matrices and calculus which will enable them to model and analyze physical phenomena involving continuous change.
- Apply and summarize the methodologies involved in solving problems related to fundamental principles of calculus.
- Develop confidence to model mathematical pattern and give appropriate solutions.

UNIT I MATRICES **9+3**

Eigenvalues and Eigenvectors –Properties (without proof)–Cayley Hamilton theorem (without proof) – Diagonalization using orthogonal transformation–Applications: Elastic membrane.

UNIT II DIFFERENTIAL CALCULUS **9+3**

Curvature – radius of curvature (Cartesian form only) – center– circle of curvature – evolute and envelope of plane curves.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Partial derivatives-total derivative – Jacobians – Taylor's Series expansion - extreme values of functions of two variables – Lagrange multipliers method.

UNIT IV INTEGRAL CALCULUS **9+3**

Evaluation of definite and improper integrals - Applications of definite integrals – surface areas – volume of revolutions.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Second and Higher order linear differential equations with constant coefficients – variable coefficients – Euler Cauchy equation – Legendre equation – Method of variation of parameters – Applications.

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS

1 Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt Ltd, New Delhi, 2018.
2 B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017

REFERENCE

1 N.P.Bali and Manish Goyel, A text book of Engineering Mathematics, Laxmi Publications; Twelfth edition, 2016.
2 G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, Pearson Education India; 14th edition, 2018
3 Maurice D. Weir, Joel Hass, Christopher Heil, "Thomas Calculus", Pearson Education, Uttar Pradesh, 2018.
4 James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

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COURSE OUTCOMES (CO)

Upon completion of the course, the students will be able to

COs	Statements	K-Level
CO1	Apply the knowledge of matrices with the concepts of eigenvalues to study their problems in core areas.	Apply
CO2	Study the behavior of a function at infinity, knowledge on curvature with its properties in Cartesian form.	Apply
CO3	Develop competency in Apply the idea of Lagrange multipliers to find extreme of functions with constraints.	Apply
CO4	Compute area and volume using definite and improper integrals.	Apply
CO5	Model the problems, when the particle changes with respect to its velocity, acceleration using higher order differential equations.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER I

U19PH101	ENGINEERING PHYSICS	Category: HSM			
		L	T	P	C
		2	0	2	3

PRE-REQUISITES

- Higher Secondary Physics

COURSE OBJECTIVE

- To understand the concepts of surface tension, flow of liquids, heat transfer and thermal conductivity of materials.
- To acquire the knowledge of ultrasonic waves and its production methods with its industrial and medical applications.
- To understand the fundamental principles of laser and fiber optics with their applications.

UNIT I PROPERTIES OF LIQUIDS 6

Surface tension - Determination of surface tension by Jaegers method - Effect of temperature on surface tension - viscosity - coefficient of viscosity - Streamline and turbulent flow - Stokes law and terminal velocity - Poiseuille's equation for flow of a liquid through a capillary tube and experimental determination.

UNIT II HEAT 6

Modes of heat transfer - thermal properties (solids and liquids) - Specific heat capacity, thermal capacity thermal diffusivity and coefficient of linear thermal expansion - Lee's disc method for determination of thermal conductivity- heat conduction through compound media (series & parallel) - Solar water heater.

UNIT III ULTRASONICS 6

Properties of ultrasonic waves - Production of ultrasonic waves - Magnetostrictive generator - Piezoelectric generator - Acoustic grating - Applications - SONAR - cavitation – drilling and welding - nondestructive testing (flaw detection) - medical applications (fetus heart movement).

UNIT IV LASER 6

Laser Characteristics - Spatial and Temporal Coherence - Einstein Coefficient and its importance, Population inversion, optical resonator - Pumping methods - Nd-YAG - CO_2 - material processing (drilling, welding) - medical applications in ophthalmology.

UNIT V FIBRE OPTICS 6

Fiber optic cable feature - total internal reflection - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials – Fiber optical communication – medical endoscopy.

LIST OF EXPERIMENTS

LISTENING

1 Determination of viscosity of the given liquid using Poiseuille's flow method
2 Determination of thermal conductivity of a bad conductor – Lee's Disc method
3 Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
4 Determination of particle size of lycopodium powder using Laser light
5 Determination of wavelength of a given laser source
6 Determination of acceptance angle and numerical aperture of an optical fiber using laser source
7 Determination of dispersive power of prism using Spectrometer
8 Determination of refractive index of a liquid using Spectrometer

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Contact Periods:

Lecture: 30 Periods Tutorial: - Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS

1 Bhattacharya, D.K. & Poonam Tandon, T. "Engineering Physics". Oxford University Press, 2016

2 Pandey, B.K. &Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2018

REFERENCE

1 Arumugam, M. "Engineering Physics". Anuradha Publishers, 2014.

2 Murugeshan, R. "Properties of matter". S.Chand & company Ltd, 2010.

3 Gaur, R.K. & Gupta, S.L. "Engineering Physics". DhanpatRai Publishers, 2016.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the concept of surface tension and viscosity of liquids	Understand
CO2	Interpret the thermal properties of materials and apply to the field of engineering.	Understand
CO3	Illustrate the production methods of ultrasonic waves and use it for the field of engineering and medicine.	Understand
CO4	Demonstrate the types of laser for various industrial and medical applications.	Apply
CO5	Classify the fibre optic cable and study its engineering applications.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1	-	-	1	1	-	-	2	1	-	1	-	-
CO2	3	1	-	-	1	1	-	-	2	1	-	1	-	-
CO3	3	1	-	-	1	1	-	-	2	1	-	1	-	-
CO4	3	1	-	-	1	1	-	-	2	1	-	1	-	-
CO5	3	1	-	-	1	1	-	-	2	1	-	1	-	-
CO	3	1	-	-	1	1	-	-	2	1	-	1	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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U19CY101	ENGINEERING CHEMISTRY - I	Category: HSM			
		L	T	P	C
		2	0	2	3

PRE-REQUISITES

Nil

COURSE OBJECTIVE

- To inculcate the fundamentals of water technology and electrochemistry.
- To gain basic knowledge of corrosion of metals and change of phases in alloys.
- To acquire knowledge about the preparation, properties and applications of nanomaterials

UNIT I WATER 6

Hardness of water – types – problems in hardness calculations – estimation of hardness by EDTA – boiler feed water – boiler trouble (scale, sludge, priming, foaming and caustic embrittlement) – softening methods – internal treatment (phosphate & calgon) – external treatment (deionization process) – desalination of water- reverse osmosis.

UNIT II ELECTROCHEMISTRY 6

Electrochemical cells – types – galvanic cells – redox reactions – EMF – concept of electrode potential - electrodes (Standard Hydrogen and Calomel electrode) – Nernst equation (derivation only) - electrochemical series and its applications – estimation of iron by potentiometry, determination of pH by pH metry.

UNIT III CORROSION AND ITS CONTROL 6

Types – chemical corrosion – electrochemical corrosion (galvanic & differential aeration) – factors influencing corrosion – corrosion control methods – sacrificial anode and impressed current method – protective coating – electroplating – Ni plating.

UNIT IV PHASE RULE AND ALLOYS 6

Phase rule – explanation of terms – advantages and limitations of phase rule – application of phase rule to one component system (water) – reduced phase rule – two component system (simple eutectic system - Lead – silver system) – alloys – definition – purpose of making alloys –ferrous (stainless steel), heat treatment – non-ferrous alloys (Brass -Dutch metal, German Silver) - composition, properties and uses.

UNIT V NANOCHEMISTRY AND ITS APPLICATIONS 6

Types – properties of nanomaterials – size dependent properties – general methods of synthesis – top down (laser ablation and CVD) – bottom up (solvothermal and precipitation) – Application of nanotechnology (medicine, electronics, defence and agriculture).

S.No. NAME OF THE EXPERIMENT

1. Determination of total, permanent and temporary hardness of a given sample water by EDTA method
2. Determination of chloride content in the water sample
3. Estimation of ferrous ion by potentiometric titration
4. Determination of strength of HCl by pH metric method
5. Determination of corrosion rate by weight loss method
6. Electroplating of Cu and electro less plating of Cu
7. Estimation of Copper in Brass by EDTA method
8. Determination of phase and degrees of freedom in $CuSO_4.5H_2O$ / KI and water / $FeCl_3$
9. Preparation of nano ruby (Al_2O_3-Cr) by combustion method
10. Preparation of nano ZnO by co-precipitation method

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Contact Periods:

Lecture: 30 Periods Tutorial: - Periods Practical: – 30 Periods Total: 60 Periods

TEXT BOOKS

1 P. C. Jain and Monika Jain, —**Engineering Chemistry**, DhanpatRai Publishing Company (P) LTD, New Delhi, 2015.

2 S. Vairam, P. Kalyani and Suba Ramesh —**Engineering Chemistry**, Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE

1 Friedrich Emich, —**Engineering Chemistry**, Scientific International PVT, LTD, New Delhi, 2014

2 Prasanta Rath, —**Engineering Chemistry**, Cengage Learning India PVT, LTD, Delhi, 2015.

3 Shikha Agarwal, —**Engineering Chemistry,** Fundamentals and Applications, Cambridge University, Press, Delhi, 2015.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the principles of water technology in treatment of industrial and domestic water and estimate the various constituents of industrial water.	Apply
CO2	Describe the utilization of electrochemical principles for chemical cells and determine experimentally the EMF of the cells.	Understand
CO3	Gain the knowledge of corrosion and prevention methods adopted in industries.	Understand
CO4	Examine the number of phases, components and variants in different heterogeneous systems, construct the phase diagrams and ferrous alloys, composition and applications and relate the change in properties due to heat treatment.	Understand
CO5	Classify the different nanomaterials, recall their properties and relate them to applications.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO2	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO3	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO4	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO5	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO	3	1	-	-	-	-	2	-	1	1	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER I

U19EEG04	BASICS OF ELECTRICAL ENGINEERING	Category: ES			
		L	T	P	C
		3	0	0	3

PRE-REQUISITES

- Nil

COURSE OBJECTIVE

- To acquire the knowledge on basics of electrical circuits and machines.
- To understand the working principle and applications of fractional HP machines.
- To select the drive motor based on thermal overloading and load variation factors.

UNIT I BASIC CONCEPTS OF ELECTRIC CIRCUITS 9

Active elements - DC and AC sources - Passive elements - Elements in series and parallel connections - Star and delta conversion - Ohm's law and Kirchhoff's laws - Mesh and Nodal analysis - Power, Power factor and Energy.

UNIT II DC MOTORS 9

DC motors - Construction, principle of operation, types, torque equation, characteristics and applications - Starters for DC motors - Speed control and braking (Qualitative Analysis only).

UNIT III AC MOTORS 9

Three phase induction motors - Construction, principle of operation, characteristics and applications - Starters for AC motors - Synchronous motors - Construction and operating principle (Qualitative Analysis only).

UNIT IV FRACTIONAL HP MACHINES 9

Construction, principle of operation, characteristics and applications: Single phase induction motor - Reluctance motor - Servomotor - Stepper motor (Qualitative Analysis only).

UNIT V SELECTION OF MOTOR FOR ELECTRIC DRIVES 9

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.

Contact Periods:

Lecture: 45 Periods Tutorial: -Periods Practical: -Periods Total: 45 Periods

TEXT BOOKS

1 Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw-Hill Education, New Delhi, 5th edition, Jul 2017.

2 R.K.Rajput, "Electrical Machines", Laxmi Publications, 6th edition, Jan 2016.

REFERENCE

1 William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw-Hill Education, New Delhi, 8th edition, Aug 2013

2 S.K. Bhattacharya, "Electrical Machines", McGraw-Hill Education, New Delhi, 4th edition, July 2017.

3 B.L.Theraja, A.K.Theraja, "A text book of Electrical Technology", S.Chand Publications, 24th edition, Jul 2014.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Solve an electric network by Apply basic laws	Apply
CO2	Explain the operating principles, characteristics and speed control methods of DC motors	Understand
CO3	Summarize the operation of three phase induction motor and synchronous motor	Understand
CO4	Interpret the working principle and applications of fractional HP machines	Understand
CO5	Select the drive motor based on thermal overloading and load variation factors	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	2	1	-	-	1	-	-	-	-	1	2	1
CO2	3	1	1	-	-	-	1	-	-	-	-	1	2	1
CO3	3	1	1	-	-	-	1	-	-	-	-	1	2	1
CO4	3	1	1	-	-	-	1	-	-	-	-	1	2	1
CO5	3	2	2	1	-	-	1	1	-	-	-	1	2	1
CO	3	1.6	1.4	1	-	-	1	1	-	-	-	1	2	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

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SEMESTER I

U19MEG01	ENGINEERING GRAPHICS	Category: ES			
		L	T	P	C
		1	0	4	3

PRE-REQUISITES

Nil

COURSE OBJECTIVE

- The students will be exposed to standards and conventions followed in preparation of engineering drawings.
- The students will understand the concepts of orthographic and isometric projections using CAD software.
- The students will develop the ability of producing engineering drawings and conveying the information through drawings using CAD software.

BASICS OF ENGINEERING DRAWING AND CAD (Not for examination) 3

Introduction, drawing instruments and its uses, sheet layout, BIS conventions, lines, lettering and dimensioning practices lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. agency, parallelism, inclination and perpendicularity.

UNIT I CONICS, SPECIAL CURVES AND PROJECTION OF POINTS 3+12

Construction of parabola, ellipse and hyperbola using eccentricity method, construction of involutes for squares and circles, Construction of Tangent and normal to the above curves. Introduction, method of projection, planes of projection, reference line and notations. Orthographic Projection of points: Points in all the four quadrants.

UNIT II PROJECTION OF STRAIGHT LINES AND SURFACES. 3+12

Projection of straight lines: Lines inclined to HP/VP plane, inclined to both HP and VP planes (straight lines are assumed to be in first quadrant only). Projection of planes: Projection of square, rectangle, pentagon, hexagon and circular plane – inclined to both the plane by change of position method.

UNIT III PROJECTIONOFSOLIDS 3+12

Introduction, projection of solids: prisms, pyramids, cylinders and cones with axis inclined to both the planes. (Solids resting on HP only)

UNIT IV DEVELOPMENT OF LATERAL SURFACES OF SOLIDS 3+12

Introduction, cutting plane, sectional views of right regular solids resting with base on HP: prisms, pyramids, cylinder and cone and true shapes of the sections.

Development of lateral surfaces of right regular prisms, pyramids, cylinders, cones resting with base on HP only. Development of their frustums and truncations.

UNIT V ORTHOGRAPHIC AND ISOMETRICPROJECTIONS 3+12

Orthographic projection: Simple machine components using free hand sketching. Isometric projection: Simple Solid exercises and combination of solids.

Contact Periods:

Lecture: 15 Periods Tutorial: - Periods Practical: – 60 Periods Total: 75 Periods

TEXT BOOKS

1. ND Bhat&VM Panchal, Engineering Drawing, Charotar Publishing House, Gujarat, 51st edition,2013.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2010.

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REFERENCE

1. Natrajan K.V., —A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2017.
2. Sam Tickoo, AutoCAD 2013 for Engineers and Designers, Dreamtech Press, 2013.
3. D.M.Kulkarni, A.P.Rastogi, A.K.Sarkar, Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi, Revised Edition, 2010.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Sketch curves, orthographic projections of points as per BIS conventions.	Apply
CO2	Illustrate the orthographic projections of straight lines and plane surfaces	Apply
CO3	Depict the orthographic projections of solids, lateral surfaces of frustums, truncated solids and its development	Apply
CO4	Translate pictorial and isometric views of simple objects to orthographic views	Apply
CO5	Convert the orthographic views into isometric projections	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	3	-	-	-	-	3	-	2	1	-
CO2	3	2	-	-	3	-	-	-	-	3	-	2	1	-
CO3	3	2	-	-	3	-	-	-	-	3	-	2	1	-
CO4	3	2	-	-	3	-	-	-	-	3	-	2	1	-
CO5	3	2	-	-	3	-	-	-	-	3	-	2	1	-
CO	3	2	-	-	3	-	-	-	-	3	-	2	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER I

U19ME101	WORKSHOP (Mechanical)	Category: ES			
		L	T	P	C
		0	0	4	2

PRE-REQUISITES

- Nil

COURSE OBJECTIVE

- The students will learn and apply the carpentry and sheet metal practices.
- The students will understand different types of welding processes and plumbing methods.
- The students will know various tools for smithy and foundry operations.

LIST OF EXPERIMENTS

1 Study on fitting tools, different types of fittings and their applications.
2 Study on carpentry tools, wooden joints and their applications.
3 Preparation of V – joint using two metal plates
4 Preparation of Dove Tail joint and Mortise & Tenon joint
5 Study of sheet metal tools, operations and applications
6 Fabrication of simple objects such as funnel and tray.
7 Study on welding tools, welding types, requirements and applications (Arc welding and gas welding)
8 Preparation of joints such as lap joint, butt joint, T-joint andL-joint using Arc welding
9 Study on plumbing and electrician tools, pipeline joints, fittings and pipe Connection requirements for various applications.
10 Preparation of pipe connections with different joints and fittings for domestic applications such as for centrifugal pump, wash basin, water heater.
11 Study on various tools used for dismantling and assembly of various mechanical components
12 Dismantling and Assembly of two stroke / four stroke engine.
13 Demonstration on production of hexagonal headed bolt using different smithy tools and preparation of green sand mould with solid pattern using foundry tools.
14 Augmented Experiments: Mini project on preparation of paperweight, tools box, key hangers, gate, book stand and shoe stand.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES (CO)

At the end of this course, the students will be able to;

COs	Statements	K-Level
CO1	Demonstrate the knowledge on fitting, carpentry and sheet metal practices.	Understand
CO2	Construct different types of arc welded joints	Apply
CO3	Develop pipe connections for various domestic requirements	Apply
CO4	Perform the assembly and disassembly of various mechanical units.	Apply
CO5	Understand the process of sand molding and usage of smithy tools.	Understand

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	-	-	-	-	2	-
CO2	3	2	1	-	1	-	-	-	-	-	-	-	-	1
CO3	3	2	1	-	1	-	-	-	-	-	-	-	-	1
CO4	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	1	-	-	-	-	-	-	-	2	1
CO	3	2	1	-	1	-	-	-	-	-	-	-	2	1
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER II

U19LE201	ADVANCED COMMUNICATIVE ENGLISH	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE-REQUISITES

Nil

COURSE OBJECTIVE

- Foster their ability to develop communicative strategies and skills.
- Strengthen the learners to evocate their listening skills and enhance writing ability.
- Exhibit proactive reading strategies and speaking techniques.

UNIT I LANGUAGE ADEPTNESS 9

Cloze test – Sentence Completion – Relative Clause - Transformation of Sentences – Common Errors – Discourse Markers – Formal and Informal Expressions – Framing Questions – Figures of Speech.

UNIT II LISTENING 9

Listening to Announcements - Interviews - Group discussions - Dialogues - News items – Documentaries – IELTS – GRE – TOEFL based listening.

UNIT III SPEAKING 9

Real life situations through role play - Language use - Pronunciation, Stress and Intonation – Narrating Events – Presentation – Group discussion

UNIT IV READING 9

Reading Strategies – Reading Comprehension – Reading short stories – Journal articles Inferring editorial column – Cloze reading.

UNIT V WRITING 9

Book Review – Guided Writing – Writing gadget review – Free Writing –Rephrasing – Interpreting text – Email Writing – Process Description.

LIST OF EXPERIMENTS

1 Listening for Announcements
2 Listening to Dialogues
3 Listening to Documentaries
4 Listening to Interviews
5 IELTS based listening
6 Role Play
7 Product Description
8 Group Discussion
9 Book Review
10 General Presentation

Contact Periods:

Lecture: – 15 Periods Tutorial: – 0 Periods Practical: 30 Periods Total: 45 Periods

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TEXT BOOKS

1 K.N.Shoba, Lourdes Joavani Rayen. "Communicative English". Cambridge University Press, 2017.

2 Sudharshana NP & Savitha C. "English for Technical Communication". Cambridge University Press, 2016

REFERENCE

1 Murphy, Raymond. "Intermediate English Grammar". Cambridge University Press. 2009.

2 Means, Thomas L. "English and Communication for Colleges". Cengage, 2017.

3 Using English: A Course book for Undergraduate Engineers and Technologists". Orient BlackSwan, 2017.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Inculcate effective reading strategy.	Understand
CO2	Express opinions in Real-Life situations.	Understand
CO3	Construct academic and professional writing.	Apply
CO4	Impart the listening ability in self-learning.	Apply
CO5	Adept to the needs of the second language learner in a grammatical context.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	2	-	1		3	-	1	-	-
CO3	-	-	-	-	-	2	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO5	-	-	-	-	-	-	2	2	-	3	-	1	-	-
CO	-	-	-	-	-	2	2	2	2	3	-	1	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER II

U19LE202	GERMAN LANGUAGE	Category: HSM			
		L	T	P	C
		1	0	2	2

PRE-REQUISITES

- Nil

COURSE OBJECTIVE

- Enhance the ability to read, write and understand the basic contexts of German language.
- Develop the listening skills and comprehend basic conversation.
- Construct and articulate basic exchange of sentences in German language.

UNIT I 9

Alphabets, Numbers, Personal pronouns and basic verbs, Greetings, Self-Introduction

UNIT II 9

WH-Questions, Definite Article, Irregular Verbs and Personal Pronouns, Hobbies, arranging an unofficial appointment and Profession.

UNIT III 9

Yes/No questions, Indefinite Article and Negation Article, Questions and Answers regarding places and finding way to places, Reading longer text.

UNIT IV 9

Irregular verbs, modal verbs and Sentence formation, Food, Shopping and preferences in food, Listening to basic conversation.

UNIT V 9

Accusative case, verbs with Accusative, time information, Questions and answers with time, Arranging an official appointment and excuse for a delay

Contact Periods:

Lecture: 45 Periods Tutorial: –Periods Practical: - Periods Total: 45 Periods

TEXT BOOKS

1 Stefanie Dengler,Netzwerk A1,Helen Schmitz,Muenchen 2013.

REFERENCE

1 Sandra Evans, Angela Pude, Franz Specht-Menschen A1 Hueber Verlag,2012.

2 Hermann Funk,ChristinaKuhn,SilkeDemme,Studio d A1,Goyal Publishers & Distributors Pvt. Ltd,2009.

3 Rosa-Maria Dallapiazza,Eduard von Jan,TilSchoener,TangramAktuell 1(Deutsch als Fremdsprache),Max Hueber Verlag,2004

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Acquire necessary vocabulary competency.	Understand
CO2	Infer the implied meaning in general and in classroom conversation.	Understand
CO3	Read and infer texts in various contexts	Understand
CO4	Listen to basic exchanges in German Language	Understand
CO5	Express opinion and employ a basic level of communication precisely.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	2	-	1	-	3	-	1	-	-
CO3	-	-	-	-	-	2	-	-	2	3	-		-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO5	-	-	-	-	-	-	2	2	-	3	-	1	-	-
CO	-	-	-	-	-	2	2	2	2	3	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

U19MA201	COMPLEX VARIABLES AND LAPLACE TRANSFORMS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- Understand the vector calculus, which extends the basic concepts of differential calculus to vector functions.
- Use the concepts of ccomplex analysis, in the study of heat flow, fluid dynamics and electrostatics.
- Apply and summarize the mathematical aspects of time domain to frequency domain using Laplace transform and Inverse Laplace transform vice versa.

UNIT I MULTIPLE INTEGRALS 9+3

Double integrals–Change of order of integration–Triple integrals – Applications: Area and volume.

UNIT II VECTOR CALCULUS 9+3

Gradient –divergence and curl – Directional derivative– Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem – Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III LAPLACE TRANSFORM 9+3

Laplace transform– Conditions for existence – Transform of elementary functions – Standard properties (statement only) –Transforms of unit step function– impulse function – Periodic function–Initial and Final value theorems– Convolution theorem (without proof)–Inverse Laplace transform–Standard properties (statement only) –Second order linear differential equations with constant coefficients.

UNIT IV COMPLEX DIFFERENTIATION 9+3

Analytic functions: Cauchy-Riemann equations (Cartesian form) and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Construction of analytic functions – Bilinear transformations.

UNIT V COMPLEX INTEGRATION 9+3

Complex integration – Statement and applications of Cauchy's Integral theorem and Cauchy's Integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's Residue theorem.

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS

1 Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt Ltd, New Delhi, 2018.

2 B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.

REFERENCE

1 N.P. Bali and Manish Goyel, A text book of Engineering Mathematics, Laxmi Publications, 12th edition. 2016.

2 G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, Pearson Education India; 9th edition, 2010

3 James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Calculate the area and volume of a body on the basis of analysis done with one/two dimensions of a body.	Apply
CO2	Apply the theoretical aspects of vector integral calculus in Electro Magnetic Theory and Field.	Apply
CO3	Apply the concepts of Laplace transform with their properties in Circuit Theory and Control Systems.	Apply
CO4	Identify the complex functions and their mapping in certain complex planes.	Apply
CO5	Differentiate and integrate functions represented as power series expansions, including Taylor series, and solve related problems.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

U19PH205	PHYSICS FOR MECHANICAL ENGINEERS	Category: BS			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- To acquire the knowledge of properties of conducting, semiconducting, magnetic and dielectric materials.
- To inculcate the properties and applications of new engineering materials.
- To gain the idea of various microscopes used in the testing of materials.

UNIT I CONDUCTING MATERIALS 9

Classical free electron theory - Expression for electrical conductivity - Expression for Thermal conductivity - Wiedemann-Franz law - success and failures - electrons in metals - Fermi-Dirac statistics - Density of energy states - Energy bands in solids.

UNIT II SEMICONDUCTING MATERIALS 9

Introduction - direct and indirect band gap semiconductors - Intrinsic semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors - Hall effect and its applications - LED - PIN diode - Solar cell.

UNIT III MAGNETIC AND DIELECTRIC MATERIALS 9

Ferromagnetism - domain theory - types of energy - hysteresis - hard and soft magnetic materials – ferrites - dielectric materials - types of polarization – Langevin - Debye equation - dielectric breakdown - Ferroelectricity - Ferroelectric materials.

UNIT IV NEW ENGINEERING MATERIALS 9

Metallic glasses -types, glass forming ability of alloys, melt spinning process, applications - shape memory alloys - phases, shape memory effect, pseudoplastic effect - NiTi alloy - applications - nanomaterials: ball milling, Chemical vapor deposition, properties and applications – carbon nanotubes: types.

UNIT V SURFACE ANALYSIS OF MATERIALS 9

Microscopic inspection - Optical microscopes for surface studies - Rayleigh criterion - resolving power - Scanning electron microscope - transmission electron microscope - Atomic force microscope - applications.

Contact Periods:

Lecture – 45 Periods Tutorial – Periods Practical – 0 Periods Total – 45 Periods

Text Books

1. Kasap S O "Principles of Electronic Materials and Devices". McGraw-Hill Education, 2007.
2. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

REFERENCE

1. Raghavan, V. - Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
2. Raghavan, V. - Materials Science and Engineering: A First course. PHI Learning, 2015.
3. Balasubramaniam, R. Callister "Materials Science and Engineering". Wiley India Pvt. Ltd. 2014.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Describe the electrical characteristics of materials.	Understand
CO2	Classify the semiconductors and illustrate its properties.	Understand
CO3	Understand and classify the magnetic and dielectric properties of materials.	Understand
CO4	Understand the different advanced materials and its application.	Understand
CO5	Summarize the different microscopy for testing of materials.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	-	1	-	1	-	-
CO2	2	1	-	-	1	-	-	-	-	1	-	1	-	-
CO3	2	1	-	-	1	-	-	-	-	1	-	1	-	-
CO4	3	1	-	-	1	1	-	-	-	2	-	2	1	-
CO5	3	2	-	-	1	-	-	-	-	2	-	2	1	1
CO	2	1	-	-	1	1	-	-	-	1	-	1	1	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

U19CY205	CHEMISTRY FOR MECHANICAL ENGINEERS	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Engineering Chemistry I

COURSE OBJECTIVE

- To acquire an adequate knowledge on polymers, engineering materials and their applications.
- To understand the demand of energy resources and storage devices.
- To gain knowledge on classification and applications of fuels.

UNIT I POLYMERS 6

Classification of polymers, polymerisation - types and mechanism - free radical, thermoplastics - (PVC, Nylon 6, Nylon 66, Nylon 11, Teflon), thermosetting plastics (Bakelite) - preparation, properties and industrial applications.

UNIT II COMPOSITE MATERIALS AND LUBRICANTS 6

Composite materials - introduction, types – Fibre Reinforced Polymers (FRP) - ceramic composites – properties and applications, lubricants – definition – types – solid lubricants (Graphite only) - characteristics of lubricants - viscosity, viscosity index, oiliness, pour point, cloud point, flash point and fire point.

UNIT III REFRACTORIES AND ABRASIVES 6

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load (RUL), dimensional stability, porosity, thermal spalling) – manufacture of alumina and zirconia bricks, abrasives – Moh's scale of hardness, classification, manufacture - Silicon carbide and Boron carbide.

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 6

Nuclear energy – nuclear fission – nuclear fusion – nuclear chain reactions – light water nuclear power plant – batteries- types of batteries – primary battery (dry cell), secondary battery (lead acid battery, lithium-ion- battery), fuel cells (H_2-O_2 cell).

UNIT V FUELS AND COMBUSTION 6

Fuels - introduction - classification of fuels - solid fuel: coal - analysis of coal (Proximate analysis only) – carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – liquid fuel: petroleum refining, manufacture of synthetic petrol (Bergius process) – octane number, cetane number – gaseous fuel: compressed natural gas (CNG) – liquefied petroleum gases (LPG) – calorific value – higher and lower calorific values – flue gas analysis (ORSAT method).

LIST OF EXPERIMENTS

1. Determination of molecular weight and degree of polymerization of an oil sample by viscosity measurement (Ostwald's viscometer).
2. Synthesis of Bakelite
3. Estimate the pour point and cloud point of a given oil sample.
4. Determination of viscosity of an oil using Redwood viscometer.
5. Determination of hardness of a given material using Moh's method.
6. Determination of porosity and water absorbing capacity of refractories.
7. Determination of EMF of an unknown batteries using Poggendorff's method.
8. Constructing and testing of a lead acid battery.
9. Determination of percentage of moisture, volatile, ash and carbon content in a given sample of coal.
10. Synthesis of biodiesel by trans esterification method.

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Contact Periods:

Lecture: 30 Periods Tutorial: –Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS

1 Jain P C and Monika Jain, "Engineering Chemistry", 16th edition, Dhanpat Rai Publishing Company, Pvt. Ltd., New Delhi, 2015

2 Vairam S, Kalyani P and Suba Ramesh, "Engineering Chemistry", 2nd edition, Wiley India Pvt. Ltd, New Delhi, 2013

REFERENCE

1 Friedrich Emich, "Engineering Chemistry", 2nd edition, Scientific International Pvt. Ltd, New Delhi, 2014

2 Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India, Pvt. Ltd, Delhi, 2015

3 Shikha Agarwal, "Engineering Chemistry, Fundamentals and Applications", 1st edition, Cambridge University Press, 2015

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Classify different types of polymers, synthesize and apply them in mechanical machinery	Understand
CO2	Suggest the application of composites in industries and to understand the nature of lubricants used for mechanical equipment	Understand
CO3	Identify the specific refractories and abrasives for various applications and determine the hardness of abrasives experimentally	Understand
CO4	Explain the utility of different energy sources, its types, process its applications in electrical energy generation and construction, working and applications of different kinds of batteries for storage of electrical energy	Understand
CO5	Apply the knowledge about nature of fuels and their combustion, analysis and utility required in industrial power generation	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO2	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO3	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO4	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO5	3	1	-	-	-	-	2	-	1	1	-	1	-	-
CO	3	1	-	-	-	-	2	-	1	1	-	1	-	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER II

U19ECG03	BASICS OF ELECTRONICS ENGINEERING	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To introduce the basic electronics components.
- To study the basic concepts of integrated circuits.
- To introduce automotive electronics.

UNIT I BASIC ELECTRONIC COMPONENTS 6

Passive components - Resistors, Capacitors-specifications, classifications, Inductor-types, inductance, inductance of coils, mutually coupled coils, Q-factor, Diode-PN junction, Zener diode-construction, operation- forward bias, reverse bias, characteristics-BJT – NPN, PNP-Construction and Operation

UNIT II APPLICATIONS OF DIODES AND TRANSISTOR 6

Half wave, full wave and bridge rectifiers-Voltage regulator- types, Zener diode shunt regulator-Amplifier-CE, CB, CC- Class A,B,C amplifiers- Oscillators-LC, RC oscillator

UNIT III INTEGRATED CIRCUITS 6

Operational amplifier- ideal characteristics, inverting, non-inverting-applications of op-amp- adder, subtract or, integrator, differentiator, comparator

UNIT IV BASICS OF DIGITAL ELECTRONICS 6

Number systems, Boolean algebra, Logic gates, sequential and combinational circuits- adder, subtract or, flip-flop, latches, counters, shift registers

UNIT V AUTOMOTIVE ELECTRONICS 6

8085 Microprocessor - architecture, instruction set, addressing modes, simple programs-8051 Microcontroller - architecture, interfacing- Arduino architecture and applications- Introduction to ECM, ECU

LIST OF EXPERIMENTS

1. PN Junction diode characteristics
2. Half and Full wave rectifier
3. Zener diode as regulator
4. Audio Amplifier
5. Mod-10 counters
6. Simple application program using 8085 microprocessor and 8051 Microcontroller

Contact Periods:

Lecture: 30 Periods Tutorial: - 0 Periods Practical: 30 Periods Total: 60 Periods

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REFERENCE

1. R. S. Sedha, "A Textbook of Applied Electronics", S.Chand & Company Ltd, 2013
2. Roy Chaudary, "Linear Integrated Circuits", Seventh Edition, New Age International Publishers, 2018
3. M.Morris Mano, "Digital Design", Pearson, 2018

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate principles of electronic components	Understand
CO2	Demonstrate applications of diodes and transistors	Understand
CO3	Explain about op-amp and its applications	Understand
CO4	Compare sequential and combinational logic circuits	Understand
CO5	Demonstrate applications of 8085 and Arduino	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	3	2	-	2	-	-
CO2	2	1	-	-	-	-	-	1	3	2	-	2	-	-
CO3	2	1	-	-	-	-	-	1	3	2	-	2	-	-
CO4	2	1	-	-	-	-	-	1	3	2	-	2	-	-
CO5	2	1	-	-	-	-	-	1	3	2	-	2	-	-
CO	2	1	-	-	-	-	-	1	3	2	-	2	-	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER II

U19CSG01	PROBLEM SOLVING USING PYTHON PROGRAMMING	Category: ES			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- To learn basics of computers and problem-solving techniques.
- To understand syntax and semantics of python programming.
- To develop simple python programs.

UNIT I COMPUTER BASICS AND PROBLEM-SOLVING STRATEGIES 6

Introduction to Computers: Characteristics, Classification, Applications, Components- Hardware and Software- Algorithms - Algorithmic building blocks - Notations: Pseudo code, Flow chart, Programming language - Programming Paradigms - Computational thinking.

UNIT II LANGUAGE BASICS 5

Python interpreter and interactive mode - Tokens - Data types –Numbers and math functions - Input and Output operations - Comments - Reserved words - Indentation - Operators and expressions - Precedence and associativity - Type conversion- Debugging - Common errors in Python – Classes and objects.

UNIT III CONTROL STATEMENTS, FUNCTIONS AND MODULES 6

Selection/Conditional branching statements: if, if-else, Nested-if, if-if-else statements - Iterative statements: while, for loop - break, continue and pass statements - Functions: Function Definition and Function call, Variable scope and Lifetime, Return statement, Lambda functions or Anonymous functions, Recursion - Modules and Packages.

UNIT IV PYTHON DATA STRUCTURES 7

Strings: Slicing, Immutability, Built-in string methods and functions, Concatenating, Appending and Multiplying strings, String modules, Regular expressions - List: Creation, accessing values, Slicing, List methods, In-built functions for Lists - Tuples: Creation, Operations on tuples, Traversing, Indexing and Slicing, Tuple assignment, In-built functions for tuples - Sets: Creation, Operations - Dictionaries: operations and methods.

UNIT V EXCEPTION AND FILE HANDLING 6

Exceptions: Errors and Exceptions, Handling exception, Built-in and User-defined exceptions - Files: Types, Operations: Open, Read, Write, Close.

LIST OF EXPERIMENTS

1. Algorithms, flowchart and pseudo code
2. Language basics
3. Input and output statements
4. Looping and decision-making statements
5. String operations
6. Recursive functions
7. Python data structures
8. Searching and Sorting
9. Generating histogram
10. File and exception handling

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Contact Periods:

Lecture: 30 Periods Tutorial: -Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS

1. Reema Thareja, "Python programming: Using problem solving approach", Oxford Press, 2017.

REFERENCE

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", McGrawHill Education, 2018.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach". Pearson India Education Services Pvt. Ltd., 2016.
4. Roland Backhouse, "Algorithmic Problem Solving", John Wiley & Sons, 2011.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret computer basics and algorithmic solutions for a given problem.	Understand
CO2	Demonstrate the usage of data types, operators and expressions in python programming.	Apply
CO3	Design python programs using functions, modules and packages.	Apply
CO4	Develop programs using python data structures.	Apply
CO5	Demonstrate the usage of exceptions and file handling.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	2	2	2	-	2	-	-
CO2	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO3	3	3	3	-	-	-	-	2	2	2	-	2	-	-
CO4	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO5	3	3	2	-	-	-	-	2	2	2	-	2	-	-
CO	3	2.8	2	-	-	-	-	2	2	2	-	2	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

U19ME201	ENGINEERING MECHANICS (ME)	Category: ES			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- The students will apply various laws of force for equilibrium of rigid bodies
- The students will estimate the friction forces and power transmission by belts
- The students will calculate the forces developed in various engineering structures.

UNIT I EQUILIBRIUM OF FORCES 9

Types of Force Systems - Coplanar Concurrent Forces – Resultant – Moment of a Force and its application– Couples and Resultant of a Force System, equations of equilibrium of coplanar concurrent and non-concurrent force systems, 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

Free body diagram – Types of supports — Support reactions – Moment of a force about a point and about an axis – Moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force - Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9

Centroids of simple figures (from basic principles)-Centroids of Composite Figures, Centre of gravity of simple body (from basic principles), center of gravity of composite bodies, Definition–Moments of Inertia of simple Figures, Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures. Definition, Moment of Inertia of simple bodies, Transfer Formula for Mass Moments of Inertia Mass moment of inertia of composite bodies.

UNIT IV FRICTION 9

Theory of Friction– Angle of Friction– Laws of Friction-Static Friction– Kinetic Friction, Friction in Bodies Moving Up or Down on an Inclined Plane- Introduction to Belt and Rope Drives, Types of Belt Drives, Velocity Ratio of Belt Drives, Slip of Belt Drives, Condition for Maximum Power.

UNIT V ANALYSIS OF PERFECT FRAMES 9

Types of Frames-Assumptions for forces in members of a perfect frame, Method of joints, Method of sections, Force table, Cantilever Trusses, Structures with one end hinged and the other freely supported on rollers carrying horizontal or inclined loads, Principle of Virtual Work-Application of the Principle of Virtual Work, potential Energy and Equilibrium- Simple Problems.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: - Periods Total: 45 Periods

TEXT BOOKS

1 S. S. Bhavikatti, Engineering Mechanics, New Age International Publishers, 2016.

2 S. Timoshenko (Author), D.H. Young (Author), J.V. Rao (Author), Sukumar Pati (Author) Engineering Mechanics, 4th Ed., TMH Education, 2016

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REFERENCE

1. Vela Murali, "Engineering Mechanics", Oxford University Press, 2010
2.. Sanjay Bansal Dr. R.K. Bansal, A Textbook of Engineering Mechanics, Laxmi Publications Pvt Ltd, 2011
3. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers: Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi 2014.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Identify various force systems and analyze the force in a plane or in space.	Understand
CO2	Solve equilibrium of rigid bodies in two dimension and three dimensions.	Apply
CO3	Identify the centroid and area moment of inertia of composite figures and bodies	Understand
CO4	Estimate the friction forces and power transmitted by belts	Apply
CO5	Analyze plane truss using method of joints and method of sections and explain the concept of Virtual Work	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO	3	3	1	-	-	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

U19MA303	FOURIER ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- Apply Fourier series for periodic signals.
- Apply and summarize the mathematical aspects that contribute to the solution of One Dimensional Wave and Heat equation.
- Understand the concept of transform techniques in the field of engineering.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of Partial Differential Equations – Solutions of standard types of first order partial differential equations – Lagrange's linear equation –Solution methods for second order homogeneous equations with constant coefficients.

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – Full range Fourier series – Odd and Even functions – Half range series – Parseval's Identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Fourier series solution – Vibrations of strings – one dimensional wave equation – one dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORM 9+3

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's Identity.

UNIT V Z - TRANSFORM 9+3

Z-transforms - Elementary properties – Inverse Z-transform -Initial and Final value theorems (statement only) - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2017.
2. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi, 2015.

REFERENCE

1. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
2. Peter V.O Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage, New Delhi, 2016.
3. James, G., "Advanced Modern Engineering Mathematics", 3rdEdition, Pearson Education, 2011.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

CO	Statements	K-Level
CO1	Use Partial Differential Equation through mathematical models.	Apply
CO2	Identify the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.	Apply
CO3	Apply Fourier series as a tool for One Dimensional Wave and Heat equations.	Apply
CO4	Analyze the spectral characteristics of signals using Fourier Transforms.	Apply
CO5	Apply Z- transform for analyze of discrete-time signals and systems.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

		Category: ES			
U19ME301	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To introduce the basic thermodynamic principles and laws
- To explore thermodynamic systems and their applications

UNIT I FUNDAMENTAL CONCEPTS AND FIRST LAW 9+3

Basic Concepts - Macroscopic and Microscopic view, Concept of Continuum, Thermodynamic System and Control Volume, Types of Systems, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics, Heat and Work,

First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1, first law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE.

UNIT II SECOND LAW OF THERMODYNAMICS AND AVAILABILITY 9+3

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements, Thermal Reservoir, Heat Engine, Heat pump - Performance factors, , Reversibility, Causes of Irreversibility, Corollaries of second law, PMM2, Carnot's theorem and its corollaries, Clausius Inequality, Entropy, Entropy changes in various thermodynamic processes, Availability and Irreversibility.

UNIT III PROPERTIES OF PURE SUBSTANCES AND GAS MIXTURES 9+3

Ideal gas equation, Properties of Ideal Gases, Equations of State, Law of Corresponding States, Properties of Mixtures, compressibility, universal compressibility chart. Pure Substances, PVT Surfaces, Properties of steam, Saturation Temperature and Pressure, Use of property tables, TS diagrams, Mollier Chart. Introduction to Vapor Power cycles.

UNIT IV THERMODYNAMIC RELATIONS 9+3

General Thermodynamic Relations – Combined First and Second law Equations– Helmholtz and Gibb's functions-application- Maxwell's Relations-derivation, Tds Equations. The- Clapeyron Equation, Equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve.

UNIT V PSYCHROMETRY 9+3

Basic Definitions, properties of atmospheric air, psychometric process, usage of sychometric charts, Simple Problems in Psychometry using formulas and charts, Applications of Psychrometry.

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS

1. Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey , "Fundamentals of Engineering Thermodynamics, 8th Edition" , Wiley, 2014
2. Yunus a. Cengel& Michael a. Boles, "Thermodynamics", 8th edition 2015.

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REFERENCE

1. P. K.Nag;Engineering Thermodynamics, McGraw Hill, 2013.
2. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
3. R.K. Rajput , "A Textbook of Engineering Thermodynamics (Fifth Edition)" ,Published by Laxmi Publications Pvt. Ltd, 2015.

STANDARDS

1 Steam tables with Mollier diagram – R.S Khurmi, S. Chand publications

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

CO	Statements	K-Level
CO1	Explain the basic concepts and first law of thermodynamics with applications.	Understand
CO2	Apply the principle of Entropy and second law of thermodynamics to assess the performance of the simple thermodynamic systems.	Apply
CO3	Determine the thermodynamic state of the pure substance by utilizing standard tables.	Apply
CO4	Develop mathematical models for the real time thermodynamic system	Apply
CO5	Explain the properties of dry air and calculate the properties of the air as a system	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	1	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO	2.8	2.4	2	2	-	-	1	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER III

U19ME302	FLUID MECHANICS AND APPLICATIONS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- To impart knowledge on the fundamentals of fluid properties.
- To solve the fluid flow problem and losses in pipes.
- To analyze the performance of hydraulic machines.

UNIT I FLUID PROPERTIES, STATICS AND KINEMATICS 11

Importance & applications of fluid mechanics. Units and Dimensions – Properties of fluids - Mass density – Specific weight – Specific volume – Specific gravity – Viscosity – Compressibility – Surface tension – Capillarity – Vapor pressure. Pressure and its measurement (description only). Introduction to fluid Statics: total pressure and center of pressure – Buoyancy and center of buoyancy – Meta centre. Introduction to fluid Kinematics: -types of fluid flow – continuity equation – flow lines - Stream and Potential functions – Flownet.

UNIT II FLUID DYNAMICS AND FLOW THROUGH PIPES 9

Introduction to fluid dynamics – Euler's equation of motion – Bernoulli's equation and its applications – momentum equation – moment of momentum equation – introduction to CFD. Losses in pipes – loss due to friction and Darcy Weisbach equation – Moody diagram – minor losses – hydraulic gradient and total energy line – flow through pipes in parallel and series.

UNIT III BOUNDARY LAYER AND DIMENSIONAL ANALYSIS 9

Boundary layer concepts – types of boundary layer thickness – Hagen-Poiseuille equation. Introduction to Dimensional Analysis - dimensional homogeneity – methods of dimensional analysis - Similitudes and its types – dimensionless numbers - model analysis and model laws – undistorted and distorted models.

UNIT IV HYDRAULIC TURBINES 8

Force exerted on moving plate/ vanes- Euler's equation – theory of roto-dynamic machines –classification of turbines - Pelton, Francis, and Kaplan turbine: Working principles- heads and efficiencies -Velocity triangles – Work done by the runner – draft tube - specific speed –unit quantities - Performance curve for turbines.

UNIT V HYDRAULIC PUMPS 8

Pump definition and classifications- efficiencies - Centrifugal pumps - Working principles-velocity triangles – work done by the impellor - Specific speed- performance curves. Reciprocating pumps – working principle - Indicator diagram – pressure vessel. Introduction to rotary pumps - Cavitation in pumps.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2009
2. Bansal.R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd., New Delhi, 2013

REFERENCE

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1. White, F.M., "Fluid Mechanics", Tata McGraw Hill, 5th Edition, New Delhi, 2017
2. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press, New Delhi, 2015
3 Subramanya.K " Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2010

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

CO	Statements	K-Level
CO1	Discuss the properties of fluids under static and dynamic conditions.	Understand
CO2	Apply principles of mass, momentum and energy conservation in fluid flow applications.	Apply
CO3	Develop mathematical models for the given fluid flow problems by dimensional analysis method.	Apply
CO4	Evaluate the performance of turbines.	Apply
CO5	Calculate the performance of pumps.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO	3	2.8	2.3	2	-	-	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER III

U19ME303	MANUFACTURING TECHNOLOGY - I	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Chemistry for Mechanical Engineers

COURSE OBJECTIVE

- To emphasize the importance of basic manufacturing processes
- To impart knowledge on casting and joining processes
- To study on metal forming, sheet metal working and processing of plastics

UNIT I METAL CASTING 9

Introduction; Patterns: Pattern materials, allowances, types of pattern; Sand Casting: Green and dry sand casting process, types of sand and its properties, molding machines; Cores: Types and applications; Special Molding Processes: CO_2 molding, Investment casting, Die casting, shell molding and Stir Casting; Casting defects; Melting Furnaces- Cupola Furnace and Induction Furnace.

UNIT II METAL JOINING 9

Introduction: Principle of welding; Classification of welding processes; Operating principle, equipment, merits, demerits and applications of : Gas welding and flame characteristics; Manual meta arc welding; Submerged arc welding; Gas metal arc welding; TIG welding; Resistance welding; Thermit welding; Electron beam welding; Resistance welding; Friction welding; Laser Welding; Soldering and brazing: methods; Flux types; Weld defects; causes and cure.

UNIT III METAL FORMING 9

Elastic and plastic deformation; Concept of strain hardening; Operating principle, equipment, types, merits, demerits and applications of Hot and cold working processes: rolling; forging; extrusion; swaging; wire and tube drawing. Load considerations for hot and cold working processes.

UNIT IV SHEET METAL WORKING 9

Introduction; Sheet metal characteristics; Shearing mechanism; Formability of sheet metal; Test methods; basic Sheet metal operations- Operating principle, equipment, types, merits, demerits and applications. Special forming Process – Hydro forming – rubber pad forming. Metal spinning – introduction to explosive forming, magnetic pulse forming, peen forming, Super plastic forming; Micro forming.

UNIT V PLASTIC PROCESSING 9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding –Rotational moulding – Film blowing — Thermoforming

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: - Periods Total: 45 Periods

TEXT BOOKS

1 Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013

2 Hajra Choudhury, S. K and Hajra Choudhury, A. K, "Elements of Workshop Technology", volume I & II, Media promoters and publishers limited, Mumbai, 2008.

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REFERENCE

1. John Schey, "Introduction to manufacturing process" 3rd edition, Tata Mcgraw hill, 2012
2. Miton C. Shaw, "Metal cutting principles" 2nd edition, Oxford university press, 2010
3. P. N. Rao, "Manufacturing Technology – Foundry, Forming and Welding, 5th edition, Tata Mcgraw hill, 2019.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

CO	Statements	K-Level
CO1	Explain different casting methods with merits and demerits	Understand
CO2	Describe the working principle of various welding processes	Understand
CO3	Discuss the hot and cold working processes	Understand
CO4	Illustrate the various sheet metal working processes	Understand
CO5	Deliberate the processing of plastics	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO	3	1	-	-	-	-	-	-	-	-	-	-	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER III

U19ME304	MATERIAL SCIENCE AND ENGINEERING	Category: ES			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Engineering Chemistry – I, Physics for Mechanical Engineers

COURSE OBJECTIVE

- To impart knowledge on the processing and properties of engineering materials.
- To learn the methods for testing of engineering materials.

UNIT I ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

UNIT II FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel- α and β stabilizers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

UNIT III HEAT TREATMENT 9

Definition of Heat Treatment – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening

UNIT IV POWDER METALLURGY 9

Steps in powder metallurgy, scope, advantages, limitations and application of P/M with examples. Powder production techniques – PIM and SHS. Powder characterization – particle size analysis. Powder consolidation – cold and hold Isostatic pressing, Sintering – solid and liquid state sintering. Finishing operations and secondary operations – machining, plating, heat treatment of P/M products.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and charpy tests, fatigue and creep failure mechanisms.

TEXT BOOKS

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company,1994.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007

REFERENCE

1. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.
2. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Mettalurgy", First Edition, Dorling Kindersley, 2012
3. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 1999.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

CO	Statements	K-Level
CO1	Explain the fundamentals of alloys and its phase diagram.	Understand
CO2	Discuss the effect of alloying elements on ferrous and non-ferrous metals	Understand
CO3	Explain the different heat treatment processes.	Understand
CO4	Explain the powder metallurgy processes.	Understand
CO5	Identify the appropriate method for testing of materials.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	3	-
CO3	3	-	-	-	-	-	-	-	-	-	-	1	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	1	3	-
CO5	3	-	-	-	-	-	-	1	-	-	-	1	3	-
CO	3	-	-	-	-	-	-	1	-	-	-	1	3	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER III

U19ME305	MACHINE DRAWING	Category: PC			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

Engineering Graphics

COURSE OBJECTIVE

- To impart knowledge on fundamentals of machine drawings.
- To study about temporary and permanent joints for engineering application.

UNIT 1 INTRODUCTION AND CONVENTIONS 10

Introduction, Tolerance, Limits, Allowance, Basic Size, Design Size, Actual Size, Unilateral and Bilateral Tolerance and its representation, Fits and its types (Clearance, Transition and Interference), Introduction of Hole Basic and Shaft Basic Method. Symbols used for machining processes, Symbols used for indication of surface roughness. Mechanical means of retention, Blue printing processes.

UNIT 2 SCREW TREADS 5

Forms of screw threads, Representation of external and internal thread, Unified thread, Whitworth thread, Seller thread, British Association thread, Square thread, ACME thread, Knuckle thread, Buttress thread, Right and left hand threads.

UNIT 3 FASTENERS 5

Types of Nuts (Hexagonal, Square, Flanged, Cap, Dome, Capstan, Ring and Wing), Types of Bolt (Hexagonal, Square, Cylindrical, Cup headed, Countersunk headed, Hook, Headless tapered, Eye bolt, Lifting bolt, Stud bolt)

UNIT 4 TEMPORARY JOINTS 5

Key and keyways, Types of Keys (Taper Key, Saddle Key, Round or Pin Key, Gib Head Key, Feather or Parallel Key, Woodruff Key), Cotter and Cotter Joint, Pin Joint or Knuckle Joint.

UNIT 5 PERMANENT JOINTS 5

Riveted Joint, Forms of riveted head (Cup, Pan, Conical, Countersunk, Rounded Countersunk and Ellipsoid), Riveted Lap and Butt Joints, Welding Joints and Symbols (Lap, Butt, Tee, Corner or Edge)

PRACTICALS

ASSEMBLY DRAWING PRACTICE (15)

Drawing practice of typical subassemblies with tolerances;

- Tail stock
- Machine vice
- Universal coupling
- Gear box
- Stop valve
- Drill jig

ASSEMBLY USING SOLID MODELING (15)

Modeling and assembly using a CAD software-extracting views and sections. Creation of bill of materials, calculation of mass and section properties, interference check between solids Drawing of assemblies;

- Sleeve and cotter joint
- Flange coupling
- Foot step bearing
- Screw jack
- Plummer block
- Stuffing box

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Learn Beyond

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

TEXT BOOKS

1. Gopala Krishna K R, "Machine Drawing", Subhas Stores, Bangalore, 2013.
2. John K C, "Text book of Machine Drawing", PHI Learning Pvt. Ltd., New Delhi 2009

REFERENCE

1. Narayana, K. L. Machine drawing. New Age International, 2009
2. Gill, P.S, Textbook of Machine Drawing. S.K. Kataria& Sons; 2013 edition (2013).
3. Singh Sadhu. Fundamentals of Machine Drawing, Second Edition. PHI Learning, 1998.

STANDARDS

1. BIS, SP: 46-2003 —Engineering Drawing Practice for Schools and Colleges", New Delhi, 2003.
2. Faculty of Mechanical Engineering, PSG College of Technology," Design Data Book", M/s. Kalaikathir Publishers, Coimbatore, 2012

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO 1	Interpret the terminologies in machine drawings	Understand
CO 2	Select appropriate screw threads and fasteners according to the application.	Understand
CO 3	Identify appropriate temporary and permanent joints for different application.	Understand
CO 4	Draft 2D machine components manually.	Apply
CO 5	Develop 3D models and assemble the parts using modelling software.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	3	-	-	-	-	-	-	-	2	-
CO5	3	-	-	-	3	-	-	-	-	-	-	-	2	-
CO	3	-	-	-	3	-	-	-	-	-	-	-	2	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER III

U19ME306	FLUID MECHANICS AND MACHINERY LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To demonstrate the various flow measurement equipment.
- To experiment the flow characteristics in pipes.
- To explore the performance characteristics of pumps and turbines.

LIST OF EXPERIMENTS

1. Verification of Bernoulli's theorem
2. Calibration of Venturimeter.
3. Calibration of Orifice meter
4. Calibration of rotameter.
5. Determination of losses in pipe flow
6. Performance characteristics of centrifugal pump
7. Performance characteristics of reciprocating pump.
8. Performance characteristics of Pelton wheel.
9. Performance characteristics of Francis turbine
10. Performance characteristics of Kaplan turbine

Contact Periods

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

LIST OF EQUIPMENT REQUIRED

1. Bernoulli's Apparatus
2. Orifice meter setup
3. Venturi meter setup
4. Rotameter setup
5. Pipe Flow analysis setup
6. Centrifugal pump test rig
7. Reciprocating pump test rig
8. Pelton wheel test rig
9. Francis turbine test rig
10. Kaplan turbine test rig

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

CO	Statements	K-Level
CO1	Prove Bernoulli's theorem experimentally	Apply
CO2	Estimate the co-efficient of discharge in different flow meters	Apply
CO3	Determine the friction factor of the pipes	Apply
CO4	Calculate the performance on centrifugal and reciprocating pumps.	Apply
CO5	Evaluate the performance of hydraulic turbines.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-		1	2	-	-	-	2	-	-	2	2	-
CO2	3	2	2	1	2	-	-	-	2	-	-	2	2	-
CO3	3	2	2	1	2	-	-	-	2	-	-	2	2	-
CO4	3	2	2	1	2	-	-	-	2	-	-	2	2	-
CO5	3	2	2	1	2	-	-	-	2	-	-	2	2	-
CO	3	2	2	1	2	-	-	-	2	-	-	2	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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SEMESTER III

U19ME307	MANUFACTURING TECHNOLOGY LABORATORY - I	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To practice various operations in lathe, shaper, drilling, and milling machines.
- Equip with the practical knowledge on machining required in the core industries.

LIST OF EXPERIMENTS

1. Taper Turning
2. External Thread cutting
3. Internal Thread Cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping
8. Fabrication of simple structural shapes using Gas Metal Arc Welding
9. Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding /Submerged arc welding
10. Preparation of green sand mould
11. Manufacturing of simple sheet metal components using shearing and bending operations.

Contact Periods

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

LIST OF EQUIPMENT REQUIRED (For a batch of 33 students)

1. Centre Lathes
2. Horizontal Milling Machine
3. Vertical Milling Machine
4. Shaper
5. Arc welding transformer with cables and holders
6. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit
7. Moulding table, Moulding Equipment
8. Sheet metal forming tools and Equipment

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

CO	Statement	K - Level
CO1	Perform simple operations on the lathe.	Apply
CO2	Use special machine tools to perform shaping operations	Apply
CO3	Join two metals using arc welding.	Apply
CO4	Use different molding tools, patterns and prepare sand molds.	Apply
CO5	Produce sheet metal components using sheet metal forming processes	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	3	-	-	-	2	-	-	2	3	-
CO2	2	1	-	-	3	-	-	-	2	-	-	2	3	-
CO3	2	1	-	-	3	-	-	-	2	-	-	2	3	-
CO4	2	1	-	-	3	-	-	-	2	-	-	2	3	-
CO5	2	1	-	-	3	-	-	-	2	-	-	2	3	-
CO	2	1	-	-	3	-	-	-	2	-	-	2	3	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER IV

U19MA405	STATISTICS AND NUMERICAL METHODS	Category: BS			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- Understand the concepts of Probability and Statistics in the field of engineering.
- Apply the concepts of testing of hypothesis for small and large samples.
- Apply design of experiments in the field of engineering.

UNIT I PROBABILITY 9

Probability – Axioms of probability – conditional probability – Total probability – Baye's theorem – Discrete and Continuous random variables.

UNIT II TESTING OF HYPOTHESIS 9

Large sample test for single mean and difference of means – Small sample test: t, Chi-square and F distributions.

UNIT III DESIGN OF EXPERIMENTS 9

One way and Two-way classifications – Completely Randomized Design -Randomized Block Design – Latin Square Design.

UNIT IV SYSTEM OF EQUATIONS 9

Newton-Raphson method – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations.

Contact Periods

Lecture: 45 Periods Tutorial: – Periods Practical: - Periods Total: 45 Periods

TEXT BOOKS

1. Johnson, R.A., Miller, I and Freund J., Miller and Freund's Probability and Statistics for Engineers, Pearson Education, Asia, 8th Edition, 2015.
2. Grewal, B.S., Numerical Methods in Science and Engineering, Khanna Publishers, Ninth Edition Reprint, 2015.
3. Gupta, S.C., Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand Publishers, 2014.

REFERENCE

1. Sheldon Ross, Introduction to Probability & Statistics for Engineers and scientists, 5th Edition, Academic Press, Elsevier publications, 2014.
2. Devore. J.L., Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., Schaum's Outlines on Probability and Statistics, Tata McGraw Hill Edition, 3rd edition,2013.
4. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson Education, Asia, 9th Edition 2012.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Outcome	K-Level
CO1	Apply probability axioms and the moments of discrete and continuous random variables.	Apply
CO2	Analyze small and large samples in industry by using testing of hypothesis.	Apply
CO3	Design, conduct experiments and analyze the results.	Apply
CO4	Apply numerical techniques to obtain solution of algebraic equations.	Apply
CO5	Use numerical methods to solve ordinary differential equations.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	1	-	-	-	-	-	-	-	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19ME401	KINEMATICS OF MACHINERY	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Engineering Graphics, Engineering Mechanics.

COURSE OBJECTIVE

- To learn the basic mechanisms in machine components.
- To impart knowledge on cam mechanisms and gear trains.
- To study the friction in machine elements.

UNIT I BASICS OF MECHANISMS 8

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms and its analysis, Straight line generators, Universal Joint – Geneva mechanism, Pawl ratchet mechanisms.

UNIT II KINEMATICS OF LINKAGE MECHANISMS 10

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centers – kinematic analysis of simple mechanisms – Coincident points – Basics of Coriolis component of Acceleration – Klein's construction for four bar and slider crank mechanisms.

UNIT III KINEMATICS OF CAM MECHANISMS 9

Classification of cams and followers –Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams –tangent cams – Pressure angle and undercutting.

UNIT IV GEARS AND GEAR TRAINS 9

Law of toothed gearing – Involutes and cycloidal tooth profiles – Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains- velocity ratio of epicyclic gear trains by tabular method.

UNIT V FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Kinematics of sliding and rolling friction – Friction drives – Friction in screw threads – Belt and rope drives.

Contact Periods:

Lecture: 45 Periods Tutorial: –Periods Practical: –Periods Total: 45 Periods

TEXT BOOKS

1. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2019.
2. Khurmi.R.S., Gupta.J.K., "Theory of Machines", S.Chand Publishing Co., 2019.

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REFERENCE

1. F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2019.
2. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2016.
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt.

Ltd., New Delhi, 2017.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the concept of mechanisms involved in machines	Understand
CO2	Determine the velocity and acceleration of mechanisms by relative velocity and instantaneous center methods	Apply
CO3	Construct the cam profiles by graphical methods	Apply
CO4	Calculate the dimensions of a gear and gear train	Apply
CO5	Evaluate the friction coefficient of simple mechanical elements	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO	3	3	1	-	-	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19ME402	MECHANICS OF SOLIDS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Engineering Mechanics.

COURSE OBJECTIVE

- To study the concepts of stress & strain in various elements, principal stresses and principal planes.
- To learn the effect of stresses and deflection in beams and columns.
- To compute the effect of loading in shaft, spring and thin shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

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

Beams – types, transverse loading on beams – Shear force and bending moment in beams Cantilevers – Simply supported beams and overhanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT IV TORSION AND SPRINGS 9

Torsion formulation, stresses and deformation in circular and hollows shafts – Stepped shafts– Compound Shafts - Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT V COLUMNS AND THIN CYLINDERS 9

Columns – Euler's theory and Rankine's theory of columns – Effect of eccentricity. Stresses in thin cylindrical shells due to internal pressure - circumferential and longitudinal stresses and deformation in thin cylindrical shell – spherical shells subjected to internal pressure – Deformation in spherical shells.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: - Periods Total: 45 Periods

TEXT BOOKS

1 Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016

2 Rattan.S.S, "Strength of Materials", McGraw Hill Publishing 'co. Ltd., New Delhi, 2018

REFERENCE

1 Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2012

2 Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2018

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3 Ferdinand P. Been, Russell Johnson, J.R. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2018

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

Cos	Statements	K-Level
CO1	Determine the stress, strain and deformation in elastic bodies.	Apply
CO2	Evaluate the shear force and bending moment of beams.	Apply
CO3	Calculate the slope and deflection of beams.	Apply
CO4	Calculate the design parameters of shaft and springs.	Apply
CO5	Design the columns and thin cylinders using appropriate theories.	Apply

COURSE ARTICULATION MATRIX:

Pos / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO	3	2.8	2	-	-	-	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER IV

U19ME403	MANUFACTURING TECHNOLOGY - II	Category: PC			
		L	T	P	C
		3	0	0	3

PRE-REQUISITES

- Manufacturing Technology – I

COURSE OBJECTIVE

- To impart knowledge on the concept and basic mechanics of metal cutting.
- To explore working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To acquire knowledge on the basic concepts of Computer Numerical Control (CNC) of machine tools and unconventional machining processes.

UNIT I THEORY OF METAL CUTTING (CONTACT CUTTING) 9

Mechanics of machining, Tools (materials, temperature, wear and life considerations), tool geometry - single point and multi point cutting tool; chip formation; surface finish and machinability; optimization, Merchant circle diagram of forces on cutting tool (simple problems only)

UNIT II MACHINES TOOLS - I 9

Introduction to Lathe, Automatic & Semi - automatic Lathe - Vertical Turret Lathe – Shaper – Planning – Milling – Drilling – Boring – Working Principles – Operations – Economics of machining processes – Lathe, Milling and Drilling. Working Holding Devices – Jig and fixtures.

UNIT III MACHINES TOOLS - II 9

Types of Grinding and Grinding Machines, Grinding wheel Specifications – Honing – Lapping – Burnishing – Super Finishing – Gear Manufacturing Processes – Gear cutting – Gear Hobbing – Gear Shaping Machines – Manufacture of Spur – Helical – Bevel – Worm and Worm Wheel.

UNIT IV CNC MACHINES 9

Introductory concepts of CAD, CAM and CIM, Numerical Control (NC) machine tools – Direct Numerical Control (DNC)- Computer Numerical Control (CNC) machine tools - CNC types - constructional details, special features, machining center – turning centre, milling centre. CNC part programming fundamentals.

UNIT V UNCONVENTIONAL AND SPECIAL MACHINING METHODS 9

Electro-Chemical, Electro Discharge, Ultrasonic, Laser, Electron Beam and Water Jet machining. Rapid Prototyping and Rapid tooling. Introduction to 3D printing, Micro Machining and thermal cutting.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: - Periods Total: 45 Periods

TEXT BOOKS

1 Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2014

2 Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.

REFERENCE

1 Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White "Machine Tool Practices", Prentice Hall of India, 1998

2 Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984

3 Roy. A. Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

Cos	Statements	K-Level
CO1	Explain the mechanics of machining and tool geometry.	Understand
CO2	Demonstrate knowledge on various machine tools like lathe, shaping, milling, and drilling.	Understand
CO3	Demonstrate knowledge on grinding and gear manufacturing processes.	Understand
CO4	Discuss the basics of computer numerical control machines	Understand
CO5	Explain the concept of various unconventional and special machining processes.	Understand

COURSE ARTICULATION MATRIX:

Pos / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	2	-	2	-	-	-	-	-	-	-	2	-
CO5	3	-	-	-	1	-	-	-	-	-	-	-	2	-
CO	3	1.5	2	-	1.5	-	-	-	-	-	-	-	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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Learn Beyond

SEMESTER IV

U19ME404	ENGINEERING METROLOGY AND MEASUREMENTS	Category: PC			
		L	T	P	C
		2	0	2	3

PRE-REQUISITES

NIL

COURSE OBJECTIVE

- To familiarize the basic principles of measurements.
- To acquire skills on various metrological equipment.
- To impart knowledge on advanced metrological instruments.

UNIT I FUNDAMENTALS OF MEASUREMENT 7

Elements of a generalized measurement system, standards, and types of signals-Static and dynamic performance characteristics, instrument types, transfer function representation, system. Response to standard input signals-step, ramp, impulse, and frequency response; Principles of calibration, Calibration of Instruments, Types of error, statistical analysis of data

UNIT II MEASUREMENT OF PHYSICAL VARIABLES 6

Linear and angular displacement, velocity, force, torque, strain, pressure, flow rate and temperature; Transfer functions of some standard measuring devices

UNIT III FORM AND FINISH MEASUREMENT 5

Measurement of surface finish, inspection of straightness, flatness and alignment, gear testing, digital read outs, Interferometry - Laser Interferometers- .

UNIT IV DIGITAL METROLOGY 6

Signal Analysis: Signal Generators, Wave Analyzer, Spectrum Analyzer. Frequency Counters: Simple Frequency Counter; Transducers: Types, Strain Gages, Displacement Transducers. Digital Data Acquisition System: Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier.

UNIT V ADVANCES AND NON CONTACT MEASUREMENT 6

Machine vision system –Non-contact type measurements – optical, acoustics, ultrasonic, radiation, thermal and capacitance based measurement, Principles of measurement system analysis.

Contact Periods:

Lecture: 30 Periods Tutorial: - Periods Practical: 30 Periods Total: 60 Periods

LIST OF EXPERIMENTS

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge, Digital height gauge –using gauge blocks
2. Non-contact(Optical) measurement using Tool Maker's Microscope &Profile Projector
3. Measurement of angles using bevel protractor, sine bar & slip gauge
4. Gear parameter measurement using Gear tooth vernier
5. Gauge dimensions(Pitch diameter, outside diameter and root diameter using floating gauge Micrometer
6. Measuring of Bore diameter by Telescopic gauge and inside micrometer
7. Surface Finish Measurement using surface roughness tester
8. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
9. Measurement of force, torque and temperature
10. Measurement of linear dimensions using Comparators

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11. Autocollimator
12. Microstructure using Optical microscope
13. Demo on Scanning Electron Microscopy
14. Demo on Transmission Electron Microscopy

TEXT BOOKS

1. Jain R.K."Engineering Metrology", Khanna Publishers, 2009.
2. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

REFERENCE

1. Beckwith, Marangoni, Lienhard, "Mechanical Measurements" ,Pearson Education, 2014.
2. Raghavendra, Krishnamurthy" Engineering Metrology & Measurements", Oxford Univ. Press,2013.
3. Donald Peckman, "Industrial Instrumentation", Wiley Eastern,2004.

STANDARDS

1. ISO: IEC:17025

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the basic principles of measuring instruments	Understand
CO2	Make use of suitable measuring devices to measure the physical variables	Apply
CO3	Apply various methods for measuring mechanical parameters	Apply
CO4	Make use of digital instrumentation to measure form and finish variables	Apply
CO5	Demonstrate the advanced measuring instruments used in machine vision	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	3	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	3	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	3	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO	3	2	-	-	2	-	-	-	-	-	-	-	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

U19ME405	THERMAL ENGINEERING	Category: PC			
		L	T	P	C
		3	0	0	3

PRE-REQUISITES

Chemistry for Mechanical Engineers, Engineering Thermodynamics.

COURSE OBJECTIVE

- To impart knowledge on the concepts of gas power cycles and its application in IC engines.
- To explore the thermodynamic concepts employed in Steam Turbines, Compressors and Refrigeration and Air conditioning systems.
- To acquire knowledge on the basics of steam boilers and its accessories.

UNIT I GAS POWER CYCLES & I.C ENGINE SYSTEMS 9

Otto, Diesel, Dual, and Brayton cycles - Efficiency and Comparison of cycles. Engine classifications - component, basic operation of four stroke and two stroke engines, mixture requirements- Stoichiometric, rich & lean fuel mixture.

UNIT II AIR COMPRESSOR 9

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor

UNIT III STEAM POWER CYCLES AND BOILERS 9

Basics of Rankine cycles & improvisation - Simple problems, Boiler classification, mountings, accessories and Boiler Standards.

UNIT IV STEAM NOZZLES AND TURBINES 9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, Meta- stable flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, Introduction to speed regulation using governor.

UNIT V REFRIGERATION AND AIR CONDITIONING 9

Refrigerants - Vapour compression refrigeration cycle- superheat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide – water systems (Theory only). Air conditioning system - Processes, Types and Working Principles. - Concept of RSHF, GSHF, ESHF- Basics of cooling load calculations.

Contact Periods:

Lecture: – 45 Periods Tutorial: - Periods Practical: - Periods Total: 45 Periods

TEXT BOOKS

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
2. Kothandaraman.C.P., Domkundwar. Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition," DhanpatRai Rai & sons, 2002

REFERENCE

1. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007.
2. Ganesan V." Internal Combustion Engines" , Third Edition, Tata McGraw-Hill 2007
3. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003

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Learn Beyond

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Solve the problems on gas power cycles of IC engines.	Apply
CO2	Determine the performance of air compressors.	Apply
CO3	Solve problems on steam power cycles and its applications.	Apply
CO4	Calculate the performance of steam nozzles and turbines.	Apply
CO5	Determine the performance of refrigeration and air conditioning systems.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	1	-	-	-	-	-	-	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	1	1	-	-	-	-	-	2	-
CO	3	2	2	-	-	1	1	-	-	-	-	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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KPRIET

U19CA001	NUMERICAL APTITUDE AND VERBAL ABILITY - I	Category: EEC			
		L	T	P	C
		1	0	0	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand the concepts of Coding, Decoding, Interpreting and Apply.
- Comprehend the basic concepts of logical reasoning.
- Acquire competency in the use of verbal reasoning

UNIT I 3

Clocks & Calendars, Alpha Numeric Series, Coding & Decoding, Blood Relations, Odd man out, Direction

UNIT II 3

Syllogism, Order and Ranking, Puzzles, Cubes and Dices, Statements, Assumptions and Conclusions, Seating Arrangements, Data Sufficiency, Data Interpretation

UNIT III 3

Parts of Speech (Nouns, Pronouns, Verbs, Adjectives, Adverbs, Preposition, Conjunction, Interjection) Gerunds, Phrases and Clauses

UNIT IV 3

Tenses, Active and Passive Voice (tense usage), Verbal Ability (Vocabulary and Reasoning)

UNIT V 3

Closet Test, Sentence Formation, Para Jumbles, Passage Formation, Spotting Errors, Verbal analogies

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: - Periods Total: 15 Periods

TEXT BOOKS

1 R S Aggarwal – Quantitative Aptitude for Competitive Examinations, 17th Edition S. Chand Publishing, New Delhi, 2017

2 Arun Sharma – How to prepare for Quantitative Aptitude for CAT, 8th Edition McGraw Hill Education, Chennai, 2018.

REFERENCE

1 R.S. Aggarwal – A Modern Approach to Verbal & Non-Verbal Reasoning,S Chand Publishing, New Delhi, 2017

2 Abhijit Guha - Quantitative Aptitude for Competitive Examination, McGraw Hill Education (India) Private Limited, 5th Edition, 2015.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statement	K-Level
CO1	Apply the concept of coding, decoding, clocks and calendars for numerical reasoning	Apply
CO2	Choose appropriate words/phrases for the sentences and present comprehensively	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO	3	-	-	-	-	-	-	-	-	3	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER IV

KPRIET
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U19ME406	MECHANICS OF SOLID LABORATORY	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To determine the mechanical properties of materials when subjected to different types of loads
- To impart knowledge on the design of components for strength and stiffness

LIST OF EXPERIMENTS

1 Tension test on a mild steel rod
2 Double shear test on Mild steel and Aluminium rods
3 Torsion test on mild steel rod
4 Impact test on metal specimen
5 Hardness test on metals - Brinell and Rockwell Hardness Number
6 Deflection test on beams
7 Compression test on helical springs
8 Strain Measurement using Rosette strain gauge
9 Hardening- Improvement in hardness and impact resistance of steels.
10 Tempering- Unhardened specimen, Quenched Specimen, Quenched and tempered specimen.
11 Microscopic Examination of Hardened and tempered samples.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

LIST OF EQUIPMENT REQUIRED

1 Universal Tensile Testing machine with double shear attachment
2 Torsion Testing Machine
3 Impact Testing Machine
4 Brinell Hardness Testing Machine
5 Rockwell Hardness Testing Machine
6 Rosette strain gauge
7 Spring Testing Machine for tensile and compressive loads
8 Metallurgical Microscopes
9 Muffle Furnace (800^{O} C)

REFERENCES

1 Laboratory manual prepared by Department of Mechanical Engineering
2 Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
3 Rattan.S.S, "Strength of Materials", McGraw Hill Publishing 'co. Ltd., New Delhi, 2018

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to		
COs	**Statements**	**K-Level**
CO1	Determine tensile and compressive strength, hardness, impact strength and flexural rigidity of materials.	Apply
CO2	Analyze the deformation behavior of materials for different types of loads.	Apply
CO3	Perform tests on springs for design purposes	Apply
CO4	Perform different heat treatment processes	Apply
CO5	Evaluate the structural changes in heat treated materials	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	3	-	-	1	-	-	-	1	2	-
CO2	3	2	-	2	3	-	-	1	-	-	-	1	2	-
CO3	3	2	-	2	3	-	-	1	-	-	-	1	2	-
CO4	3	2	-	2	3	-	-	1	-	-	-	1	2	-
CO5	3	2	-	2	3	-	-	1	-	-	-	1	2	-
CO	3	2	-	2	3	-	-	1	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER IV

U19ME407	MANUFACTURING TECHNOLOGY LABORATORY - II	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Study and acquire knowledge on various basic machining operations in special purpose machines
- Understand the applications of special machining in real life manufacture of components

LIST OF EXPERIMENTS

1 Contour milling using vertical milling machine
2 Spur gear / helical gear cutting in milling machine
3 Gear generation in hobbing machine / gear shaping machine
4 Keyway & spline cutting using Slotter / shaper
5 Plain Surface grinding & Cylindrical grinding
6 Tool angle grinding with tool and Cutter Grinder
7 Taper Turning and Threading using CNC Lathe

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

8 Drilling and Grooving using CNC Lathe with canned cycle
9 Pocketing and Contour milling using CNC Milling Machine
10 Drilling and Tapping using CNC Milling Machine

LIST OF EQUIPMENT REQUIRED

1. Horizontal Milling Machine
2. Vertical Milling Machine
3. Surface Grinding Machine
4. Cylindrical Grinding Machine
5. Centerless Grinding Machine
6. Tool and Cutter Grinder
7. Shaper
8. Slotter
9. Gear Hobbing Machine
10. CNC Lathe
11. CNC Milling

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REFERENCES

1 Laboratory manual prepared by Department of Mechanical Engineering
2 Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White "Machine Tool Practices", Prentice Hall of India, 1998
3 GeofreyBoothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Perform various milling operations	Apply
CO2	Use different machine tools to manufacturing gears.	Apply
CO3	Conduct grinding operations for different surface conditions	Apply
CO4	Manufacture tools using cutter grinder	Apply
CO5	Develop CNC part program for performing turning and machining operation in CNC machine	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	1	-	1	2	-
CO2	3	3	2	-	2	-	-	-	-	1	-	1	2	-
CO3	3	3	2	-	2	-	-	-	-	1	-	1	2	-
CO4	3	3	2	-	2	-	-	-	-	1	-	1	2	-
CO5	3	3	2	-	3	-	-	-	-	2	-	3	2	-
CO	3	3	2	-	2.2	-	-	-	-	1.2	-	1.4	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER V

U19ME501	DESIGN OF MACHINE ELEMENTS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Mechanics of Solids.

COURSE OBJECTIVE

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component.
- To learn to use standard practices and standard data.

UNIT I FUNDAMENTALS OF DESIGN 9

Introduction to the design process - design considerations - material selection - Static stresses - Impact and shock loading - principle stresses for combined loading - eccentric loading - curved beams - Factor of safety - theories of failure - stress concenFtration - design for variable loading - endurance limit.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength and rigidity - critical speed of shafts - Introduction to Keys and keyways - Selection of rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Design of knuckle joints - design of bolted joints, welded joints and riveted joints including eccentric loading.

UNIT IV DESIGN OF LEVERS, SPRINGS AND FLYWHEEL 9

Design of levers - Design of helical springs - concentric springs - consideration of variable loading. Design of leaf springs - stresses in flywheel - design of flywheel for engines and punching machines.

UNIT V DESIGN OF BEARINGS 9

Selection of rolling contact bearing - static and dynamic load carrying capacity, cubic mean load, probability of survival. Design of sliding contact bearing - theory of lubrication - hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2017.

2 Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2011.

REFERENCE

1 Sundararajamoorthy T. V. Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2015.

2 R.B. Patel, "Design of Machine Elements", MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011

3 Khurmi.R.S, and Gupta.J.K,"Machine Design", S.Chand Publishing., 2011

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Familiarize the various steps involved in the design process and design a mechanical element considering static stresses and combined stresses using standard data and catalogues	Apply
CO2	Understand the various loadings and stresses that a shaft and coupling is subjected and able to design the same using standard data and catalogues	Apply
CO3	Classify the different types of permanent and temporary joints and choose the suitable joint for machine element using standard data and catalogues	Apply
CO4	Identify the different energy storing elements and design the components such as helical springs, leaf springs and flywheels using standard data and catalogues.	Apply
CO5	Distinguish between the two types of bearings and selection of the same for the required design using standard data and catalogues	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	-	-	-	1	-	-	-	-	2	-
CO2	3	2	3	-	-	-	-	1	-	-	-	-	2	-
CO3	3	2	3	-	-	-	-	1	-	-	-	-	2	-
CO4	3	2	3	-	-	-	-	1	-	-	-	-	2	-
CO5	3	2	3	-	-	-	-	1	-	-	-	-	2	-
CO	3	2	3	-	-	-	-	1	-	-	-	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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Learn Beyond

SEMESTER V

U19ME502	DYNAMICS OF MACHINES	Category: PC			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

Kinematics of Machinery

COURSE OBJECTIVE

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms through analytical methods and experiments.
- To understand the undesirable effects of imbalances resulting from prescribed motions in mechanism through analytical methods and experiments.
- To understand the effect of Dynamics of undesirable vibrations and the principles in mechanisms used for speed control and stability control through analytical methods and experiments..

UNIT I FORCE ANALYSIS **6+3**

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 – Crankshaft torque – Turning moment diagrams –Fly Wheels

UNIT II BALANCING **6+3**

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline – Partial balancing in engines

UNIT III MECHANISMS FOR CONTROL **6+3**

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

UNIT IV FREE VIBRATION **6+3**

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.

UNIT V FORCED VIBRATION **6+3**

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

Contact Periods:

Lecture: 30 Periods Tutorial: 15 Periods Practical: –30 Periods Total: 75 Periods

LIST OF EXPERIMENTS

1. Study of Four bar, slider crank and double rocker mechanism
2. Dynamic Analysis of Cam mechanism – Determination of Cam profile and Jump speed
3. Kinematics of Single Universal Joint – Comparison of theoretical and experimental velocity ratio
4. Study of Epicyclic gear train and differential gear trains
5. Whirling of Shaft – Transverse vibration
6. Compound Pendulum – Determination of natural frequency
7. Spring-mass system – Longitudinal vibration system
8. Balancing of Reciprocating masses
9. Balancing of Rotating masses – Dalby's method of balancing a shaft with several masses in several planes
10. Cantilever beam apparatus – Determination of Young's modulus of the given beam material
11. Two rotor system – Comparison of theoretical and experimental torsional frequency
12. Experiment on Motorized gyroscope – Comparison of theoretical and experimental precessional velocity.

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13 Universal Governors – I (Watt and Porter governor) – Determination of centrifugal force and equilibrium speed

14 Universal Governors – II (Proell and Hartnell) - Determination of centrifugal force and equilibrium speed

15 Modelling of vehicle dynamics using MATLAB and Simulink.

TEXT BOOKS

1 Rattan, S.S, "Theory of Machines", 4TH Edition, Tata McGraw-Hill, 2019.

2 Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2018.

REFERENCE

1 F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2016.

2 Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2017.

3 Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2015

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

Cos	Statements	K-Level
CO1	Perceive the concept of force-motion relationship and calculate various forces with respect to reciprocating engines and interpret T-θ diagrams to determine the fluctuation of energy. kinematic analysis o f mechanism and gear trains.	Apply
CO2	Measure the degree of unbalance for both rotating and reciprocating mass systems analytically and select suitable methods to balance them.	Apply
CO3	Design various types of governors and Gyroscopes and differentiate them based on their working and area of applications	Apply
CO4	Formulate various relationships for free vibrations mathematically and implement on physical systems.	Apply
CO5	Formulate various relationships for forced vibrations mathematically and implement on physical systems.	Apply

COURSE ARTICULATION MATRIX:

Pos / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	1	-	-	-	-	-	-	1	2	-
CO2	3	3	-	-	1	-	-	-	-	-	-	1	2	-
CO3	3	3	-	-	1	-	-	-	-	-	-	1	2	-
CO4	3	3	2	-	1	-	-	-	-	-	-	1	2	-
CO5	3	3	2	-	1	-	-	-	-	-	-	1	2	-
CO	3	3	2	-	1	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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KPRIET
Learn Beyond

SEMESTER V

U19ME503	FUNDAMENTALS OF AUTOMATION	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To learn the Hydraulic and Pneumatic circuit for automation.
- To learn the architecture of Microprocessor, automation systems, and measurement systems.
- To include sensors, signal conditioning, for interfacing and transfer data for needed applications.

UNIT I COMPONENTS USED IN AUTOMATION 9

Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement – Actuators – process control valves – Introduction of DC and AC servo drives for motion control.

UNIT II MICROPROCESSOR AND AUTOMATION ARCHITECTURE 9

Microprocessor – 8085 architectures – Automation overview – Requirement of automation systems – Architecture of Industrial Automation system. Introduction to Intel processors.

UNIT III INTRODUCTION TO HYDRAULICS AND PNEUMATICS 9

Hydraulic Actuators: Cylinders – Types and construction, Application Direction Control, Flow control and pressure control valves. Pneumatic Properties of air – Perfect Gas Laws – Compressor –FRL unit, Quick Exhaust Valves, and Pneumatic actuators. Electro Pneumatic System – Elements – Ladder diagram – Problems

UNIT IV INTERFACING OF SYSTEMS 9

Man-Machine interface – computer aided process control hardware – process related interfaces – Communication and networking – Industrial communication systems – Data transfer techniques – data Acquisition system – DCS – Types – Internet of things (IoT).

UNIT V INDUSTRIAL AUTOMATION 9

Industry 4.0 - Industrial automation using robots – AS/RS, AGV – Basic construction and configuration of robot - Pick and place robot – Welding robot, Automation in material handling.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Total: 45 Periods

TEXTBOOKS

1 S.K. Singh, "Industrial Instrumentation and Control", The McGraw Hill Companies, 2016.

2 Anthony Esposito, "Fluid Power with Applications", Pearson Education 2012

REFERENCE

1 Richard.K.Miller,"Industrial Robot Handbook",Springer, 2013.

2 Groover M.P. "Automation Production Systems and Computer integrated manufacturing", Pearson, 2016.

3 Shanmuga Kannan, M.K, "Hydraulic and Pneumatic controls", Chand and Co, 2013.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

Cos	Statement	K-Level
CO1	Analyze the components needed for an automated system and applications.	Understand
CO2	Explain the architecture of Microprocessor and Automation system.	Understand
CO3	Explain the hydraulic and Pneumatic circuits.	Apply
CO4	Use the Internet of Things for industrial automation.	Apply
CO5	Apply the knowledge of robotics for industrial applications.	Apply

COURSE ARTICULATION MATRIX:

Pos / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO3	3	2	2	-	-	-	-	-	-	2	-	1	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	2	-
CO5	3	2	2	-	-	-	-	-	-	-	-	1	2	-
CO	3	2	2	-	-	-	-	-	-	2	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER V

U19CA002	NUMERICAL APTITUDE AND VERBAL ABILITY - II	Category: EEC			
		L	T	P	C
		1	0	0	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand the concepts of Number System, Profit and Loss and interpret.
- Infer Time, Speed, Distance and Work concepts.
- Write correct sentence structure in professional context.

UNIT I 3

Divisibility tests (Divisibility Factor, Prime Factor, Divisibility Rules, Finding UNIT Digit), LCM &HCF (Listing Multiples, Prime Factorization, Division method, etc.), NUMBER SYSTEM (Numbers, Prime, Composite, Co-Prime numbers), PERCENTAGE (Percentage, Fractions of Percentages, Expenditure, Price, Consumption, Population, Depreciation)

UNIT II 3

PROFIT, LOSS & DISCOUNTS – (CP, SP, MP, Profit, Loss, Discount), RATIO & PROPORTION (Compounded Ratio, Mean Proportional, Componendo, Dividendo, Directly Proportional, Inversely Proportional), Age Problems (Various techniques to solve age problems).

UNIT III 3

Averages (Simple average, weighted average) Mixtures and Allegations (Various techniques to solve mixtures and allegations), Time, Speed and Distance, Train Problems (Problems in same and opposite Direction), Boats and Streams (Downstream, Upstream, Average Speed).

UNIT IV 3

Time & Work (Problems on Time, Work and Efficiency), Permutation & Combination (arrangements & selections, together and not together problems), Probability (Coins, card, Dice) Logarithms (Log Function, Common Log, Natural Log, Binary Log, Laws of Logarithms), Areas and Volumes.

UNIT V 3

Reading Comprehension, Letter Writing, Email Writing, Essay Writing, Resume Building.

Contact Periods:

Lecture: 15 Periods Tutorial: - Periods Practical: – Periods Total: 15 Periods

TEXT BOOKS

1 R S Aggarwal – Quantitative Aptitude for Competitive Examinations, 17th Edition S. Chand Publishing, New Delhi, 2017.

2 Arun Sharma – How to prepare for Quantitative Aptitude for CAT, 8th Edition McGraw Hill Education, Chennai, 2018.

REFERENCE

1 R.S. Aggarwal – A Modern Approach to Verbal & Non-Verbal Reasoning,S Chand Publishing, New Delhi, 2017

2 Abhijit Guha - Quantitative Aptitude for Competitive Examination, McGraw Hill Education (India) Private Limited, 5th Edition, 2015.

3 R S Aggarwal – Objective General English, S Chand Publishing, New Delhi, 2017

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Use basics of counting through Permutation and Combination for arrangement kind of tasks	Apply
CO2	Draft letters, emails and make notes with appropriate use of words.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO	3	-	-	-	-	-	-	-	-	3	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER V

U19ME504	MECHATRONICS LABORATORY	Category: ES			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVES

- To develop the skills of programming using microprocessors and microcontrollers.
- To understand the design and analysis of pneumatic and hydraulic circuits.
- To execute automatic control using PLC and implement the concept of mechatronics.

LIST OF EXPERIMENTS

Pneumatics

1 Operation of Single Acting and Double Acting Cylinders
2 Meter-In & Meter-Out Circuits
3 Door opening and closing circuits
4 Single and Multicycle Automation (A+A-) of a Double Acting Cylinder
5 Sequencing of Two Double Acting Cylinders (A+B+A-B-)
6 Cascading of Two Double Acting Cylinders (A+B+B-A-)
7 Cascading of Three Double Acting Cylinders (A+B+C+C-B-A-)

Electro Pneumatics

8 Operation of a Double Acting Cylinder Using SR and SS Valve
9 Single Cycle Automation and Multicycle Automation of a Double Acting Cylinder
10 Sequencing of Two Double Acting Cylinders (A+B+A-B-)
11 Cascading of Two Double Acting Cylinders (A+B+B-A-)

Electro Pneumatics with PLC

12 Multicycle Automation Using Logo Soft PLC
13 Sequencing of Two Double Acting Cylinders Using Logo Soft PLC (A+B+A-B-)

Sensors, Electrical Drives and Controls

14 Data Logging System to Measure Temperature, Pressure, Flow
15 Speed control of AC and DC Motors Using PID Controller
16 Assembly Language Programming of 8085
17 Stepper Motor Interfacing with 8051 Microcontroller Clockwise and Anticlockwise Rotation
18 Study: Hydraulic components and circuits
19 Study: Image Processing hardware and software
20 Study: Traffic Light Interface
21 Basic sensor & actuator interfacing with Atmega or ARM controllers (Capstone Projects)

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Experiment with the various design concepts involved in pneumatics and hydraulics	Apply
CO2	Demonstrate various programs using microprocessor and microcontroller	Apply
CO3	Build basic automation control circuits using PLC	Apply
CO4	Outline the applications of image processing techniques in automation	Understand
CO5	Design and develop automation modules using electronic controllers, PLC, suitable sensors and actuators	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	1	2	-
CO2	3	2	-	-	2	-	-	-	-	-	-	1	2	-
CO3	3	2	-	-	2	-	-	-	-	-	-	1	2	-
CO4	3	2	-	2	2	-	-	-	-	-	-	1	2	-
CO5	3	2	-	2	2	-	-	-	-	-	-	1	2	-
CO	3	2	-	2	2	-	-	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER V

U19ME505	TECHNICAL SEMINAR	Category: EEC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced. In this course, a student has to present three Technical papers or recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

Contact Periods:

Lecture: - Periods Tutorial: - Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Prepare and explain a technical content	Apply
CO2	Organize the content and present within the stipulated time	Apply
CO3	Use ICT tools for presentation	Apply
CO4	Select references from reliable sources	Apply
CO5	Provide clear and insightful answers to all the questions	Apply

COURSE ARTICULATION MATRIX:

Cos \ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	3	3	-	3	3	-
CO2	3	3	3	3	-	-	-	-	3	3	-	3	3	-
CO3	3	3	3	3	-	-	-	-	3	3	-	3	3	-
CO4	3	3	3	3	-	-	-	-	3	3	-	3	3	-
CO5	3	3	3	3	-	-	-	-	3	3	-	3	3	-
CO	3	3	3	3	-	-	-	-	3	3	-	3	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER VI

		Category: PC			
		L	T	P	C
U19ME601	DESIGN OF TRANSMISSION SYSTEM	3	0	0	3

PRE–REQUISITES:

Kinematics of Machinery

COURSE OBJECTIVE

- To understand the various elements involved in a transmission system.
- To analyze the various forces acting on the elements of a transmission system.
- To produce working drawings of the system involving various machine elements like pulleys, gears, clutches and brakes

UNIT I FLEXIBLE TRANSMISSION ELEMENTS 9

Introduction to transmission systems –factors -materials selection –stresses – belt & chain drives, Design of flat and V- belts, Design of chain drives, Design of rope drives. Design of linear drive systems.

UNIT II DESIGN OF SPUR, HELICAL & HERRINGBONE GEARS 9

Introduction - gear kinematics – forces & stresses – factors –materials selection – design of spur gears. Introduction – types - gear kinematics – virtual number of teeth - forces & stresses – factors – design of helical gears. Fundamentals of Herringbone gears.

UNIT III DESIGN OF BEVEL, WORM, SPIRAL AND HYPOID GEARS 9

Introduction – classifications - gear kinematics – factors – design of bevel gears – force analysis. Introduction – classifications – applications – efficiency – design of worm gears. Fundamentals of spiral and Hypoid gears.

UNIT IV DESIGN OF GEAR BOXES 9

Introduction – Types – Components – gear box housing – progression ratio – kinematic arrangement – ray diagram – design of synchronous gearboxes for Automobiles - Automatic gear box Design

UNIT V DESIGN OF CLUTCHES AND BRAKES 9

Design of Plate Clutch – Axial Clutches – Cone Clutches – Internal Expanding Rim Clutches – Electromagnetic Clutches. Design of Brakes: Band and Block Brakes – External Shoe Brakes – Internal Expanding Shoe Brakes.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Richard G. Budynas, J.Keith Nisbett, "Shigley's Mechanical Engineering Design", 10th edition, McGraw–Hill Education, 2014

2 Robert L.Norton, "Machine Design – An Integrated Approach", 5th edition, Pearson Higher Education, 2014.

REFERENCE

1 V.B. Bhandari, "Design of Machine elements", 3rd Edition, Tata Mc Graw Hill, 2010.

2 Juvinal, R.C and Kurt M.Marshek, "Machine component design", John Wiley, 2012.

3 Design Datas, PSG College of Technology, DPV Printers, Coimbatore, 2010.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Design of pulleys, chain drives, rope drives and belt drives.	Apply
CO2	Analyze forces acting on elements of transmission systems.	Apply
CO3	Determine performance requirements in the selection of commercially available transmission drives.	Apply
CO4	Design of various types of gears and gearboxes.	Apply
CO5	Design of various types of clutches and brakes	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	1	-	-	-	-	3	-
CO2	3	3	3	-	-	-	-	1	-	-	-	-	3	-
CO3	3	3	3	-	-	-	-	1	-	-	-	-	3	-
CO4	3	3	3	-	-	-	-	1	-	-	-	-	3	-
CO5	3	3	3	-	-	-	-	1	-	-	-	-	3	-
CO	3	3	3	-	-	-	-	1	-	-	-	-	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

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SEMESTER VI

U19ME602	HEAT AND MASS TRANSFER	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Engineering Thermodynamics

COURSE OBJECTIVE

- To understand the mechanism of conduction under steady and transient conditions.
- To understand the concepts of heat transfer through convection, phase change processes and radiation.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of heat pipes, thermosyphons and mass transfer.

UNIT I CONDUCTION HEAT TRANSFER 9

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation –Fourier Law of Conduction - General Differential Conduction equation in Cartesian and Cylindrical Coordinate systems – One Dimensional Steady State Heat Conduction - Extended Surfaces - Unsteady Heat Conduction – usage of Heislers Chart.

UNIT II CONVECTION AND PHASE CHANGE HEAT TRANSFER 9

Basic Concepts – Convective Heat Transfer Coefficients – Dimensionless numbers - Formation of thermal boundary layer- Forced and Free convection (Simple problems), Turbulent and Combined flows. Condensation and boiling - Nusselt's theory of condensation - Regimes in boiling. (Simple Problems).

UNIT III HEAT EXCHANGERS, HEAT PIPES AND THERMOSYPHONS 9

Types of Heat Exchangers- parallel and counter flow heat exchanger - compact heat exchanger – Overall Heat Transfer Coefficient –Fouling Factors - LMTD and Effectiveness – NTU methods of Heat Exchanger Analysis. -Problems – Simulation of Heat Exchangers using MATLAB - Basic concepts in Heat pipes and Two phase Thermosyphons. Applications of Heat Pipes in electronics Cooling.

UNIT IV RADIATION 9

Radiation- Nature of thermal radiation-definitions and concepts- emissive Power-Intensity of radiation-solid angle- absorptivity, reflectivity and Transmissivity-Concept of black body- Planck' law- Kirchhoff's law-Wein's displacement Law-Stefan Boltzmann's Law-Configuration factor for simple geometries - Electrical analogy -Radiation Shields. Gas Radiation. Case Study – Heat transfer through mobile phone casing.

UNIT V MASS TRANSFER 9

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations - Problems.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2010

2 Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition, 2015

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REFERENCE

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2011.
2. R.K. Rajput. "Heat and mass transfer", S.Chand & Co.,2015
3. Dr. D.S. Kumar, "Heat & Mass Transfer", S.K. Kataria & Sons; Reprint 2013 edition, 2013.

STANDARDS

1 C.P. Kothandaraman, S. Subramanya, "Heat and Mass Transfer Data Book", New Age Publications, 2014.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply basic heat conduction equations to various heat transfer systems.	Apply
CO2	Analyze heat transfer phenomenon involved convection and phase change heat transfers.	Apply
CO3	Perform the thermal analysis on heat exchangers and understand the basic principles of heat pipes and Thermosyphons.	Apply
CO4	Explain fundamental concepts of radiation and apply it to various systems.	Apply
CO5	Explore concepts of mass transfer along with and correlations to implement them for different applications.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	1	-	-	-	-	-	-	-	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	1	1	-	-	-	-	-	-	-	-	-	2	-
CO	3	2	2	-	1	-	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VI

U19ME603	FINITE ELEMENT ANALYSIS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Mechanics of Solids

COURSE OBJECTIVE

- To introduce the concepts of Mathematical Modeling for Engineering Problems.
- To appreciate the use of FEM to a range of variable Problems.
- To impart he applications of FEM in heat transfer and fluid mechanics.

UNIT I INTRODUCTION 6

Historical Background – Mathematical modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Introduction to boundary, initial and eigenvalue problems– Weighted residual methods – Variational formulation of boundary value problems – Ritz technique – Basic concepts of the FEM.

UNIT II ONE-DIMENSIONAL PROBLEMS 6

One Dimensional second order equations – Discretization – Element types- Linear and Higher order Elements –Shape functions, Stiffness matrices and force vectors- Assembly of Matrices - beam element – nodal approximation – shape functions – element matrices and vectors – assembly

– solution of problems from solid mechanics.

UNIT III TWO-DIMENSIONAL SCALAR VARIABLE PROBLEMS 6

Second order 2D Equations involving scalar variable functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions, element matrices and vectors. Application to field problems - Thermal problems – Quadrilateral elements.

UNIT IV TWO-DIMENSIONAL VECTOR VARIABLE PROBLEMS & VIBRATION PROBLEMS 6

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces & temperature effects – Stress calculations. Introduction to vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations – solution of eigenvalue problems – vector iteration methods – normal modes – transient vibrations.

UNIT V HEAT TRANSFER & FLUID MECHANICS USING FEA 6

One Dimensional heat transfer element – application to one-dimensional heat transfer problems- scalar variable problems in 2D – Applications to heat transfer in Two Dimension – Application to problems in fluid mechanics in 2D – Introduction to Iso-parametric formulation.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: Periods Total: 45 Periods

TEXT BOOKS

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw- Hill, 2016
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2017.

REFERENCE

1. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2018.
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 2019
3. Cook,Robert.D., Plesha,Michael.E & Witt,Robert.J. "Concepts and Applications of Finite Element Analysis",Wiley Student Edition, 2012. ISBN-10 81-265-1336-5

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

Cos	Statements	K-Level
CO1	Comprehend the concepts of boundary value problems, weighted residual, Rayleigh-ritz and potential energy methods	Apply
CO2	Apply the basic finite element equations for structural applications of bar and beam element problems.	Apply
CO3	Formulate the finite element equations for two dimensional elements of triangular and quadrilateral elements.	Apply
CO4	Articulate the finite element equations for axisymmetric and vibration problems.	Analyze
CO5	Analyze the heat transfer and fluid mechanics problems using one- and two-dimensional finite element equations.	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	1	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	1	2	-	-	-	-	-	-	-	-	3	-
CO4	3	3	1	2	-	-	-	-	-	-	-	-	3	-
CO5	3	3	1	2	-	-	-	-	-	-	-	-	3	-
CO	3	3	1	2	-	-	-	-	-	-	-	-	3	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER VI

U19ME604	SIMULATION AND ANALYSIS LABORATORY	Category: ES			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

Objective of this course is to

- To give exposure to software tools needed to analyze engineering problems.
- To expose students to different applications of simulation and analysis tools.

LIST OF EXPERIMENTS

1 Effect of self-weight of Cantilever Beam
2 Stress Analysis of Cantilever Beam
3 Stress Analysis of Simply Supported Beam
4 Stress Analysis of Fixed Beam
5 Shear Force and Bending Moment Diagrams of Beams
6 Stress Analysis of Rectangular Plate
7 Stress Analysis of a Plate with a Circular Hole
8 Stress Analysis of Rectangular L bracket
9 Static & Dynamic Analysis of a 2-D Truss Component
10 Stress Analysis of an axi-symmetric Component
11 Thermal stress Analysis of plates
12 Thermal Stress Analysis of Cylindrical Shells
13 Conductive Heat transfer Analysis of a 2-D Component
14 Convective Heat transfer Analysis of a 2-D Component
15 Modal Analysis of Cantilever Beam
16 Modal Analysis of Rectangular Plate
17 Modal Analysis of Plate with Holes
18 Harmonic Analysis of Cantilever Beam
19 Harmonic Analysis of Rectangular Plate
20 Harmonic Analysis of Plate with Holes
21 Vibration Analysis of Spring Mass System
22 Transient Analysis of Beams & 2-D Components
23 MATLAB-Based Finite Element Analysis in a Vibrational system
24 Simulation of Heat Exchanger Process
25 Flow Development in a channel

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 45 Periods Total: 45 Periods

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Demonstrate stress analysis of various beams by giving suitable loads and constraints.	Understand
CO2	Develop a 2-D structural and non-structural model and perform structural analysis	Apply
CO3	Analyze thermal stresses in a component to determine conduction and convection.	Apply
CO4	Perform modal analysis for 2D component	Apply
CO5	Analyze the structures based on the vibration and perform harmonic analysis upon them using simulation software.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	3	-	-	-	-	-	-	-	3	-
CO2	3	3	1	2	3	-	-	-	-	-	-	-	3	-
CO3	3	3	1	2	3	-	-	-	-	-	-	-	3	-
CO4	3	3	1	2	3	-	-	-	-	-	-	-	3	-
CO5	3	3	1	2	3	-	-	-	-	-	-	-	3	-
CO	3	3	1	2	3	-	-	-	-	-	-	-	3	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VI

		Category: ES			
U19ME605	**THERMAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Conduct different tests on IC engines, steam turbines and steam boilers.
- Determine the constants involved in heat transfer process and access the performance of thermal systems
- Conduct Numerical investigations on heat transfer process using MATLAB

LIST OF EXPERIMENTS

IC engines and Steam Laboratory

1 Study of Port timing and Valve timing diagrams of Two stroke and Four Stroke IC Engines.

2 Performance test in four stroke diesel engines with different loading mechanisms, retrieval of P-θ data using DAQ.

3 Retardation test on slow speed four stroke Diesel engine

4 Emission test on a Single cylinder diesel engine.

5 Performance test on Steam boiler and Turbines.

6 Performance Test on Reciprocating Air Compressors

Heat transfer Laboratory

7 Determination of Thermo Physical Properties of Polymer-Based Composite Materials

8 Determination of heat transfer coefficient of natural and forced convection process.

9 Determination of emissive power of a grey body.

10 Determination of Stephan Boltzmann constant.

11 Performance analysis of HC refrigeration system.

12 Performance analysis of Air conditioning system

13 Performance analysis of parallel and counter flow heat exchanger

14 Performance analysis of Fluidized bed cooling tower.

15 Heat transfer through lagged pipe and composite walls.

16 Modelling heat transfer system using MATLAB and Spreadsheets

Augmented Experiments

17 Determination of heat transfer coefficient Natural and forced convection over Pin – Fin apparatus.

18 Determination of heat transfer through insulating powder.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Demonstrate the use of studying valve timing and port timing diagrams	Understand
CO2	Analyze the performance, combustion & Emission characteristics of an IC engine and Steam Power Plant.	Apply
CO3	Determine the heat transfer characteristics and performance of various heat transfer systems.	Apply
CO4	Determine the heat transfer coefficient for various heat transfer processes	Apply
CO5	Develop a MATLAB/Spreadsheet based mathematical model for heat transfer systems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	2	-
CO2	3	2	-	-	-	1	-	-	-	-	-	1	2	-
CO3	3	2	-	1	-	1	-	-	-	-	-	1	2	-
CO4	3	2	-	-	-	1	-	-	-	-	-	1	2	-
CO5	3	2	3	3	3	1	-	-	-	-	-	1	2	-
CO	3	2	3	2	3	1	-	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER VI

U19ME606	MINI PROJECT	Category: PC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS

The students will work on a specific topic approved by the head of the division as a team and under the guidance of a faculty member who is familiar in this area of interest. The group of 3 to 4 members can select any topic which is relevant to the area of Mechanical Engineering. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The team will be evaluated through a viva-voce examination by a panel of examiners.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOME (CO)

Upon completion of the course, the student will be able to

CO	Statement
CO	The students will have a clear idea of their area of work and they will be in a position to carry out the main project work systematically.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	3	3	3	2	3	2	2	2	3	2	3	2	3	2
Correlation levels:	1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)													

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SEMESTER VII

U19ME701	TOTAL QUALITY MANAGEMENT	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand the evolution of quality principles and practices.
- Apply the tools and techniques of quality management.
- Apply standards of quality management systems.

UNIT I INTRODUCTION 9

Need and evolution of quality, Definition of quality, Important philosophies- Deming, Juran, Crosby, Ishikawa and Taguchi. Fundamentals of TQM and TQM framework. Barriers to TQM, Leadership- quality council, Quality statements and quality planning.

UNIT II TQM PRINCIPLES 9

Customer focus - Customer satisfaction, customer perception of quality, customer complaints and customer retention. Employee Involvement - Motivation, empowerment, Team and team work. Supplier quality management - supplier partnership, supplier selection and supplier rating. Continuous Process improvement - Juran trilogy, PDSA cycle, 5S, Kaizen and Re-engineering. Performance measures - quality costs.

UNIT III PROCESS CONTROL 9

Seven QC tools- New seven management tools. Statistical fundamentals- Normal Curve, charts for variables and attributes, process capability studies.

UNIT IV TQM TOOLS AND TECHNIQUES 9

TQM tools- Benchmarking process, Quality function deployment and house of quality, FMEA- design FMEA and Process FMEA. Six sigma- Concepts, methodology, application in manufacturing and service sectors. Total productive maintenance.

UNIT V QUALITY MANAGEMENT SYSTEMS 9

Need of ISO 9001:2015 - Elements, Implementation, documentation auditing, and Registration. Environmental management system - ISO 14001:2015 - concept, Requirements and benefits. OSHAS 18000- concept, Requirements and benefits. Case studies.

Contact Periods:							
Lecture:	45 Periods	Tutorial:	– Periods	Practical:	- Periods	Total:	45 Periods

TEXT BOOKS

1 Bester field, D. H., Besterfield-Michna, C., Besterfield-Sacre, M., Bester field, G. H., & Urdhwareshe, H. "Total Quality Management", revised 3rd Edition, Pearson, 2012.

2 Adam, E. E.,, Jr., & Swamidass, P. M. (1989). Assessing operations management from a strategic perspective. Journal of Management, 15, 181-203.

REFERENCE

1 James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.

2 Janaki Raman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall(India) Pvt. Ltd., 2006.

3 Ismael Dambolena, Lawrence P. Carr, Ashok Rao, Robert J Kopp, "Total Quality Management: A cross functional perspective", John Wiley and Sons, 1996.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the principles of TQM	Understand
CO2	Explain the involvement of employees and suppliers for customer satisfaction.	Understand
CO3	Implement the QC tools for Process control.	Apply
CO4	Apply the tools and Techniques of TQM	Apply
CO5	Implement the quality management system in an organization.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO2	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO3	2	2	-	-	-	-	-	-	-	-	1	-	-	3
CO4	2	2	-	-	-	-	-	-	-	-	1	-	-	3
CO5	2	1	-	-	-	-	2	-	-	-	1	-	-	3
CO	2	1.67	-	-	-	-	2	-	-	-	1	-	-	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER VII

U19ME702	OPERATIONS RESEARCH	Category: PC			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- To impart the knowledge of formulation of practical problems using the linear programming method and its extensions.
- To understand the theoretical basics of different computational algorithms used real time problems.
- To apply decision models to real time problems.

UNIT I LINEAR MODELS **9+3**

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis using software (TORA).

UNIT II NETWORK MODELS **9+3**

Network models - Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling - Sequencing models- Demonstration of network model using software.

UNIT III INVENTORY MODELS **9+3**

Inventory models - Economic order quantity models - Quantity discount models - Stochastic Inventory models - Multi product models - Inventory control models in practice- Introduction to SAP.

UNIT IV QUEUEING THEORY **9+3**

Queueing models - Queueing systems and structures - Notation - parameter - Single Server and multi-server models - Poisson input - Exponential service - Constant rate service - Infinite population - Simulation

UNIT V DECISION MODELS **9+3**

Decision models - Game theory - Two person zero sum games - Graphical solution - Algebric solution - Linear programming solution - Replacement models - Models based on service life - Economic life - Single/ Multi variable search technique - Application of OR models - Case studies.

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: - Periods Total: 60 Periods

TEXT BOOKS

1 H.A.Taha, " Operations Research ", Prentice Hall of India, 2016, Eighth Edition.

2 Shennoy, Srivastava, " Operation Research for Management ", Wiley Eastern, 2014

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REFERENCE

1 Ravindran, A., Phillips, D. T., & Solberg, J. J. "Operations research- principles and practice" (2nd ed.). New Delhi: Wiley India (P.) Ltd. (Indian print), 2015

2 Hillier, F. S., & Lieberman, G. J. "Introduction to operations research- concepts and cases" (9th ed.). New Delhi: Tata McGraw Hill (Indian print), 2017

3 Frank, S.Budnick, Dennis, McLeavy, " Principles of Operation Research for Management", Richard D Irwin, 1990.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Describe the basic concepts of convex analysis and explain the theoretical foundations of various issues related to linear programming and modelling	Apply
CO2	Perform sensitivity analysis to identify the direction and magnitude of change network models and critical path scheduling	Apply
CO3	Use the optimization techniques in inventory control	Apply
CO4	Formulate the Queueing theory and simulation	Apply
CO5	Demonstrate solution methods including graphs and linear programming to analyze and solve the Two-person, zero-sum games	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	-	1	-	-	-	-	-	-	1	3	3
CO2	2	3	1	-	1	-	-	-	-	-	-	1	3	3
CO3	2	3	1	-	1	-	-	-	-	-	-	1	3	3
CO4	2	3	1	-	1	-	-	-	-	-	-	1	3	3
CO5	2	3	1	-	1	-	-	-	-	-	-	1	3	3
CO	2	3	1	-	1	-	-	-	-	-	-	1	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER VII

U19ME703	AUTOMOBILE ENGINEERING	Category: PC			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Introduce the fundamentals of vehicle technology and its systems.
- Provide hands on experience in automotive systems.
- Infuse the application of electronics in automobile engineering and passenger safety.

UNIT I VEHICLE STRUCTURE AND FRAMES 6

Introduction- Classification of Vehicles, Basic construction of chassis, Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frames. aerodynamic forces on the vehicle body.

UNIT II DRIVE LINE, FINAL DRIVE LINE AND DIFFERENTIALS. 6

Driving Thrust and its effects, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Final drive, different types of final drive, Worm and Worm wheel, straight bevel gear, spiral bevel gear and hypoid gear final drive. Differential principle. Constructional details of differential unit, Differential housings, Non–Slip differential, Differential locks.

UNIT III STEERING AND SUSPENSION SYSTEMS 6

Types of front axle, steering Geometry, Self-returning property, Ackerman and Davis steering linkages, Steering system layout. Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs, independent suspension, rubber suspension, pneumatic suspension, shock absorbers.

UNIT IV AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM 6

Batteries and accessories Lighting system: insulated and earth return system, Horn, wiper system and trafficator. Starting System, Charging System, Fundamentals of Automotive Electronics electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

UNIT V BRAKING AND PASSENGER SAFETY SYSTEMS 6

Classification of brakes, drum brakes and disc brakes, hydraulic system, vacuum assisted system, air brake system, antilock braking, retarded engine brakes, eddy retarders. Air bags, Seat Belts, ASP. and ABS.

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

LIST OF EXPERIMENTS

1. Demonstration on structure of automotive chassis components and frames. (car, jeep, truck, bus).
2. Assembling and dismantling of Automatic gearbox (Audi A8).
3. Demonstration on working of a multi cylinder engine and gearbox using cut section models.
4. Assembling and dismantling of single and Multi-plate Clutch Assemblies.
5. Battery and electrical accessories testing.
6. On board engine diagnostics system.

TEXT BOOKS

1. Heinz Hazler, "Modern Vehicle Technology", Butterworth, London, 2005.
2. Giri. N.K., "Automotive Mechanics" Khanna Publishers, New Delhi, 2005.

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REFERENCE

1. Devaradjane. Dr. G., Dr. M. Kumaresan, "Automobile Engineering", AMK Publishers, 2013
2. Newton Steeds and Garret, "Motor Vehicles" 13th Edition, Butterworth, London, 2005.
3 K.Ramalingam ,Automobile Engineering 2nd Edisson, Scitech Publishers

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Differentiate between various types of automotive chassis and frames.	Understand
CO2	Explain the transmission of power from engine to wheels in an automobile	Understand
CO3	Enumerate the types of suspension system and steering system used in an automobile	Understand
CO4	Explain the working of various electrical and Electronics systems available in automobile	Understand
CO5	Identify the various components in Braking systems and passenger safety systems.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO	3	-	-	-	-	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER VII

U19ME704	COMPUTER AIDED MODELLING AND MACHINING LABORATORY	Category: ES			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining center.

LIST OF EXPERIMENTS

1 Creation of 3D assembly model of Flange Coupling and applications.
2 Creation of 3D assembly model of Screw Jack and applications.
3 Creation of 3D assembly model of stuffing box and applications.
4 Creation of 3D assembly model of Plummer Block and applications.
5 Creation of 3D assembly model of Universal Joint and applications.
6 Creation of detail view of Connecting Rod and BOM.
7 Creation of detail view of Safety Valve and BOM.
8 Study of CNC Machine and Part Programming (Turning & Milling)
9 Create a part program for external step turning operations
10 Create a part program for grooving and threading operations.
11 Create a Part Program for Contour Milling Operations
12 Create a Part Program for Mirroring Operations
13 Create a Part Program for Circular Pocketing Operations
14 Application of CAPP in Machining and Turning Centre

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES (CO)

At the end of this course, the students will be able to;

COs	Statements	K-Level
CO1	Draw 3D and Assembly drawing using CAD software	Understand
CO2	Construct different types of Mechanical components	Apply
CO3	Develop the assembly and disassembly of various mechanical parts.	Apply
CO4	Ability to understand the CNC control in modern manufacturing system	Understand
CO5	Design and Simulate a various Mechanical components system using modern engineering software tools.	Apply

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	2	-	-	2	-
CO2	3	2	1	-	1	-	-	-	1	2	-	-	2	-
CO3	3	2	1	-	1	-	-	-	1	2	-	-	2	-
CO4	3	2	1	-	1	-	-	-	1	2	-	-	2	-
CO5	3	2	1	-	1	-	-	-	1	2	-	-	2	-
CO	3	2	1	-	1	-	-	-	1	2	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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SEMESTER VIII

U19ME801	PROJECT WORK	Category: PC			
		L	T	P	C
		0	0	20	10

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports, to analyze the results, make conclusions and to face viva-voce examination.

SYLLABUS

The students individually/ in a group of 3 – 4 members can work on a topic approved by the Head of the Department under the guidance of a faculty member who is familiar in the area of interest. The student can select any topic which is relevant to Mechanical Engineering. The progress of the project is evaluated based on a minimum of three reviews. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by an internal examiner and an external examiner.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 300 Periods Total: 300 Periods

COURSE OUTCOME (CO)

Upon completion of the project work,

COs	Outcome
CO	The students will be in a position to take up any challenging practical problem in the field of mechanical engineering and find better solutions to it.

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO	3	3	3	2	3	2	2	2	3	2	3	2	3	2
Correlation levels:	1: Slight (Low)						2: Moderate (Medium)				3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19MEP01	DESIGN FOR MANUFACTURE AND ASSEMBLY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand the concept of design for manufacturing, assembly and environment.
- Emphasis on the role of computer application in design for manufacturing and assembly.
- Adapting environmental standards in industrial application.

UNIT I INTRODUCTION 9

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.

UNIT II FACTORS INFLUENCING FORM DESIGN 9

Working principle, material, manufacture, design - Possible solutions - materials choice – Influence of materials on form design - form design of welded members, forgings and casting.

UNIT III COMPONENT DESIGN AND MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, countersunk screws - reduction of machined area - simplification by separation -simplification by amalgamation - design for machinability - design for economy - design for clamping – design for accessibility - design for assembly – product design for manual assembly -product design for automatic assembly – robotic assembly.

UNIT IV COMPONENT DESIGN - CASTING CONSIDERATION 9

Redesign of castings based on parting line considerations - minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - modifying the design -group technology - computer Applications for DFMA.

Capstone Project on part assembly/ product from scratch without manufacturing constraints.

UNIT V DESIGN FOR ENVIRONMENT 9

Introduction – Environmental objectives – Global issues – Regional and local issues –Basic DFE methods – design guidelines – application – Life cycle assessment – basic method – AT&T's environmentally responsible product assessment -Weighted sum assessment method – Life cycle assessment method -Techniques to reduce environmental impact - design to minimize material usage – design for disassembly – design for recyclability – design for manufacture– design for energy efficiency – design to regulations and standards.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Boothroyd, G, "Design for Assembly Automation and Product Design". New York, Marcel Dekker, 2016

2 Harry Peck, "Designing for Manufacture", Pitman–19738.Kevin Otto and Kristin Wood, Product Design. Pearson Publication, (Fourth Impression) 2009.

REFERENCE

1 Bralla, Design for Manufacture handbook, McGraw hill, 1999.Fixel, J. Design for the Environment McGraw Hill.2012

2 Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 2014.

3 Graedel T.Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 2018.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the appropriate design principles for sustainable manufacturing.	Understand
CO2	Elaborate on the factors influencing form design of a product.	Understand
CO3	Design a product by considering the machining requirements.	Apply
CO4	Design a component to be manufactured by casting.	Apply
CO5	Design an equipment considering the environmental factors.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	2	3	3	-	1	-	-	-	1	-	-	-	2	-
CO5	2	3	3	-	-	3	3	-	-	-	-	-	2	-
CO	2	3	3	-	1	3	3	-	1	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP02	COMPUTER AIDED DESIGN	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To provide an overview of how computers are being used in mechanical component design.
- To understand and master the nature of CAD systems, their basic structure, their use in engineering tasks and their use to create geometric models of simple parts.
- To provide recent development in the area of product design and to relate developments to the application-oriented needs of industrial users.

UNIT I INTRODUCTION 9

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – coordinate systems- 2D and 3D transformations- homogeneous coordinates – Line drawing -Clipping- viewing transformation.

UNIT II NURBS AND SOLID MODELING 9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid geometry - comparison of representations - user interface for solid modeling.

UNIT III GEOMETRIC MODELING 9

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.

UNIT IV VISUAL REALISM 9

Hidden – Line-Surface-Solid Removal Algorithms – Shading – Coloring – Engineering Animation.

UNIT V CAD STANDARDS 9

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. Capstone project on simple Mechanical Products.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1. Agoston and Max K, "Computer Graphics & Geometric Modeling", Springer-Verlag London Limited, 2014.
2. Gerald Farin, "Curves and Surfaces for CAGD - A Practical Guide", Morgan Kaufmann, 2015.

REFERENCE

1. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2012.
2. Ibrahim Zeid, "Mastering CAD/CAM", McGraw Hill, International Edition, 2017.
3. Shah J J and Mantyla M, "Parametric and Feature-based CAD/CAM", John Wiley & Sons, New York, 1995.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able

COs	Statement	K-Level
CO1	To understand the fundamentals of computer graphics and their application in computer aided design software.	Understand
CO2	To apply the theory and practices of NURBS and curves, in geometric modeling & new product development.	Apply
CO3	To apply the theory and practices of Surface and Solids, in geometric modeling & new product development.	Apply
CO4	To examine the concepts like rendering, visualization, motion, animation and their role in geometric modeling.	Apply
CO5	To develop the CAD standards to ensure the correct data conversion between different CAD software	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	-	3	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	3	-	-	-	-	-	-	-	-	-
CO3	2	2	3	-	3	-	-	-	-	-	-	-	-	-
CO4	2	2	3	1	3	-	-	-	-	-	-	-	-	-
CO5	2	2	3	-	3	-	-	-	-	-	-	-	-	-
CO	2	2	3	1	3	-	-	-	-	-	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19MEP03	NON-DESTRUCTIVE TESTING OF MATERIALS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Give an insight in the various Non-Destructive Testing (NDT) and Destructive testing.
- Develop the skills, to examine the materials and components by NDT methods to increase the product quality
- Enhance the recent trends in manufacturing equipment.

UNIT I OVERVIEW OF NDT 7

NDT Versus Mechanical testing, Overview of the Non- Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided. ASTM Standards for NDT

UNIT II SURFACE NDT METHODS 8

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 10

Thermography- Principles, Contact and non-contact inspection methods, Techniques for Apply liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 10

Ultrasonic Testing - Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications, Calibration with V1, V2 blocks.

UNIT V RADIOGRAPHY 10

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrometers, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography,

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

2 Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

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REFERENCE

1 ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, Volume-17, 2000.

2 Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005

3 Charles, J. Hellier, Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the Overview of the Non-Destructive Testing Methods, material characterization and Visual inspection	Understand
CO2	Liquid Penetrant Testing usage and working, Magnetic Particle Testing theory and applications	Understand
CO3	Illustrate Thermography Principles, Contact and non-contact inspection Eddy Current Testing Interpretation /Evaluation	Understand
CO4	Understand the Ultrasonic Testing-Principle and Acoustic Emission Technique–Principle, AE parameters in NDT	Understand
CO5	Explain the Radiography Principle, Xero-Radiography and the difference Computed Radiography, and Computed Tomography	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	1	3	-	-	-	-	-	-	-	2	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	2	-
CO3	2	3	3	3	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	2	-
CO5	2	3	3	3	1	-	-	-	-	-	-	-	2	-
CO	3	3	3	3	2	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP04	PROJECT MANAGEMENT	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Learn to evaluate and choose an optimal project and build a project profile.
- Attain knowledge on project plans and its components, risk identification and risk analysis.
- Learn to apply project and resource management techniques to manage resources.

UNIT I INTRODUCTION & PROJECT INITIATION 9

Introduction to project and project management- projects in contemporary organization - The project life cycle - project initiation - project evaluation methods & techniques - project selection criteria - project design - work break down structure.

UNIT II RISK ANALYSIS 9

Sources of risk: Project Specific - competitive - industry specific - market and international risk - perspectives of risk - Risk analysis: sensitivity analysis - scenario analysis - breakeven analysis - simulation analysis - decision tree analysis - managing / mitigating risk - project selection under risk.

UNIT III PROJECT PLANNING & IMPLEMENTATION 9

Project planning - importance - functions- areas of planning - planning objectives and policies - steps in planning process - WBS - capital requirements - budgeting and cost estimation - feasibility analysis - creation of project plan - project implementation: pre-requisites - forms of project organization - project responsibility matrix - project leadership, communication and soft skills.

UNIT IV PROJECT MANAGEMENT TECHNIQUES 9

Project scheduling - network construction - estimation of project completion time - identification of critical path - PERT/CPM/PDM - network techniques for manufacturing critical chain methods - using software such as MS project / primavera for CPM/PERT/PDM - scheduling using software such as MS project / primavera for project monitoring and control.

UNIT V PROJECT RESOURCE MANAGEMENT 9

Crashing of project network - complexity of project scheduling with limited resources - resource allocation - resource leveling - resource smoothing - project resource management - project risk management using ERP in projects.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1. Prasanna Chandra, "Projects: Planning, Analysis, Financing, Implementation and Review", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Narendra Singh, "Project Management and Control", Himalaya Publishing, New Delhi, 2015.

REFERENCE

1. Jerome, D. Weist and Ferdinand K. Levy, "A Management Guide to PERT/CPM", Prentice Hall of India, New Delhi, 1994.
2. John M Nicholas, "Project Management for Business and Technology: Principles and Practice", Prentice Hall of India, 2002
3. Robert K. Wysocki, Robert Back Jr. and David B. Crane, "Effective Project Management", John Wiley, 2002.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Evaluate & select a project as well as develop a project profile.	Understand
CO2	Identify various risks associated with the project and manage it effectively.	Understand
CO3	Prepare a detailed project plan addressing its components	Apply
CO4	Apply project management techniques for maximizing resource utilization.	Apply
CO5	Apply resource management in the projects	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	1	-	-	-	-	2	3	1	-	-
CO2	2	-	-	-	1	-	-	-	-	2	3	1	-	-
CO3	2	3	3	-	1	-	-	-	-	2	3	1	-	-
CO4	2	3	3	-	1	-	-	-	-	2	3	1	-	-
CO5	2	3	3	-	1	-	-	-	-	2	3	1	-	-
CO	2	3	3	-	1	-	-	-	-	2	3	1	-	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19MEP17	MAINTENANCE AND ERECTION ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry and to understand the erection principles.

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics

UNIT II MAINTENANCE POLICIES — PREVENTIVE MAINTENANCE 7

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis, Crack Monitoring, Vibration Monitoring.

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS AND MATERIAL HANDLING EQUIPMENT 11

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location. Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

UNIT V ERECTION ENGINEERING 9

Erection Tools & Materials- Types of wire ropes, Hoisting chain. Handling loads on slings. Erection Procedures and Techniques. Checking and Inspection of Erection work. Safety and erection hazards.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Venkataraman. K "Maintenance Engineering and Management", PHI Learning, Pvt. Ltd., 5th Edition, 2015.

2 R. Keith Mobley, Maintenance Engineering Handbook, McGraw Hill, 8th edition,2016.

REFERENCE

1 Higgins L.R., "Maintenance Engineering Hand book", 7th Edition, McGraw Hill, 2011

2 Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 2010.

3 Doc Palmer, "Maintenance Planning and Scheduling Handbook", McGraw hill Publisher, 4th edition, 2019

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the importance of reliability concepts and time management of maintenance sources by considering economic factors.	Understand
CO2	Identify different categories of maintenance and to apply TPM principles in industries.	Apply
CO3	Apply the condition monitoring techniques in the field of maintenance engineering and to compare cost involvements in Crack Monitoring, and Vibration Monitoring.	Apply
CO4	Adapt repair methods for basic machine elements & material handling equipment to maximize output and to predict failure analysis of machine elements and to compile equipment records.	Apply
CO5	Understand the different erection tools and procedure for safe commissioning.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	3	-	-	3
CO2	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO3	2	-	-	-	3	-	3	-	-	-	-	-	-	3
CO4	2	-	-	-	2	-	3	-	-	-	-	-	-	3
CO5	2	-	-	-	-	-	3	-	-	-	-	-	-	3
CO	3	-	-	-	3	1	3	-	-	-	3	-	-	3
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19MEP06	GAS DYNAMICS AND JET PROPULSION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVE

- Introduce the learner with the key concepts in compressible flows.
- Introduce the applications of standard charts and tables to calculate properties of gasses.
- Apply the principles of gas dynamics to design and analyze systems for aircraft and rocket propulsion.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on Compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers – Use of Gas tables.

UNIT II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalized gas dynamics. Multi- dimensional Flows- cartesian coordinate and cylindrical coordinate system, potential function and stream function.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations - Rankine-Huguenot equation– Use of table and charts – Applications. Numerical solution of Governing equation.

UNIT IV JET PROPULSION 9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ramjet, turbojet, turbofan and turboprop engines.

UNIT V SPACE PROPULSION 9

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 S.M. Yahya, "Fundamentals of Compressible Flow with aircraft and rocket propulsion", 6th edition, New Age International (P) Limited, New Delhi, 2019.

2 Anderson, J.D., "Modern Compressible flow", McGraw Hill, Indian Edition, 2017.

REFERENCE

1 H. Cohen, G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,1980

2 V. Ganesan, "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2014

3 N.J. Zucrow, Principles of Jet Propulsion and Gas Turbines, John Wiley, New York, 2000.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Elaborate on one - dimensional steady compressible fluid flow	Understand
CO2	Calculate the adiabatic and isentropic properties in various conditions of flows with friction and heat transfer.	Apply
CO3	Analyze the flow properties on shock waves in various flow regions.	Apply
CO4	Apply the gas dynamics principles for designing and evaluating Aircraft engine	Apply
CO5	Apply the gas dynamics principles for designing and evaluating rocket engines for space propulsion.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	1	2	-	-	-	-	-	-	-	1	-
CO4	3	2	2	-	-	-	-	-	1	-	-	-	1	-
CO5	3	2	-	-	-	-	-	-	1	-	-	-	1	-
CO	3	2	2	1	2	-	-	-	1	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

19MEP07	MICROCONTROLLERS AND PLC	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To study the addressing modes & instruction sets of 8051 with simple programs, and interface peripheral devices with microcontrollers.
- To familiarize the learners in PLC components, and to create ladder diagrams.
- To learn the specification of DCS and apply PLC in real time applications.

UNIT I 8051 MICROCONTROLLERS 9

Microcontroller Hardware – I/O Pins, Ports – External memory – Counters and Timers – Serial data I/O – Interrupts – 8051 Assembly Language Programming: Instruction set of 8051, Addressing modes, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, interrupts and returns, interrupt handling.

UNIT II PERIPHERAL INTERFACING 9

Peripheral interfacing: Switch – Keypad – LED – A/D and D/A converters – High Power devices using relays. Speed control: DC Motor – Stepper motor.

UNIT III PROGRAMMABLE LOGIC CONTROLLER 9

Introduction – Architecture of PLC – Principles of operation – Advantages Programming devices – Types of PLC – I/O modules: Discrete I/O modules –Analog I/O modules – CPU processor memory module – Selection of PLC.

UNIT IV PROGRAMMING OF PLC 9

Sourcing and sinking concept – Ladder diagram – Conversion of relay ladder to PLC ladder diagram – Instructions: Arithmetic – Data manipulation – Timer – Counter. PLC Advanced functions: Analog PLC operation – networking of PLC – Simple programs.

UNIT V DCS AND APPLICATION OF PLC 9

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS. Case studies on PLC: Automatic car park barrier, Pick and place Robot.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Mazidi Muhammad Ali, Mazidi Janice Gillispie and McKinlay Rolin, — "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Prentice Hall of India, New Delhi, 2013.

2 Petruzella Frank D., "Programmable Logic Controllers", 2nd Edition, McGraw-Hill, New York, 2015.

REFERENCE

1 Uffenbeck John E., The 80x86 Family: Design, Programming and Interfacing, 3rd Edition, Prentice Hall of India, New Delhi, 2002.

2 Patel, The 8051 Microcontroller based Embedded Systems, 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.

3 R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Interpret the basic concepts of 8051 microcontroller	Understand
CO2	Interface peripheral devices with microcontroller	Apply
CO3	Interpret PLC architecture and I/O modules	Understand
CO4	Develop and Implement PLC programming for simple process control case studies	Apply
CO5	Learn the DCS specification and application of PLC in real time.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	-
CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	-
CO5	2	2	2	2	2	-	-	-	-	-	-	-	2	-
CO	3	2	2	2	2	-	-	-	-	-	-	-	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP08	INDUSTRIAL ROBOTICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robots, sensors and their applications in robots
- To discuss the various applications of robots, justification and implementation of robots.

UNIT I INTRODUCTION 9

Definition of a Robot - Basic Concepts - Robot configurations - Industrial brands and specification- Types of Robot drives - Basic robot motions - Point to point control - Continuous path control.

UNIT II COMPONENTS AND OPERATIONS 9

Robot Anatomy- Basic control system concepts - control system analysis - robot actuation and feedback, Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface. Manipulators - director and inverse kinematics, Coordinate transformation - Brief Robot dynamics.

UNIT III SENSING AND MACHINE VISION 9

Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis- Image storage, Lighting technique, segmentation, object recognition.

UNIT IV ROBOT SIMULATION 9

Methods - languages - Capabilities and limitations - AI and Robotics- kinematic simulation using MATLAB.

UNIT V INDUSTRIAL APPLICATIONS 9

Selection of robots for industrial applications- Welding - Assembly - Material handling - Loading and unloading - Demonstration using beginner level robots.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Richard D Klafter, Thomas Achmielewski and MickaelNegin, "Robotic Engineering – An integrated Approach" Prentice HallIndia, New Delhi, 2001.

2 Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, 2015.

REFERENCE

1 James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.

2 Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 1994.

3 Cotsaftis, Vernadat, "Advances in Factories of the Future, CIM and Robotics", Elsevier, 2013.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Recall the basic concepts, components and types of robots	Remember
CO2	Identify the sensors drives and end effector for need applications	Apply
CO3	Understand the concepts of sensing and image processing for robotic inspection systems.	Understand
CO4	Simulate the robot kinematics for different applications.	Apply
CO5	Experience various industrial robot applications.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	1	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-
CO3	3	3	-	3	3	-	-	-	-	-	-	-	3	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	1	-
CO5	3	3	3	3	2	-	-	-	-	-	-	-	3	-
CO	3	3	3	2	2	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP09	TWO AND THREE WHEELERS ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Introduce the subsystems present in two and three wheelers.
- Present a problem oriented in depth knowledge of two and three-wheeler technology.
- Address the underlying concepts and methods behind two and three-wheeler technology.

UNIT I ENGINE TECHNOLOGY 9

Selection criteria and Design considerations for two-wheeler & three-wheeler engines Systems requirements for Engine lubrication, cooling & starting (Kick starter mechanism, Moped cranking mechanism & Button Start mechanism). Recent developments in engine (2 stroke/4 stroke engines, Fuel used–Gasoline, CNG, Diesel- & high-powered engine), Electric Vehicles

UNIT II TRANSMISSION SYSTEM 9

Clutch–special requirements, different types used in two & three-wheeler. Need of primary reduction, selection of transmission-gearbox, gear shift mechanism, Chain OR belt drive system for transmission of torque to drive wheels, automatic transmission (Continuously Variable Transmission- CVT, Epicyclic gear train), arrangement of final drive & differential for three-wheeler.

UNIT III STEERING AND SUSPENSION SYSTEM 9

Steering system arrangement for two & three-wheeler, steering column construction, steering geometry, Suspension requirements, design considerations, trailing & leading link, swinging arm, springs & shock absorbers.

UNIT IV FRAME AND BODY 9

Types of frame, construction, loads, design consideration, materials, Types of three-wheeler bodies, layout, RTO regulations, aerodynamic, aesthetic & ergonomics considerations for bodywork, sidecar.

UNIT V BRAKE WHEELS AND TYRES 9

Design consideration of brake, types of brakes–disc, drum and braking mechanism– mechanical, hydraulic & servo. Hand operated or Foot operated brakes. Wheel types–spokes construction, alloy wheels, pressed wheel disc or split wheel disc. Types of Tyres for two & three- wheeler.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Newton Steed, "The Motor Vehicle", McGraw Hill Book Co. Ltd., New Delhi, 2013

2 Siegfried Herrmann, "The Motor Vehicle", Asia Publishing House, Bombay, 1992

REFERENCE

1 Irving. P. E., "MotorCycle Engineering", Temple Press Book, London–1992.

2 G.B.S. Narang, "Automobile Engineering", 5th Edition, Khanna Publishers,Delhi.

3 Raymond Broad Lambretta, "A Practical Guide to maintenance and repair", S.Chand &Co., New Delhi-1987.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Select the engine suitable for two and three-wheeler vehicles based on its operational parameters.	Apply
CO2	Explain about the working of the transmission system for various types of two and three wheeled automobiles	Understand
CO3	Design the steering and suspension system for any two and three-wheeler vehicles	Apply
CO4	Design the body and chassis for automobiles based on the ergonomics considerations	Apply
CO5	Design the braking system for 2 and 3 wheeled vehicles.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	-	3	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	3	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-	3	-
CO5	2	2	1	-	-	-	-	-	-	-	-	-	3	-
CO	2	2	1	-	-	-	-	-	-	-	-	-	3	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19MEP10	MACHINE TOOL DESIGN	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To understand different machine tools used for machining.
- To understand the design criteria for machine tool structures.
- To know the designing of slideways, Power screws and spindles for machine tools.

UNIT I INTRODUCTION 9

Classification of machining processes, machine tools – machine tool construction – factors – performance criteria – trends in modern machine tools – kinematic arrangement of different types of machine tools- calculation of cutting forces and power requirements for machining operation– force distribution on different parts of machine tools.

UNIT II DESIGN OF GUIDEWAYS AND POWER SCREWS 9

Design Criteria (Wear Resistance & Stiffness) 'Stick Slip' phenomena aerostatic Slide-ways, Design of Antifriction Guide-way, Concept of Combination Guideways. Function & Types of Guide-ways and Slideways, Types of Slide-ways & Antifriction Ways, sliding friction Power Screw for Wear Resistance, Strength, Stiffness, & Buckling Stability.

UNIT III DESIGN OF SPINDLE & SPINDLE SUPPORTS 9

Function & Requirements of Spindle Units, their Materials, Effect of Machine Tool Compliance on Machining accuracy, Design of Spindle for Bending, Deflection of Spindle Axis, Location of Bearings and Drive elements, Balancing. Device Requirements of Spindle Supports.

UNIT IV DESIGN OF MACHINE TOOL STRUCTURE 9

Function & Requirement of Machine Tool Structure, Design Criteria from Strength & Stiffness considerations, Torsion and Bending, Manufacturing Factors affecting stiffness of machine tool structures, Basic Design procedure of machine tool structures.

UNIT V DESIGN FOR FLUCTUATING LOADS 9

Stress Concentration and remedies, S.N. Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative damage, Soderberg and Goodman's Diagram.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 N. K. Mehta, "Machine Tool Design", Tata McGraw Hill, ISBN 0-07-451775-9, 2017.

2 D. K Pal, S. K. Basu, "Design of Machine Tools", 4th Edition. Oxford IBH 2005, ISBN 81-204-0968, 2017

REFERENCE

1 Bhattacharya and S. G. Sen., "Principles of Machine Tools", New central book agency Calcutta, ISBN 81-7381-1555, 2019

2 N. S. Acherkan, "Machine Tool Design, Vol. I, II, III and IV" MIR publications, 2013

3 F. Koenigsberger, "Design Principles of Metal Cutting Machine Tools", The Macmillan Company New York 1964.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain different machine tools used for machining	Understand
CO2	Design sliding and rolling friction elements like guideways and power screws	Apply
CO3	Design spindles using minimum deflection criterion and design proper bearings for spindle supports.	Apply
CO4	Analyze and design various machine tool structure using principle of free body diagram and using minimum deflection design criterion	Apply
CO5	Design components for fluctuating loads.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	1	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	1	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	1	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	1	2	-	-	-	-	-	-	-	-	-	2	-
CO	3	1	2	-	-	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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U19MEP11	SMART MATERIALS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To recognize intelligent materials and their applications in engineering.
- To understand the implications of trending materials for actuators and sensors.
- To impart knowledge on fabrication methods of smart materials.

UNIT I INTRODUCTION 9

Components of Smart Systems – Smartness, Sensors, Actuators, Transducers, MEMS. Evolution of Smart Materials and Structures, Application Areas for Smart Systems, Introduction to Shape Memory Alloys

UNIT II SENSORS FOR SMART SYSTEMS 9

Introduction – Conducto-metric Sensors, Capacitive Sensors, Piezo-Electric Sensors, Magneto-strictive Sensors, Piezo Resistive Sensors, Optical Sensors, Resonant Sensors, Semiconductor-based Sensors, Acoustic Sensors, Polymeric Sensors and Carbon Nano Tube Sensors

UNIT III ACTUATORS FOR SMART SYSTEMS 9

Introduction – Electrostatic Transducers, Electro Magnetic Transducers, Electro Dynamic Transducers, Piezo Electric Transducers, Electro-strictive Transducers, Magneto-Strictive Transducers, Electro Thermal Actuators and Comparison of Actuation Schemes.

UNIT IV FABRICATION METHODS OF MEMS 9

Fabrication Process of Silicon MEMS, Deposition Techniques for Thin Films in MEMS, Bulk Micro Machining for Silicon Based MEMS, Silicon Surface Machining, Processing by both Bulk and surface Micro Machining, LIGA Process

UNIT V APPLICATIONS OF SMART MATERIALS 9

Structural Health Monitoring Applications, Vibration and Noise Control Applications, Nuclear Industries, Structural and Biomedical Applications.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1. Vijay. K. Varadhan, K. J. Vinoy., "Smart Material Systems and MEMS: Design and Development Methodologies". John Wiley & Sons Ltd., 2011.
2. William D Callister and R. Balasubramaniam, "Callister's Materials Science and Engineering", Wiley-India, 2012.

REFERENCE

1. Duerig,T. W., Melton, K. N, Stockel, D. and Wayman, C.M., "Engineering aspects of Shapememory Alloys", Butterworth – Heinemann, 1990.
2. Mohsen Shahinpoor and Hans-Jorg Schneider "Intelligent Materials", RSC Publishing, 2008
3. Mel Schwartz (Ed), Encyclopaedia of Smart Materials" Volume –I and II, John Wiley & Sons, Inc. 2002

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Learn Beyond

OURSE OUTCOMES (CO)

Upon completion of the course, the student will be able

COs	Statements	K-Level
CO1	To introduce the concept of smart systems and materials.	Understand
CO2	To impart knowledge on the sensors for smart systems	Understand
CO3	To impart knowledge on the transducers for smart systems	Understand
CO4	To introduce the fabrication methods of MEMS.	Understand
CO5	To impart knowledge on the real-time applications of smart materials	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO	2	-	-	-	-	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP12	BIOMATERIALS AND IMPLANT MATERIALS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Introduce basic structure and properties of different classes of biomaterials
- Introduce the basics of biological and tissue engineering responses to implant materials.
- Introduce the properties and applications of bio and implant materials.

UNIT I PROPERTIES OF BIOMATERIALS 9

Biomaterial definition, Requirements & classification of biomaterials, Comparison of properties of biomaterials, cellular responses (extra and intra-vascular system), Surface, physical and mechanical, corrosion properties of biomaterials.

UNIT II BIOLOGICAL SYSTEM AND TISSUE ENGINEERING 9

The Biological Environment, Genetic Regulation and Control Systems, Plasma Membrane, Cyto-Skeleton and Motility, Cell-to-cell communication Pathways. Tissue Engineering Approaches, Cells, Scaffold Properties – Cell Seeded Scaffolds, Assessment of Cell and Tissue Properties – The Extra Cellular Environment, Extra Cellular Matrix Mimics, Cell Interactions with Non-Cellular Substrates.

UNIT III NATURAL BIO MATERIALS 9

Introduction – Collagen – Elastin – Silk – Chitosan – Cellulose – Alginate – Hyaluronan – Chondroitin Sulphate, Coral.

UNIT IV POLYMER IMPLANT MATERIALS 9

Molecular Structure of Polymers, Types of Polymerization, Physical State if Polymers – Common Polymeric Biomaterials, Hydrogels and Nano Polymers

UNIT V METAL & CERAMIC IMPLANT MATERIALS 9

Titanium and its Alloys – Stainless Steel – Cobalt Chromium Alloys – Nitnol – Tantalum, Magnesium. Ceramic Implant Materials: General Properties and Classifications, bio ceramics and nano ceramics

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 C. Mauli Agarwal. Joo. L. Ong, Mark R. Appleford Gopinath Mani, "Introduction to Biomechanics; Basic Theory with Engineering Applications". Cambridge University Press, 2016.

2 Joon B. Park., Joseph D. Bronzino., "Biomaterials: Principles and Applications". CRC Press, 2002.

REFERENCE

1 Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and Krati Jain. — Implant biomaterials: A comprehensive reviewll, World Journal of Clinical Cases, 2015

2 A.C Anand, J F Kennedy, M. Miraftab, S. Rajendran, —Woodhead Medical Textiles and Biomaterials for Healthcarell, Publishing Limited 2006.

3 Jonathan Black, "Biological Performance of Materials: Fundamentals of Biocompatibility" Fourth Edition: CRC Taylor & Francis Group, London, 2006.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Define and understand the properties of biomaterials including host responses	Understand
CO2	Understand the concepts of biological system and tissue engineering	Understand
CO3	Classify natural bio materials, their properties and understand appropriate applications and limitations	Understand
CO4	Understand mechanical, physical and surface properties of polymeric implants along with their biological applications	Understand
CO5	Understand the classification, properties and applications of metal and ceramics, composites	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP13	PROCESS PLANNING AND COST ESTIMATION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To understand the significance of ergonomics and apply it in industry sector
- To understand the process planning concepts to make cost estimation for various products.
- To understand the requirement of estimation in production, application industry to provide initial knowledge of costing for manpower, material, equipment including maintenance cost and additional cost.

UNIT I WORK STUDY AND ERGONOMICS 9

Definition – Method study – Objectives-Motion economy - Principles – Tools and Techniques - Applications – Work measurements - purpose – use – procedure – tools and techniques - Standard time – Ergonomics – principles – applications.

UNIT II PROCESS PLANNING 9

Definition – Objective – Scope – approaches to process planning – Drawing interpretation – Material evaluation – steps in process selection – production equipment and tooling selection - Process planning activities – Finished part requirements - operating sequences - machine selection – material selection parameters - Set of documents for process planning - Developing manufacturing logic and knowledge - production time calculation – selection of cost optimal processes – Economics of process planning – case studies.

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation – methods of costing - elements of cost estimation – Types of estimates – Estimating procedure - Estimation labour cost, material cost - allocation of overhead charges - Calculation of depreciation cost.

UNIT IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.

2 Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCE

1 Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.

2 Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.

3 Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the method study concepts and recording techniques to existing processes or methods for productivity improvement and identify areas where ergonomics principles can be applied for improving the worker productivity.	Understand
CO2	Describe the process planning activities in taking a component from design to manufacture	Understand
CO3	Classify the costs and estimate material cost, labour cost and overhead expenses of various products/components	Apply
CO4	Estimate the production cost for different types of jobs in forging, welding and foundry shop	Apply
CO5	Estimate the machining time for different lathe operations, drilling, boring, milling, shaping, planning and grinding operations	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	3	3	-	-	-	-	-	-	-	-	-	-	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO	3	3	3	-	-	-	-	-	-	-	-	-	-	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP14	HEATING, VENTILATION AND AIR CONDITIONING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To learn the fundamental principles and applications of Heating Ventilation and Air Conditioning.
- To Study and apply various Air- Conditioning systems and its heat load estimation.
- To Apply various Auxiliary systems and to draft the HVAC subsystems.

UNIT I INTRODUCTION TO HVAC 9

Introduction-Scope of Modern HVAC- Objective of HVAC -Air-Conditioning Processes- Basic Refrigeration cycle - Sensible and Latent heat -Refrigeration units, codes and standards- Environment for human comfort - Application of HVAC systems.

UNIT II AIR-CONDITIONING SYSTEMS AND PSYCHROMETRY PROCESSES 9

HVAC basic components -Working of HVAC system -Psychrometric processes, Psychrometric Chart - Basic Air-Conditioning system- Classification, Window A/C system, Split A/C system, Ductable split A/C system, Package A/C system, VRF/VRV system, Central Air-Conditioning system, Chilled Water system, All water system, Air – water system, Direct Refrigerant system, In-Direct Refrigerant system.

UNIT III HEAT LOAD ESTIMATION 9

Sources of Heat -Heat Load Formula-Finding U value for Walls, Roof, Glass - Determining temperature difference value for Walls, Roof, and Glass - Determination of Heat Gains - Ventilation requirements, -Infiltration Gains-Heating load calculations - ASHRAE heat load calculation Excel Sheet.

UNIT IV AIR DISTRIBUTION SYSTEM & HYDRONIC SYSTEM 9

Duct design methodologies - Gauge selection for Sheet Metal - Selection of air terminals, dampers, filters - Pressure drop estimation, - Duct Materials and Insulation materials - Duct Routing - Basic Hydronic system, chiller, pumps, valves - types and arrangements, Piping- Routing and sizing, Pumping system- TDH, NDSH and Cavitation.

UNIT V DRAFTING OF HVAC SYSTEMS 9

Introduction to drafting using AutoCAD, Symbols and code in HVAC designing, study and preparation of floor drawings, Conventional AC systems drawing, Ventilation system Drawings, Ductable AC system Drawings, Section drawings.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Samuel C. Sugarman, "HVAC Fundamentals", Fairmount Press 3rd Edition, 2016.

2 Jan F. Kreider, "Heating ventilation and air conditioning", CRC press, 1st edition, 2000.

REFERENCE

1 Arthur A Bell, "HVAC Equations, Data and Rules of Thumb", Mc Graw. Hill, 2nd edition, 2007.

2 Herbert W. Stanford, "HVAC Water Chillers and Cooling Towers Fundamentals, Application, and Operation", CRC press, 2nd edition, 2011.

3 A. Vedavarz, S. Kumar & Hussain, "HVAC- Handbook of Heating Ventilation and AC", Industrial press, 4th edition, 2006

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate the fundamental principles and applications of Heating Ventilation and Air Conditioning.	Understand
CO2	Describe the basic components of an HVAC system and basics of Psychrometric processes.	Understand
CO3	Calculate heat load for air conditioning systems used for various purposes.	Apply
CO4	Implement the suitable air distribution systems and hydronic system for improving efficiency.	Apply
CO5	Draft the HVAC system as per the codes and standards to meet various applications.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	2	-	3	-	-	-	-	-	-	-	3	-
CO	3	3	2	-	3	-	-	-	-	-	-	-	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP15	COGENERATION AND WASTE HEAT RECOVERY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To analyze the basic energy generation cycles
- To detail about the concept of cogeneration, its types and probable areas of applications
- To study the significance of waste heat recovery systems and carry out its economic analysis

UNIT I INTRODUCTION 9

Introduction – Principles of thermodynamics – cycles – topping – bottoming – combined cycle – organic Rankine cycles – Performance indices of cogeneration systems – Waste heat recovery – sources and types – concept of tri generation.

UNIT II COGENERATION TECHNOLOGIES 9

Configuration and thermodynamic performance – Steam turbine cogeneration systems – gas turbine cogeneration systems – Reciprocating IC engines cogeneration systems – combined cycles cogeneration systems – Advanced cogeneration systems: Fuel cell, Stirling engines etc.

UNIT III ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES 9

Cogeneration plants electrical interconnection issues – Utility and cogeneration plant interconnection issues – Applications of cogeneration in the utility sector – Industrial sector – building sector – Rural sector – Impacts of cogeneration plants – fuel, electricity and environment.

UNIT IV WASTE HEAT RECOVERY 9

Selection criteria for waste heat recovery technologies – Recuperators – Regenerators – Economizers – Plate heat exchangers – Thermic fluid heaters – Waste heat boilers – classification, location, service conditions, design considerations – Fluidized bed heat exchangers – heat pipe exchangers – heat pumps – sorption systems.

UNIT V ECONOMIC ANALYSIS 9

Investment cost – economic concepts – Measures of economic performance – Procedure for economic analysis – examples – Procedure for optimized system selection and design – load curves – sensitivity analysis – Regulatory and financial framework for cogeneration and waste heat recovery systems. Case studies.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Charles H. Butler, Cogeneration, McGraw Hill Book Co., 1984.

2 EDUCOGEN – The European Educational tool for cogeneration, Second Edition, 2001

REFERENCE

1 Horlock JH, Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford,1987.

2 Seagate Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 1983.

3 De Nevers, Noel., Air Pollution Control Engineering, McGrawHill, New York,1995

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Demonstrate the working of basic cycles and combined operation the cycles for cogeneration.	Understand
CO2	Describe the configuration and evaluate the thermodynamic performance of the combined cycle power plants.	Understand
CO3	Address the issues in application of cogeneration in various sectors.	Understand
CO4	Select the appropriate waste heat recovery systems for various thermodynamic systems.	Understand
CO5	Estimate the operational cost of the powerplant and optimize the system based on the operational cost.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO	3	-	-	-	-	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP16	INDUSTRIAL INTERNET OF THINGS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value.
- Bring the IoT perspective in thinking and building solutions.
- Introduce the tools and techniques that enable IoT solution and Security aspects.

UNIT I INTRODUCTION 9

Introduction to IOT, what is IIOT? - IOT Vs. IIOT, History, Components of IIOT, Networks, People & Process, Hype cycle, IOT Market, Trends & future Real-life examples, Role of IIOT in Manufacturing Processes. Sustainability through Business excellence tools, Challenges.

& Benefits in implementing IIOT.

UNIT II ARCHITECTURES AND PROTOCOLS 9

Overview of IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT. Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Modbus, SPI, I2C, IIOT protocols –COAP, MQTT,6LoWPAN, LWM2M, AMPQ.

UNIT III SENSOR AND INTERFACING 9

Introduction to sensors, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACnet, M2M.

UNIT IV CLOUD, PRIVACY, SECURITY AND GOVERNANCE 9

IIOT cloud platforms: Overview of cots cloud platforms, Predix, thing works, azure etc. Data analytics, cloud services, Business models: SaaS, PaaS, IaaS. Introduction to web security, Vulnerabilities of IoT, Security requirements, Threat analysis, IoT security tomography and layered attacker model, Identity establishment, Access control, Security model for IoT, Network security techniques.

UNIT V IOT ANALYTICS AND APPLICATIONS 9

IOT Analytics: Role of Analytics in IOT, Data visualization Techniques, Introduction to R Programming, Statistical Methods. Internet of Things Applications: Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIOT in Manufacturing Sector.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978- 3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2011.

2 Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications 2013.

REFERENCE

1 Olivier Hersent, David Boswarthick and OmarElloumi, "The Internet of Things: Key Applications and Protocols", John Wiley & Sons Ltd., UK, 2012.

2 Ovidiu & Peter; Internet of Things- From Research and Innovation to Market Deployment; River Publishers Series, 2014

3 Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications, 2011.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the history and the importance of Industrial Internet of Things in the next industrial revolution.	Remember
CO2	Ability to select and implement proper internet structure and protocols to implement an IIOT System.	Apply
CO3	Classify the types of sensors used in an industry setting and interface the components using the proper structure.	Understand
CO4	Explain the types of platforms and services in relation to cloud computing and exhibit knowledge about the importance in following the security protocols	Understand
CO5	Interpret the data and activities that are taking part in an industry using modern tools and list the applications of IIOT.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO	3	-	-	-	-	-	-	-	-	-	-	-	3	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP17	ROBOT SENSORS AND LANGUAGE	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To familiarize students with the various sensors used in robots
- To study algorithms for robot localization, path planning and obstacle avoidance.
- To adapt the different sensors, programming methods and algorithms to model a beginner level robot.

UNIT I INTRODUCTION 9

An introduction to sensors and transducers – History and Definitions - Classification of sensors – Static and Dynamic characteristics of transducers – Performance measures of sensors – Sensor error analysis – Need of sensors in robotics.

UNIT II SPECIFICATION AND APPLICATIONS OF SENSORS 9

Range sensors – Proximity sensors – Tactile sensors – Force and Torque sensors – Slip sensors – Voice Recognition systems – Algorithms for localization, path planning and obstacle avoidance in known and unknown environments – Case study: Choice of sensors for a 6-axis industrial robot and self-driving cars.

UNIT III VISION SYSTEMS ALGORITHMS 9

Introduction to Machine vision - Sensing and digitizing - Image processing and analysis algorithms – Robot guidance and navigation through vision sensors – Vision algorithms – Case Study: Applications of machine vision systems in robotics for inspection and quality control.

UNIT IV ROBOT PROGRAMMING METHODS 9

Robot software functions: coordinate systems, position control and subroutines – Methods of robot programming: Online, offline, lead through and teach pendant – Robot program as a path in space, defining position in space and motion interpolation.

UNIT V ROBOT LANGUAGES 9

Robot Languages - Classification of Robot Languages, Computer Control and Robot Software – Robot Operating Systems (ROS), Raspberry Pi based programming for robots - Inverse Kinematics and Path Planning Programming using ROS.

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 S.R.Rucco, "Robot sensors and transducers", John Wiley and Sons, 2013.

2 Saeed. B. Niku, "Introduction to Robotics, Analysis, System, Applications", Pearson, Educations, 2012.

REFERENCE

1 Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.

2 Mikell P. Groover, Mitchell Weiss, Roger.N.Nagel, Nicholas.G.Odrey, Ashish Dutta " Industrial Robotics : Technology, Programming and Applications ",2nd Edition Tata McGraw Hill Education Private Limited, 2012.

3 Lentin Joseph, "Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy", 1st edition, Apress, 2018.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Classify sensors and list their performance measures	Understand
CO2	Select appropriate sensors for different applications using robots	Apply
CO3	Experiment with machine vision systems using the vision algorithms	Apply
CO4	Summarize the different programming methods used in robotics	Understand
CO5	Model beginner level robots using a controller and ROS	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	3	1	1	-	3	-	-	-	-	-	-	3	-
CO3	3	3	3	3	-	3	-	-	-	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	-
CO	3	3	2	2	-	3	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

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PROFESSIONAL ELECTIVE

U19MEP18	AUTOMATIC TRANSMISSION	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Impart basic skills and Understand of automobile transmission systems basic components, their working principle, classification and performance characteristics.
- Know about the various transmission and driveline units of automobiles.
- Explore the various electrical drives and hybrid vehicles.

UNIT I INTRODUCTION 9

Need for Transmission system, Tractive Effort and Resistances to Motion of a vehicle, Requirements and Classification of Transmission systems, Single, Two- and Four-Wheel drive systems, Multi axle drives, Chain, Shaft and Electric drives, Location of transmission system, Different transmissions in scooter, car, MUV's and transport vehicles of Indian make.

UNIT II CLUTCH 9

Principle of operation, Constructional details, calculation of torque capacity, axial force. Different types of clutches, Friction lining materials. Over-running clutch. Modes of operating a clutch – mechanical, hydraulic and electric, clutch maintenance.

UNIT III GEAR BOX 9

Objective of the Gearbox, Determination of gear ratios for vehicles, Performance characteristics in different speeds, Different types of gear boxes – sliding, constant and synchromesh type, Planetary gearbox, Need for double declutching and working of synchronizing unit. Power and economy modes in gearbox, Transfer box, Transaxles, Overdrives.

UNIT IV HYDRODYNAMIC DRIVE AND HYDROSTATIC DRIVE 9

Fluid coupling, Principle of operation, Constructional details, Torque capacity, Performance characteristics, Reduction of drag torque, Torque Converter-Principle of operation, constructional details, performance characteristics, Converter coupling – Construction - Free wheel – Characteristic performance. Hydrostatic drive – principle, types, advantages, limitations

UNIT V ELECTRIC DRIVE AND AUTOMATIC APPLICATIONS 9

Electric drive, Principle of early and modified Ward Leonard Control system, Advantage & limitations, Performance characteristics, Study of drive system in an electric and hybrid vehicle. Chevrolet "Turbo glide" Transmission, Power glide Transmission Toyota "ECT-i" Automatic Transmission with Intelligent Electronic controls system, Hydraulic Actuation system.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Heisler H. - 'Advanced Engine Technology' - SAE - 2016.

2 Newton and Steeds, "Motor vehicles", Illiffe Publishers, 2017.

REFERENCE

1 Crouse. W.H., Anglin., D.L., Automotive Transmission and Power Trains construct, McGraw-Hill,2016.

2 Kirpal Singh, Automobile Engineering Vol-1 ,2017.

3 P S Gill, Automobile Engineering Vol-II, S K Kataria & Sons, 2015.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the basic working principles of basic elements of the automobile transmission system.	Understand
CO2	Recognize the element and Classification, Construction of clutch	Remember
CO3	Identify the information of the gear box and its industrial application.	Apply
CO4	Compare the different types of drives such as hydrodynamic, hydrostatic	Apply
CO5	Design of electric and automatic drives and its concepts.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	-	2	-	-	-	-	-	-	-	3	-
CO3	3	3	3	-	2	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	-	-	-	-	-	3	-	-	-	3	-
CO	3	3	3	-	2	-	-	-	3	-	-	-	3	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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U19MEP51	COMPREHENSION - I	Category: PE			
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

Objective of this course is to

- Prepare the students with depth of knowledge on specific topics that takes them for higher studies.
- Train the students on specific topics for potential placements through competitive exams.

ENGINEERING MECHANICS

Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.

THERMODYNAMICS

Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

FLUID MECHANICS

Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings.

ENGINEERING MATERIALS

Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

CASTING, FORMING AND JOINING PROCESSES

Different types of castings, design of patterns, mould and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

MACHINING AND MACHINE TOOL OPERATIONS

Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, design of jigs and fixtures.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Solve problems on the physics of engineering bodies.	Apply
CO2	Apply the laws of thermodynamics to solve real life problems.	Apply
CO3	Make use of the principles of fluid mechanics.	Apply
CO4	Apply the concepts that govern the mechanical properties of materials.	Apply
CO5	Solve problems involving the concepts of manufacturing technology.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO	3	2	-	-	-	-	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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U19MEP20	TOOL AND DIE DESIGN	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Select materials for cutting tools and tool material improvement methods and design of cutting tools and locating devices and clamps.
- Analyze the design of jigs and fixtures for various applications.
- Analyze the tools for Bending, Forming and Drawing operations, and design of press tools.

UNIT I INTRODUCTION TO TOOL DESIGN 9

Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing-Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials - Ferrous and Nonferrous Tooling Materials Carbides, Ceramics and Diamond -Nonmetallic tool materials-Designing with relation to heat treatment.

UNIT II DESIGN OF CUTTING TOOLS 9

Metal cutting process - Selection of tool materials - Design of single point and multipoint cutting tool - Form tools, Drills, milling cutters, broaches and chip breakers – Problems on design of single point cutting tools only.

UNIT III DESIGN OF JIGS 9

Types of drill jigs - General considerations in the design of drill jigs - Drill bushings - Types, methods of construction - Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers and Pot Jigs.

UNIT IV DESIGN OF FIXTURES 9

Basic Principles of location - Locating methods and devices - Principles of clamping - Mechanical, Pneumatic and Hydraulic actuations - Clamping force analysis – Design problems. Principles - Types of fixtures - Fixtures for machine tools: Lathe, Milling, Boring, Broaching and grinding - Assembly fixtures - Inspection and Welding fixtures.

UNIT V DESIGN OF PRESS TOOL DIE AND FORMING DIE 9

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing. Bending dies– Forging dies – Extrusion dies - Drawing dies - Design and drafting.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Donaldson C., Lecain G.H., Goold V.C., Tool Design, 4th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2012.

2 K.Venkataraman,"Design of Jigs, Fixtures and press tools". 4th edition,John Wiley and sons ltd,UK,2015.

REFERENCE

1 E.G.Hoffman, Jig and Fixture Design, Thomson Asia Pvt Ltd, Singapore, 2010.

2 John Nee, Fundamentals of Tool Design, Sixth Edition, SME, 2010.

3 Frank W. Wilson, Fundamentals of Tool Design, ASTME, Prentice Hall of India, New Delhi.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Select suitable tool material and cutting tool design	Understand
CO2	Design of cutting tools and Forming tools for various industrial applications.	Apply
CO3	Design Jigs and Fixtures for Manufacturing, Testing and Assembly applications	Apply
CO4	Design locators and clamps for jigs and fixtures.	Apply
CO5	Design Press Tools and forming dies using various design rules	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO	3	3	2	-	-	-	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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PROFESSIONAL ELECTIVE

KPRIET

U19MEP21	MECHANICS OF COMPOSITE MATERIALS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 9

Introduction - Classification - Polymer matrix composites, metal matrix composites, ceramic matrix composites, Metal matrices- Properties - Aluminium, Titanium, Magnesium, copper Alloys, Liquid state Solid state in situ fabrication techniques.

UNIT II POLYMER COMPOSITE MATERIALS 12

Natural Fibre and Synthetic Fiber properties, Glass, Silica, Kevlar, Carbon, Boron, Sisal, Banana, Kenaf flax fibers. Particulate composites- Polymer composites - Thermoplastic properties and types.

UNIT III MANUFACTURING OF COMPOSITES 6

Hand layup method, Compression and Resin Transfer Moulding, pressure and vacuum bag process, filament winding, protrusion, reinforced RIM, RRIM, Injection moulding, thermosets, SMC and DMC, Advantages and disadvantages of each method

UNIT IV LAMINA STRENGTH ANALYSIS 9

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 V THERMAL ANALYSIS 9

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.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Gibson, R.F, "Principles of Composite Material Mechanics", Fourth Edition, McGraw-Hill, CRC press, 2016.

2 Robert M. Jones, "Mechanics of Composite Materials", CRC Press, NY, 2015.

REFERENCE

1 Halpin, J.C, "Primer on Composite Materials, Analysis", Technomic Publishing Co, 2017.

2 Agarwal, B.D, and Broutman L.J, "Analysis and Performance of Fiber Composites", Wiley, 2017.

3 Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford, 2013.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the classification of composites and Metal matrix fabrication techniques	Understand
CO2	Understand the properties of various matrix and reinforcement in polymer-based composites.	Understand
CO3	Correlate various manufacturing / fabricating techniques for composite structures based on design	Understand
CO4	Analyze the Lamina strength	Apply
CO5	Analyze the thermal behavior of Composite laminates	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	3	-	-	-	-	-	-	-	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO	3	2	2	-	3	-	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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PROFESSIONAL ELECTIVE

KPRIET

U19MEP22	NON-TRADITIONAL MACHINING PROCESS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To introduce basics of non-traditional machining processes.
- To study the mechanical energy based non-traditional machining processes.
- To provide knowledge on electrical, thermal and chemical energy based non-traditional machining processes.

UNIT I NON-TRADITIONAL MACHINING PROCESS 7

Introduction - Need - Classification - Energies employed in the processes - Brief overview of Abrasive jet machining (AJM), Water jet machining (WJM), Ultrasonic machining (USM), Electric discharge machining (EBM), Electro-chemical machining (ECM), Electron beam machining (EBM), Laser beam machining (LBM), Plasma arc machining (PAM).

UNIT II MECHANICAL AND THERMAL ENERGY BASED PROCESSES 10

Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining - Working Principles, Equipment, Process parameters, Material removal rate, Applications. Laser Beam machining, Plasma Arc Machining - Principles, Equipment. Electron Beam Machining - Principles, Equipment, Types, Beam control techniques, Material removal rate - Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining - Working Principles, Equipment, Process Parameters, Material removal rate, Electrode / Tool, Power Circuits, Tool Wear, Dielectric, Flushing, Wire cut EDM Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining - Etchants, Maskants - techniques. Electro-chemical machining - Working principle, Equipment, Process Parameters, Material removal rate, Electrical circuit. Electrochemical grinding - Electro-chemical honing - Applications.

UNIT V HYBRID MACHINING PROCESS 10

Electrochemical Drilling – Shaped Tube Electrolytic Machining – Electro stream Drilling – Electrochemical Jet Drilling – Electro Chemical Deburring - Electro Chemical Grinding (ECG) – Electro Chemical Honing (ECH) – Electrochemical super finishing – Electrical Discharge Grinding (EDG) – Electrical Discharge Diamond Grinding (EDDG) - Electrochemical Discharge Grinding (ECDG) – Process capabilities and applications.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing", Prentice Hall of India Pvt. Ltd., New Delhi, 2011.

2 Joao Paulo Davim, "Nontraditional Machining Processes: Research Advances", Springer, NewYork,2013.

REFERENCE

1 P. K. Mishra, "Non-Conventional Machining", Narosa Publishing House, New Delhi, 2007

2 P. C. Pandey and H.S. Shan, "Modern Machining Processes", Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2008.

3 Vijaya Kumar Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi,2005.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Know the basics of non-traditional machining processes.	Remember
CO2	Select the suitable mechanical and thermal energy based non- traditional machining processes for the given industrial applications.	Understand
CO3	Find the suitable machining processes for machining electrically conductive materials.	Understand
CO4	Choose appropriate chemical and electro-chemical energy-based processes for precision machining	Understand
CO5	Select the suitable hybrid process for cutting and machining of the hard materials.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	3	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	3	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	3	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	-	-	-
CO	2	2	-	-	3	-	-	-	-	-	-	-	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19MEP23	PLANT LAYOUT AND MATERIALS HANDLING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

Objective of this course is to

- Impart knowledge on the fundamentals of plant layout.
- Explore the techniques involved in plant layout design.
- Understand the different types of material handling systems in an industry.

UNIT I PLANT LAYOUT 9

Introduction- Types of Plant Layout: Product, Process, Fixed position, Hybrid, Cellular, FMS Advantages and Limitations of different layouts, Process layout & Product layout: Selection, specification, Implementation and follow up, comparison of product and process layout. Characteristic features, suitability and applications of different types of layout installation.

UNIT II LAYOUT PLANNING 9

Phases of Layout Planning, Systematic Layout Planning: Principles of plant layout design, Procedure for plant layout design, Quantitative techniques for developing alternative layouts, Design of process and product layouts, Line balancing techniques. Systematic Layout Planning, P-Q Analysis, Flow of Materials Analysis – Charting & Diagram Techniques, Activity Relationship Analysis – REL Diagram.

UNIT III COMPUTERIZED LAYOUT PLANNING 9

Concepts, Designing process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Algorithms and models for Group Technology. MADM approaches: SAW, WPM, AHP and TOPSIS.

UNIT IV MATERIAL HANDLING 9

Principles of Material Handling, Material Handling Function, Scope and Functions of Material Handling, Manual Mechanical Handling Ratio, MH Equipment Types Material Handling Equipment: Belt Carrier, chain and cable roller. Transport Equipment – Conveyors, Cranes, Industrial Trucks. Storage Equipment, AGVs and Robots.

UNIT V FACTORY PLANNING AND MATERIAL HANDLING 9

Plant location factory handling, the layout as key materials handling problem, Production Control and materials handling: Types of Production Control, material control. Production planning, production scheduling, production dispatching and follow up as related to materials handling.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 G. K. Agrawal, "Plant layout & Material Handling", Jain Publishers, New Delhi, 2017

2 S.C. Sharma, "Plant Layout and Materials Handling," Khanna Publishers, 3rd Edition 2000.

REFERENCE

1 Matthew P. Stephens Fred E. Meyers, "Manufacturing Facilities Design and Material Handling" Purdue University Press West Lafayette, Indiana, 5th edition, 2013

2 Siddhartha Ray, "Introduction to Materials Handling" Paperback, New Age International Pvt Ltd, 2017.

3 R. Panneerselvam, " Production and Operations Management", 3rd edition, PHI Learning Private Ltd., New Delhi, 2012.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the fundamentals of plant layout	Understand
CO2	Make use of appropriate techniques for designing plant layout	Apply
CO3	Explain the computerized techniques involved in plant layout design	Apply
CO4	Explain the various material handling Equipment	Understand
CO5	Discuss the production control techniques with respect to materials handling	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1
CO2	3	2	-	-		-	-	-	-	-	-	-	3	1
CO3	3	2	-	-	3	-	-	-	-	-	-	-	3	1
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	1
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	1
CO	3	2	-	-	3	-	-	-	-	-	-	-	3	1
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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PROFESSIONAL ELECTIVE

KPRIET

U19MEP24	STATISTICAL PROCESS CONTROL	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To understand the statistics and its uses in process control
- To apply the control charts
- To use the sampling techniques in various projects

UNIT I STATISTICAL FUNDAMENTALS 9

Random Variables, Data Types, Discrete and Continuous Distributions- Mean, Median and Mode- Standard Deviation and Variance- Grouped and Ungrouped Data-Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal Distributions

UNIT II STATISTICAL PROCESS CONTROL 9

Chance and Assignable Causes of Variation, Statistical basis of the control charts-Basic Principles, Choice of control limits, analysis of patterns on control charts, uses of control charts and how to implement it in online and offline

UNIT III CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES 9

Control chart for variables-X bar Chart and R Chart, X bar and S Chart- Process capability - Process capability studies. Control chart for Attributes- Control chart for nonconforming- p chart and np chart- control chart for nonconformities - c and u charts- Multivariate control charts- Hotelling T^2 control chart

UNIT IV ACCEPTANCE SAMPLING 9

Types of sampling plan- Lot formation- Probability of acceptance in single for attributes, double, multiple sampling techniques and Sequential sampling plan-operating characteristic curve- producer's risk and consumer's risk - Average Quality Level (AQL), Lot Tolerance Percent Defective (LTPD), Average Total Inspection (ATI), Average Sample Number (ASN), Average Outgoing Quality Limit (AOQL)

UNIT V ACCEPTANCE SAMPLING VARIABLES AND SOFTWARE IN SPC 9

Acceptance sampling variables - Dodge Romig Sampling Plans- Use of standard sampling plans. Software in SPC- Use of Excel in implementing control charts- One Standard software in implementing SPC

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Douglas C. Montgomery, "Introduction to Statistical Quality Control", John Wiley and Sons Inc, Sixth Edition 2009

2 Eugene L Grant, Richard S Leavenworth," Statistical Quality Control", Tata Mc-Graw Hill, New Delhi,2011

REFERENCE

1 Dale H Besterfield," Quality Control", Pearson Education, New Delhi 2008.

2 Hitoshi Kume, "Statistical Methods for Quality Improvement" Productivity Press (India) Pvt. Ltd.2019.

3 John Oakland,"Statistical Process Control", Fourth Edition,Butterworth-Heinemann, publisher, 1999.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	To understand the statistics used in Statistical Process Control	Understand
CO2	To understand the basics of Statistical Process Control and its applications.	Understand
CO3	To construct the control charts for variables and attributes.	Apply
CO4	To apply the sampling plans and measure its performance.	Apply
CO5	To apply the software (Excel or Standard) for Statistical Process Control.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	1	2	-	-	2	-	-	-	-	-	3
CO2	2	1	-	1	2	-	-	2	-	-	-	-	-	3
CO3	3	2	2	1	2	-	-	1	-	-	1	1	-	3
CO4	2	2	2	1	2	-	-	1	-	-	1	1	-	3
CO5	2	2	2	1	3	-	-	1	-	-	1	1	-	3
CO	2	2	2	1	2	-	-	1	-	-	1	1	-	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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PROFESSIONAL ELECTIVE

U19MEP25	ENERGY MANAGEMENT AND EQUIPMENT DESIGN	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To understand the various methods of energy management.
- To understand the various techniques of energy auditing.
- To model and simulate energy systems and various optimization techniques.

UNIT I IMPORTANCE OF ENERGY MANAGEMENT AND CONSERVATION 9

Energy management as a profession, primary and secondary sources of energy, Energy Scenario - world and India. Energy Resources Availability in India. Energy consumption pattern. Energy intensive industries - an overview. Energy conservation and energy efficiency – needs and advantages. Energy Conservation Act.

UNIT II ENERGY AUDIT 9

Definition, need, and types of energy audit; Energy management (audit) approach: Understand energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements; Energy auditing - types, methodologies, barriers. Energy audit instruments; Duties and responsibilities of energy managers and auditors - Energy audit questionnaire.

UNIT III INTRODUCTION TO ENERGY EQUIPMENT DESIGN 9

Primary energy analysis - energy balance for closed and control volume systems - applications of energy analysis for selected energy system design - modeling overview - levels and steps in model development - Examples of models – curve fitting and regression analysis

UNIT IV MODELING AND SYSTEMS SIMULATION 9

Modeling of energy systems – heat exchanger - solar collectors – distillation - rectification turbo machinery components - refrigeration systems - information flow diagram - solution of set of nonlinear algebraic equations - successive substitution - Newton Raphson method.

UNIT V OPTIMISATION TECHNIQUES 9

Objectives - constraints, problem formulation - unconstrained problems - necessary and sufficient Conditions. Constrained optimization - Lagrange multipliers, constrained variations, Linear Programming - Simplex tableau, pivoting, sensitivity analysis - New generation optimization Techniques

Contact Periods:							
Lecture:	45 Periods	Tutorial:	– Periods	Practical:	– Periods	Total:	45 Periods

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TEXT BOOKS

1 F Kreith, D.Y.Goswami, "Energy management and conservation handbook", CRC Press, 2008.

2 Stoecker W.F., "Design of Thermal Systems", McGraw Hill, 2011

REFERENCE

1 Steve Doty, "Energy Management Handbook", 7th Edition, the Fairmont Press, Inc., 2009.

2 Yogesh Jaluria, "Design and Optimization of Thermal systems", 2nd Edition, CRC Press, 2007.

3 C. Balaji, Essentials of Thermal System Design and Optimization, CRC Press, 2011

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Realize the present energy scenario and the need for energy management and various energy conservation measures	Understand
CO2	Conduct energy audits and understand the roles and responsibilities as an individual for optimizing the energy requirements.	Understand
CO3	Understand the process of energy analysis and its application in equipment design	Understand
CO4	Perform the Simulation and Modeling of typical energy systems and application of numerical methods for energy analysis.	Apply
CO5	Design energy systems and apply new generation optimization techniques for energy system simulation.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	1	-	-	-	-	2
CO2	2	-	-	-	-	-	2	-	1	-	-	-	-	2
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	-
CO5	2	2	3	2	-	-	-	-	-	-	-	-	-	2
CO	3	2	3	2	-	-	2	-	1	-	-	-	2	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP26	REFRIGERATION AND AIR CONDITIONING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Learning the fundamental principles and different methods of refrigeration and air conditioning.
- Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
- Understand the basic air conditioning processes on psychrometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.

UNIT I INTRODUCTION TO REFRIGERATION & AIR CONDITIONING 9

Necessity and applications – Unit of refrigeration and C.O.P. – Reversed Carnot cycle & heat pump - Modified reverse Carnot cycle (Bell Coleman cycle) - Refrigerants and their properties – Nomenclature – Ozone depletion – Global warming - VCR cycle – Psychrometric properties.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEMS 9

Working principle and essential components of the plant – Simple vapour compression refrigeration systems – COP – Representation of cycle on T-S and p-h (Mollier) charts – Effect of sub cooling and super heating – Cycle analysis – Actual cycle influence of various parameters on system performance – Use of p-h charts – Simple problems.

UNIT III VAPOUR ABSORPTION REFRIGERATION SYSTEMS 9

Description and working of Ammonia - water system and Li Br - water (Two shell & Four shell) System - Calculation of maximum COP - Principle and operation of three fluid absorption system, salient features - Steam Jet Refrigeration System: Working Principle and basic components - Principle and operation of thermoelectric refrigerator and vortex tube.

UNIT IV PSYCHROMETRIC AND AIR CONDITIONING 9

Psychrometric processes – Characterization of sensible and latent heat loads - Ventilation and infiltration - Load concepts of SHF, RSHF, GSHF and ESHF - Simple problems using psychrometric chart - Requirements of human comfort and effective temperature comfort chart – Comfort air conditioning and Industrial air conditioning - Air conditioning load calculations.

UNIT V AUXILIARY SYSTEMS AND APPLICATIONS OF RAC 9

Auxiliary AC systems - All air, all water, and air-water systems - Room air conditioners - Packaged air conditioning systems - Central air conditioning systems - Split air conditioning systems - Applications: Domestic Refrigerator and Air Conditioners - Automotive Air Conditioners - Evaporative coolers, water coolers - Commercial Refrigeration- Dairy, Cold storage, Ice plant - Commercial Air Conditioning- Multiplex, Hospitals.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Arora.S.C and Domkundwar.S, "A course in Refrigeration and Air conditioning", DhanpatRai (P) Ltd.,New Delhi, 2012.

2 Ananthanarayanan.P.N, "Basic Refrigeration and Air Conditioning", Tata McGraw Hill, 3rd Edition,New Delhi, 2013

REFERENCE

1 Manohar Prasad, "Refrigeration and Air conditioning", New Age International (P) Ltd, New Delhi,2011.

2 Roy J. Dossat," Principles of Refrigeration", Pearson Education Asia, 4th Edition, 2002.

3 Arora, C. P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 2012

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Illustrate the principles, nomenclature and applications of refrigeration and air conditioning systems.	Understand
CO2	Explain vapour compression refrigeration system and estimate the performance using Mollier charts.	Apply
CO3	Understand the working principles of vapor absorption, thermoelectric, steam-jet and thermoelectric refrigeration systems.	Understand
CO4	Estimate the performance of air-conditioning systems using the principles of psychrometry.	Apply
CO5	Understand the fundamental concepts of auxiliary RAC systems and applications.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	2	-	-	-	-	-	2	-
CO2	3	2	2	2	-	-	2	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	2	-	-	-	-	-	2	-
CO4	3	2	2	2		2	2	-	-	-	-	-	3	-
CO5	3	-	-	-	-	2	-	-	-	-	-	-	2	-
CO	3	2	2	2	-	2	2	-	-	-	-	-	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19MEP27	MEMS AND NEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To introduce the concepts of micro and nano electromechanical devices
- To impart the knowledge of micro-fabrication and forming processes
- To make the students understand the design concepts of micro sensors, micro actuators and nano Systems.

UNIT I INTRODUCTION TO MEMS/NEMS 9

MEMS vs NEMS - Evolution of Micro-sensors and MEMS - Introduction to NEMS - Design of MEMS and NEMS - Nano-mechanical Resonators and Nano-mechanical Sensors - Applications of Micro and Nanoelectromechanical systems - Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals - Bonding & Packaging of MEMS.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation - Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating - Etching techniques: Dry and wet etching, electrochemical etching - Micromachining: Bulk Micromachining, Surface Micromachining.

UNIT III MINIATURIZATION TECHNIQUES 9

Introduction -Absolute and Relative Tolerance in Manufacturing - Human Manufacturing - Top-Down Manufacturing Methods - Silicon on Insulator Technology (SOI) - Bottom-Up Approaches -Modelling, packaging and sample preparation.

UNIT IV MICRO SENSORS AND ACTUATORS 9

MEMS Sensors: Introduction to design of Vibratory gyroscope, Capacitive and Piezoresistive Pressure sensors – Introduction to design of Actuators: Actuation using thermal forces, shape memory alloys and piezoelectric crystals - Micromechanical Motors and pumps.

UNIT V NANO DEVICES 9

Atomic Structures and Quantum Mechanics - Molecular and Nanostructure Dynamics: Schrodinger Equation and Wavefunction Theory - Electromagnetic Fields and their quantization - Molecular Wires and Molecular Circuits - ZnO nanorods based NEMS device: Gas sensor.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Marc Madou, "Fundamentals of Microfabrication", CRC Press, 2012.

2 Tai Ran Hsu," MEMS and Microsystems Design and Manufacture", Tata McGraw Hill, 2017

REFERENCE

1 Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices and Structures" CRC Press, 2012

2 Mahalick N P, "MEMS", Tata McGraw Hill Education, 2012

3 Chang Liu, "Foundations of MEMS", Pearson education India limited, 2nd Edition, 2011

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Recall the basic concepts related to MEMS / NEMS	Remember
CO2	Outline the various fabrication techniques and micro machining processes for MEMS / NEMS	Understand
CO3	Apply various fabrication techniques to develop a MEMS / NEMS System	Apply
CO4	Interpret the key performance aspects of electromechanical transducers including sensors and actuators	Understand
CO5	Analyze the theoretical foundations of quantum mechanics and nano systems	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	1	1	-	-	-	-	-	-	-	-	3	1	-
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO	3	2	2	3	3	-	-	-	-	-	-	3	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

KPRIET

U19MEP28	AUTOMOTIVE ENGINE AND SUBSYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Impart knowledge in construction and principle of operation of SI and CI Engines.
- List various engine components, combustion, cooling and lubrication systems.
- Understand the recent development in the area of engines.

UNIT I ENGINE BASIC THEORY 9

Engine types – otto, diesel, dual operating cycles - Engine design and operating parameters – Two and four stroke engines - Typical performance curves for automobile engines- two stroke engine - performance and pollution aspects.

UNIT II FUEL SUPPLY AND IGNITION SYSTEMS 9

Theory of carburetion and carburetors — Design aspects — Diesel fuel injection - pumps and injectors, Introduction to Petrol Injection system - conventional ignition systems, advance mechanisms.

UNIT III COOLING AND LUBRICATING SYSTEMS 9

Air cooling and water cooling – thermo syphon cooling, forced cooling systems. Fins and radiator - design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petrol lubrication system, forced feed lubrication system.

UNIT IV AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS 9

Premixed combustion, diffused combustion, laminar and turbulent combustion of fuels in engines. Droplet combustion — combustion in SI and CI engines. - Cylinder pressure data and heat release analysis. Optimized design of combustion chambers. Supercharger and Turbochargers.

UNIT V NEW ENGINE TECHNOLOGY 9

Lean Burn engine – Different approaches to lean bum – LHR engine – Surface ignition concept – catalytic ignition – homogeneous charge compression ignition – variable valve timing – Multi Port Injection System - Gasoline Direct Injection – Common Rail Direct Injection – Recent Trends.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 J.B.Heywood, "Internal combustion engine Fundamentals", McGraw Hill Book Co, 1989.

2 V.Ganesan, "Internal combustion Engines", Tata McGraw Hill Book Co, Eighth Reprint, 2005.

REFERENCE

1 M.Khovakh, "Motor Vehicle Engines", Mir Publishers, Mascow,1976

2 W.H.Crouse and A.L.Anglin, "Automotive Emission control", McGraw Hill Book Co, 1995.

3 M. L. Mathur, R. P. Sharma, "Internal combustion engines", Dhanpat Rai Publication, 2005

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able

COs	Statements	K-Level
CO1	To understand the Construction and operation of IC Engine	Understand
CO2	To compare different Fuels and ignition techniques in in IC Engines	Understand
CO3	To identify the best cooling and lubricating system among counterparts	Apply
CO4	To summarize all combustion and combustion chamber employed in IC engine	Understand
CO5	To adopt new engine technology in the conventional IC engines and compare their merits and demerits	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	1
CO2	3	2	-	2	-	-	-	-	-	-	-	1	-	1
CO3	3	2	-	2	-	-	-	-	-	-	-	1	-	1
CO4	3	1	-	2	-	-	-	-	-	-	-	1	-	1
CO5	3	1	-	-	2	-	-	-	-	-	-	1	-	1
CO	3	1	-	2	2	-	-	-	-	-	-	1	-	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP52	COMPREHENSION - II	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Prepare the students with depth of knowledge on specific topics that takes them for higher studies.
- Train the students on specific topics for potential placements through competitive exams.

MECHANICS OF MATERIALS

Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

METROLOGY AND INSPECTION

Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

COMPUTER INTEGRATED MANUFACTURING

Basic concepts of CAD/CAM and their integration tools.

PRODUCTION PLANNING, INVENTORY CONTROL

Forecasting models, aggregate production planning, scheduling, materials requirement planning. Deterministic models, safety stock, inventory control systems.

OPERATIONS RESEARCH

Linear programming, simplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Use the governing concepts of Mechanics of Solids to solve problems.	Apply
CO2	Apply the knowledge of measurements in manufacturing.	Apply
CO3	Apply the concepts of CAD/ CAM for integration in manufacturing	Apply
CO4	To implement planning and control for effectiveness in production.	Apply
CO5	To analyze the real-time problems using operations research.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	2	-	2	-	-	-	-	-	-	-	-	-
CO3	3	-	3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	1	-	-	-	-	-	-	-	2	3
CO5	3	3	3	-	1	-	-	-	-	-	-	1	-	-
CO	3	3	3	-	2	-	-	-	-	-	-	1	2	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP30	PRODUCT LIFE CYCLE MANAGEMENT	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To Familiarize with various strategies of PLM
- To Understand the concept of product design and simulation
- To Develop New product development, product structure and supporting systems

UNIT I INTRODUCTION TO PRODUCT LIFE CYCLE MANAGEMENT 9

Product life cycle – Introduction, growth, maturity & decline, Product Lifecycle Management- Definition & Overview, Background for PLM-corporate challenges, Need of PLM, Components/Elements of PLM, Emergence of PLM, Significance of PLM - life cycle problems to be resolved, product development problems to be resolved, Customer Involvement.

UNIT II CONSTRUCTING PRODUCT LIFE CYCLE MANAGEMENT & DRIVING ENVIRONMENT 9

PLM Life cycle model- plan, design, build, support & dispose. Threads of PLM computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM). Weaving the threads into PLM, comparison of PLM to Engineering resource planning (ERP). PLM characteristics - singularity, cohesion, traceability, reflectiveness, Information Mirroring Model.

UNIT III DIGITAL LIFECYCLE AND PRODUCT LIFECYCLE MANAGEMENT SYSTEM 9

Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting. Digital Mock up and Prototype development. Virtual testing and collateral. Introduction to Digital Manufacturing. Product life cycle management - system architecture, Information models and product structure. Reasons for the deployment of PLM systems

UNIT IV PRODUCT LIFE CYCLE ENVIRONMENT 9

Product Data issues – Access, applications, Archiving, Availability, Change, Confidentiality. Product Workflow, The Link between Product Data and Product Workflow, The PLM Strategy, Principles for PLM strategy, preparing for the PLM strategy, developing a PLM strategy, Strategy identification and selection, Change Management for PL

UNIT V COMPONENTS OF PRODUCT LIFE CYCLE MANAGEMENT 9

Different phases of product lifecycle and corresponding technologies, Foundation technologies and standards e.g. visualization, collaboration and enterprise application integration, Core functions e.g., data vaults, document and content management, workflow and program management, Functional applications e.g., configuration management. Human resources in product lifecycle. PLM Case Study.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004. ISBN 1852338105

2 Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006

REFERENCE

1 Product Lifecycle Management, Michael Grieves, Tata McGraw Hill

2 Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management, Springer, 1st Edition (Nov.5, 2003)

3 Saaksvuori Antti, Immonen Anselmie, product Life Cycle Management Springer, Dreamtech, 2005

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the various strategies of PLM and Product Data Management	Understand
CO2	Describe decomposition of product design and model simulation	Understand
CO3	Interpret the technology forecasting and product innovation and development in business processes	Understand
CO4	Apply the concept of New Product Development and its structuring	Apply
CO5	Apply the virtual product development and model analysis	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	2		3		1	3	-	2	-
CO2	3	2	1	-	-	2		3	3		3	-	2	-
CO3	3	2	2	-	-	1		3	2		3	-	2	-
CO4	3	2	2	-	-	2		3	2	2	3	-	2	-
CO5	3	2	1	-	-	2		3		2	3	-	2	-
CO	3	2	1	-	-	2	-	3	2	2	3	-	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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KPRIET

PROFESSIONAL ELECTIVE

		Category: PE			
U19MEP31	FMEA AND PROTOTYPING	L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To understand the material selection and design to withstand the failure and its analysis
- To aid in Understand the need, types, application, method of operation and the future of Rapid Prototyping system in industrial application
- To Modulation is formulated to enhance innovative thinking and solve business case studies in RP / RM techniques

UNIT I MATERIALS, DESIGN PROCESS AND FRACTURE MECHANICS 9

Factors affecting the behavior of materials in components, effect of component geometry and shape factors, designing with high strength and low toughness materials, designing for hostile environments, the design process, materials selection in design, processes and their influence on design, systematic process selection, ductile fracture, brittle fracture, cleavage-fractography, ductile-brittle transition, fracture mechanics approach to design-energy criterion, stress intensity approach, time dependent crack growth and damage

UNIT II WEAR FAILURES AND ELEVATED TEMPERATURE FAILURES AND FAILURE ANALYSIS TOOLS 9

Types of wear, different methods of wear measurement, analysis wear failures, wear at elevated temperatures, wear on different materials, role of friction on wear, stick slip friction, creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure, Reliability concept and hazard function, life prediction, life extension, application of Poisson, exponential and Weibull distribution for reliability, bath tub curve, parallel and series system, MTBF,MTTR, FMEA definition-Design FMEA, process FMEA, analysis causes of failure, modes, ranks of failure modes, fault tree analysis, microscopic failure analysis, industrial case studies / Projects on FMEA.

UNIT III VIRTUAL PROTOTYPING, MATERIALS SELECTION & PROCEDURE FOR PROTOTYPING 9

Using Commercial Software for Virtual Prototyping – Prototyping Materials – Material Selection Methods – Rapid Prototyping Overview –Rapid Prototyping Cycle - Rapid Prototyping Procedure – STL files – Converting STL File from Various CAD Files – Controlling Part Accuracy in STL Format – Slicing the STL File – Case Studies in Design for Assembly.

UNIT IV TYPES OF RAPID PROTOTYPING PROCESS 9

Types of RP Process – Stereo lithography — Fused Deposition Modelling – Selective Laser Sintering – 3D Printing Process — Laminated Object Manufacturing – Electron Beam Melting Process - – History - Operation – Advantages and Disadvantages – Applications - Relation to Other RP Technologies - (applies to all the process) - Direct Laser Deposition

UNIT V APPLICATIONS OF PROTOTYPING 9

Investment Casting – Sand Casting – Permanent Mold Casting – Direct RP Tooling – Silicone Rubber Tooling – Investment Cast Tooling – Powder Metallurgy Tooling – Desktop Machining - Case Studies on Current Applications of RP- Novel Application of RP Systems - Future Trends of RP Systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Shipley R. J. and W. T. Recker, "ASM Handbook Volume 11 : Failure Analysis and Prevention", ASM International, 2002

2 Liou, W.F (2008), Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA

REFERENCE

1 Joseph Shigley, Charles Mischke, Budynas Richard, Keith Nisbett, "Mechanical Engineering Design", Tata Mc-graw Hill Education, 2008.

2 Kai., C.C, Lim, C.S. and Leong, F.K. (2008), Rapid Prototyping: Principles and Applications in Manufacturing, Wiley Publication

3 Hopkinson, N., Hague, R.J.M, and Dickens, P.M.(2006), Rapid Manufacturing, An Industrial Revolution for the Digital Age, John Wiley & Sons, Ltd, UK

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statement	K-Level
CO1	Understand the material selection and design process involved in the component manufacturing	Understand
CO2	Understand the different types of failure associated with the components	Understand
CO3	Apply the failure tools to analyze the failure of component during the design stage	Apply
CO4	Have in-depth knowledge about RP/RM technologies along with recent trends in advanced manufacturing	Understand
CO5	Understand quick response manufacturing and developing end to end solutions in product manufacture	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	2	3	3
CO2	3	3	-	-	2	-	-	-	-	-	-	2	3	3
CO3	3	3	-	-	2	-	-	-	-	-	-	2	3	3
CO4	3	-	-	-	3	-	-	-	-	-	-	2	3	3
CO5	3	-	-	-	3	-	-	-	-	-	-	2	3	3
CO	3	3	-	-	2	-	-	-	-	-	-	2	3	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)		

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PROFESSIONAL ELECTIVE

U19MEP32	WELDING TECHNOLOGY	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand the basics of welding and to know about the various types of welding processes
- Understand the weldability issues in joining of different ferrous and nonferrous metals
- Understand the need for Robots in welding applications

UNIT I ARC AND RESISTANCE WELDING PROCESSES 9

Variants of TIG and MIG welding, CMT welding process, Plasma arc welding, Electroslag welding processes, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, and High frequency resistance welding processes– advantages, limitations and applications.

UNIT II SOLID STATE WELDING PROCESSES 9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Friction stir welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT III DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS 9

Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and non-destructive testing of weldments

UNIT IV INTRODUCTION TO WELDING ROBOTS 9

Need for Robots in welding, Classification of robots - Types of end effectors - Special types of grippers, Robot architecture, Welding automation in aerospace, nuclear & surface transport vehicles.

UNIT V SENSORS IN ROBOTIC WELDING 9

Welding current measurement - Hall effect sensor, Distance control - Capacitive sensor, Weld seam tracking - Eddy current sensor, Weld penetration monitoring- Infrared radiation sensor, Weld pool monitoring- Vision sensor, Weld quality inspection- Ultrasonic sensor, Robot programming for Welding application

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.

2 Parmer R.S., "Welding Engineering and Technology", 1st Edition, Khanna Publishers, New Delhi, 2008.

REFERENCE

1 AWS- Welding Hand Book. 8th Edition. Vol- 2. "Welding Process"

2 Nadkarni S.V. "Modern Arc Welding Technology", Oxford IBH Publishers, 1st Edition, 2005.

3 John Vetelino and Aravind Reghu, —Introduction to Sensors, CRC Press, 2010.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the construction, working principles and applications of various types of arc and Resistance welding processes	Understand
CO2	Acquire the knowledge of solid-state welding process for engineering applications	Understand
CO3	Identify various nomenclature, symbol and standards in the weld joint design and Select suitable processes for producing quality weldments for ferrous and nonferrous alloys.	Apply
CO4	interpret the features of an industrial robot and estimate the gripping force of robot end effector	Apply
CO5	identify the various sensors and develop programing for robotic welding application	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	1	-	-	-	-	-	2	1	-
CO2	3	-	-	-	-	1	-	-	-	-	-	2	1	-
CO3	3	-	-	-	-	1	-	-	-	-	-	2	1	-
CO4	3	-	-	-	-	1	-	-	-	-	-	2	1	-
CO5	3	-	-	-	-	1	-	-	-	-	-	2	1	-
CO	3	-	-	-	-	1	-	-	-	-	-	2	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP33	COMPUTER INTEGRATED MANUFACTURING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand the application of computers in various aspects of Manufacturing
- Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I INTRODUCTION TO CAD AND CAM 9

Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system

– Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING 9

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III CELLULAR MANUFACTURING 9

Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 9

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS 9

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008

2 Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCE

1 Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.

2 Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.

3 Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems	Understand
CO2	Summarize the production planning and control and computerized process planning	Understand
CO3	Differentiate the different coding systems used in group technology	Understand
CO4	Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system	Understand
CO5	Classification of robots used in industrial applications	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO2	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO3	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO4	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO5	3	1	-	-	1	-	-	-	-	-	-	-	-	1
CO	3	1	-	-	1	-	-	-	-	-	-	-	-	1
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19MEP34	COMPUTATIONAL FLUID DYNAMICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Introduce the discretization techniques in the numerical solution of fluid equations and concept of different schemes used in the CFD solution.
- Identification of the applicability of different models in respective problems that occur in the solution of such equations.
- Get a significant result from the various methods of numerical solution.

UNIT I OVERVIEW OF THE BASIC CONSERVATION EQUATIONS 9

A brief overview of the basic conservation equations for fluid flow, classification of partial differential equations and relevant physical behavior, parabolic, elliptic and hyperbolic equations.

UNIT II DISCRETIZATION METHODS 9

Discretization methods (Introduction of finite difference, finite element and finite volume methods). Idea of explicit and implicit schemes, consistency, stability and convergence for numerical solution of nonlinear partial differential equations using finite-difference and finite volume methods.

UNIT III SOLUTION METHODS OF ALGEBRAIC EQUATIONS 9

Numerical solution of linear algebraic equations (Concepts of elimination and iterative methods, Gaussian elimination, tridiagonal matrix algorithm, gradient search methods). Consequences of discretization of unsteady State Problems.

UNIT IV THE FINITE VOLUME METHOD OF DISCRETIZATION FOR UNSTEADY (TURBULENT) FLOW PROBLEMS 9

The finite volume method of discretization for two-dimensional unsteady flow problems, source- term linearization. Discretization for multi-dimensional flow problems. The solution of discretized equations using point and line iterations, strongly implicit methods. Schemes for a numerical solution (central difference, upwind, exponential, hybrid and power-law schemes, QUICK scheme).

UNIT V NUMERICAL SOLUTION OF THE NAVIER-STOKES SYSTEM FOR INCOMPRESSIBLE FLOWS 9

Stream-function vorticity and artificial compressibility methods, the requirement of a staggered grid. An introduction to unstructured grid finite volume methods. Simulating Hagen Poisuille flow using programming.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Anderson, J.D. and Wendt, J, "Computational fluid dynamics" (Vol. 206, p. 332), New York, McGraw-Hill, 1995.

2 Versteeg, H.K. and Malalasekera, W, "An introduction to computational fluid dynamics: the finite volume method". Pearson education, 2007.

REFERENCE

1 Munson, B.R., Okiishi, T.H., Huebsch, W.W. and Rothmayer, A.P., "Fluid mechanics" (p. 147). Singapore: Wiley, 2013.

2 Pletcher, R.H., Tannehill, J.C. and Anderson, D., "Computational fluid mechanics and heat transfer", CRC press, 2012.

3 Zikanov, O, " Essential computational fluid dynamics", John Wiley & Sons,2019.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	An ability to identify, formulate, and solve engineering flow problems	Understand
CO2	An ability to use the techniques, models, and scams necessary for the numerical solutions	Understand
CO3	An ability to find proper discretization methods	Understand
CO4	An ability to obtain grid independent solution	Understand
CO5	To carried out the Numerical solution for engineering flows	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	-	-	-	-	-	-	-	2	-
CO2	2	3	2	2	2	-	-	-	-	-	-	-	2	-
CO3	2	3	2	2	2	-	-	-	-	-	-	-	2	-
CO4	2	3	2	2	2	-	-	-	-	-	-	-	2	-
CO5	2	3	2	2	2	-	-	-	-	-	-	-	2	-
CO	2	3	2	2	2	-	-	-	-	-	-	-	2	-
Correlation levels:		1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)						

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PROFESSIONAL ELECTIVE

KPRIET

U19MEP35	INDUSTRY 4.0	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Offer learners an introduction to Industry 4.0 (or the Industrial Internet)
- Facilitate the applications of Industry 4.0 in the business world.
- Gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges and its cyber security.

UNIT I INTRODUCTION TO INDUSTRIAL 4.0 9

Understand Industry 4.0, A Conceptual Framework for Industry 4.0, Main Concepts and Components of Industry 4.0, Supportive Technologies, Proposed Framework for Industry 4.0, Lean Production Systems for Industry 4.0, and Automation Based Lean Production Applications, Maturity and Readiness Model for Industry 4.0 Strategy.

UNIT II ROAD TO INDUSTRY 4.0 AND ITS TECHNOLOGY 9

Internet of Things (IoT) & Industrial Internet of Things (IIoT) , Internet of Services , Smart Manufacturing , Smart Devices and Products, Smart Logistics , Smart Cities, Predictive Analytics, Data Analytics in Manufacturing , Power Consumption in Manufacturing .

UNIT III ADVANCES IN ROBOTICS IN THE ERA OF INDUSTRY 4.0 9

Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics. Industrial Robotic Applications, Manufacturing, Maintenance, Assembly.

UNIT IV THE ROLE OF AUGMENTED REALITY IN THE AGE OF INDUSTRY 4.0 9

Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Additive Manufacturing (AM) Technologies, Advances in Virtual Factory Research and Applications. Digital Traceability Technologies, Architectural Framework, Project Management in Digital Traceability.

UNIT V CYBER SECURITY IN THE INDUSTRY 4.0 ERA 9

Introduction, Security Threats and Vulnerabilities of IoT, Industrial, Evolution of Cyber Attacks, Cases (Cyber-Attacks and Solutions), Strategic Principles of Cyber Security, Cyber Security Measures. Business issues in Industry 4.0, Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist • 2016

2 Quick Start Guide to Industry 4.0: One-stop Reference Guide 2018

REFERENCE

1 Analyze the Impacts of Industry 4.0 in Modern Business Brunet-Thornton, Richard, Martinez, Felipe • 2018

2 The Concept Industry 4.0 - Prof. Alberto J. Alvares 2019.

3 Designing the Internet of Things (Nov 2015) by Adrian McEwen & Hakim Cassimally 2018

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the drivers and enablers of Industry 4.0	Understand
CO2	Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services	Understand
CO3	Develop the outline of various Robotic systems used in a manufacturing plant and their role in an Industry 4.0 world	Apply
CO4	Appreciate the power of Augmented Reality in a networked economy	Apply
CO5	Build the opportunities, challenges brought about by Industry 4.0 and Strategic Principles of Cyber Security	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	1	-	-	-	-	-	-	-	-	-	1
CO3	3	3	3	1	-	-	-	-	-	-	-	-	-	1
CO4	3	3	3	1	-	-	-	-	-	-	-	-	-	1
CO5	2	2	2	2	-	-	-	-	-	-	-	-	-	1
CO	3	3	3	1	-	-	-	-	-	-	-	-	-	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP36	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Reform the knowledge about the application of electrical and electronics in automotive systems
- Gain knowledge about charging and lighting technologies
- Have an insight on vehicle motion control and diagnostics

UNIT I BATTERIES AND STARTING SYSTEMS 9

Vehicle Batteries –Lead acid battery Construction, Working Principle, Battery Rating. Lead Acid battery Charging methods and Testing Methods and Fault Diagnosis. Requirement of a starting System, Starter motor Construction and Working. Starter Drive Mechanism –Bendix drive and Folo-thru drive Starter Drive Mechanism – Over Running Clutch and Solenoid Mechanism. Starter Motor Fault Diagnosis. New Developments in Battery Technologies and Starting System

UNIT II CHARGING SYSTEM AND LIGHTING AUXILIARIES 9

Alternator Principle, Construction, Working and its merits over D.C Generator. Alternator Charging Circuits and Rectification of AC to DC, Alternator Testing Methods. Mechanical and Electronic Voltage regulator –Principle and Working. Lighting Fundamentals and Lighting Circuit. Conventional Headlamps and LED Lighting System. Wiper system, Signaling and Warning system

UNIT III ELECTRONIC ENGINE MANAGEMENT SYSTEM 9

Electronics and feedback in the injection system. Conventional ignition vs electronic ignition methods & knock control system. Digital Engine Control Modes. EGR Control & variable valve timing. Ignition Controlling–Closed loop ignition timing, Spark Advance Correction Scheme

UNIT IV FUNDAMENTALS OF VEHICLE MOTION CONTROL 9

Cruise Control System and Adaptive Cruise Control System Working – Throttle Actuator Stepper Motor Based Control. Antilock Braking Mechanism –Tyre Slip Controller. Electronic Suspension System – Variable Damping, Variable Spring rate. Electric Power Assisted Steering Mechanism, Four Wheel Steering and Steer-by-Wire

UNIT V TELEMATICS AND VEHICLE DIAGNOSTICS 9

GPS Navigation, GPS Structure and Dead Reckoning using Inertial Navigation System. In Vehicle infotainment systems, ADAS features. Electronic Control System Diagnostics, OBDII, Diagnostics Fault Codes. Introduction to Model-based Sensor Failure Detection –Case Study on MAF Sensor calibration

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Tom Denton "Automobile Electrical and Electronic Systems" 3rd edition, Elsiever Butterworth-Heinemann 2004.

2 William.B.Ribbens , "Understand Automotive Electronics" 7th edition Butterworth-Heinemann publications, 2012.

REFERENCE

1 Allan.W.M.Bonnick "Automotive Computer Controlled System", Butterworth- Heinemann, 2001

2 Robert Bosch Gmbh "Bosch Automotive Electric and Electronics" 5th edition Springer-Vieweg

3 Tom Denton, Automobile Electrical and Electronic Systems, 5th Edition

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand battery, Cranking motor construction and testing methods	Understand
CO2	Understand the principle of alternator and to test the alternator	Understand
CO3	Understand the Electronic Controls in Gasoline Engine	Understand
CO4	Understand the basics of Vehicle Motion Control and telematics system	Understand
CO5	Understand the infotainment systems and vehicle diagnostics	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO	3	1	-	-	-	-	-	-	-	-	-	-	2	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U9MEP37	AUTOTRONICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To present a problem oriented in depth knowledge of Autotronics
- To gain knowledge about electronic system approach in engine controls
- To address the underlying concepts and methods behind Autotronics.

UNIT I AUTOMOTIVE ELECTRONICS 9

Fundamentals of Automotive Electronics: Microprocessor and microcomputer applications in automobiles; components for engine management System; electronic management of chassis system; vehicle motion control; electronic panel meters.

UNIT II SENSORS AND ELECTRONICS 9

Introduction; Basic sensor arrangement; Types of Sensors such as oxygen sensors, Crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow Sensors, throttle position sensors, solenoids, stepper motors, relays. Electromagnetic Interference Suppression: Electromagnetic compatibility Electronic dashboard instruments - Onboard diagnosis system. Security and warning system.

UNIT III FUEL INJECTION, IGNITION & CONTROL 9

Electronic Fuel Injection & Ignition System: Introduction; feedback carburetor system; throttle body injection and multi point fuel injection System; injection system controls; advantage of electronic ignition systems; types of solid-state system and their principle of operation; electronic spark timing. Control Systems

UNIT IV SYSTEMS APPROACH 9

Fundamentals, electronic components and circuits, digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, automotive instrumentation and telematics, new developments.

UNIT V SAFETY AND DIAGNOSTICS 9

Seats, mirrors and sun roofs; central locking and electric Windows; cruise control; in-car multimedia; security; airbag and belt tensioners; other safety and comfort systems; new developments. Electromagnetic compatibility Electronic dashboard instruments - Onboard diagnosis system. Security and warning system.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Ljubo Vlacic, Michel Parent, and Fumo Harashima – Intelligent Vehicle Butter worth Heinemann Woburn, Oxford, 2011.

2 Tom Denton – Automobile electrical and electronic systems, Butterworth-Heinemann, 3rd edition, 2004

REFERENCE

1 William B. Ribbens – Understand Automotive Electronics, 5th edition, Butter worth Heinemann Woburn, 1998.

2 Bechhold – Understand Automotive Electronics, SAE, 1998

3 Tom Denton – Automobile electrical and electronic systems, Butterworth-Heinemann, 3rd edition, 2004

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Define the basics of Autotronics and the elements that constitute their characteristics	Understand
CO2	Illustrate the kinds of sensors used in an automotive system, and explain the potential issues in the times of malfunction.	Understand
CO3	Label the types of the fuel injection and ignition systems and interpret the ways by which the vehicle control system.	Understand
CO4	Define the electronic components that constitute the control unit.	Understand
CO5	Illustrate the safety protocols and systems followed in electronics enabled automobile systems.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO	3	-	-	-	-	-	-	-	-	-	-	-	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP38	PRODUCT DEVELOPMENT AND REVERSE ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Improve a student's conception on how a product is developed.
- Satisfy the customer's requirements by properly Understand their needs.
- Follow the intended rules and norms to develop the best and ethical product.

UNIT I INTRODUCTION 9

Product design, importance of product design, Design Process, Design Thinking and Innovation, challenges of product development, use of IT in product design, concept of CPC, PDM/PLM.

UNIT II PRODUCT DESIGN APPROACHES AND REVERSE ENGINEERING 9

Product development versus design, types of design and redesign, quality function deployment, axiomatic design, failure mode and effect analysis concurrent engineering, reverse engineering, scanning methods for reverse engineering, cloud points, NURBS surfaces, reengineering, tear down approach, benchmarking.

UNIT III NEW PRODUCT DEVELOPMENT 9

Design creativity-innovations in design alternatives, S-curve. Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality. Concept generation, Information gathering, brain ball, C- sketch/6-3-5 method, morphological analysis. Concept selection, technical feasibility, ranking, measurement theory.

UNIT IV MATERIAL SELECTION FOR PRODUCT DEVELOPMENT 9

Performance characteristics of materials, the material selection process, economics of materials, methods of material selection, materials performance indices, material selection by expert systems, value analysis, cradle to cradle reuse practices, composites and advanced materials.

UNIT V PROTOTYPING & IPR 9

Prototype basics, principles of prototyping, prototyping technologies, concepts of virtual prototyping. Intellectual property, steps in patenting – formulate strategy and plan, study prior inventions, outline claims, write description of invention, refine claims, pursue application, reflect on the results and the process.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Karl T. Ulrich, Steven D. Eppinger, Maria C. Yang. "Product Design and Development". McGraw-Hill Education,7th edition 2020.
2 A. K. Chitale, "Product Design And Manufacturing". PHI Learning Pvt Ltd., 2013.

REFERENCE

1 Dr. Ali Jamnia. "Introduction to Product Design and Development for Engineers". CRC Press, 2018.
2 Lorraine Justice, "The Future of Design: Global Product Innovation for a Complex World". Nicholas Brealey Publishing, 2019.
3 Liou, Frank W, "Rapid prototyping and engineering applications: a toolbox for prototype development". CRC Press, 2019.

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Learn Beyond

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the importance of design thinking in the process of designing and developing a product.	Understand
CO2	Display a clear idea about the technologies involved in the field of reverse engineering.	Remember
CO3	Ability to convert the customer inputs and feedback into achievable goals for making the best product.	Apply
CO4	Ability to select a material based on the product requirements.	Apply
CO5	Use rapid prototyping methods and have a clear knowledge about the issues related to intellectual property in product development.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	3	-	-	3	-	2	-	-	3	-
CO2	2	3	-	-	3	-	-	3	-	-	-	-	3	2
CO3	-	3	3	-	2	-	-	3	-	3	3	-	-	2
CO4	3	3	2	-	-	-	2	2	-	-	3	-	3	2
CO5	2	2	-	-	3	-	2	3	-	-	3	2	3	2
CO	2	2	3	-	3	-	2	3	-	3	3	2	3	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP39	FOUNDRY PRACTICES AND MANAGEMENT	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To understand the principle, procedure and applications of various foundry processes.
- To understand the different types of gating systems.
- To know about destructive and Nondestructive testing methods and casting defects and remedies.

UNIT I CASTING PROCESS 9

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and 3 box moulding processes.

UNIT II CASTING METALLURGY 9

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys ,Babbitt alloy and Cu alloy.

UNIT III DESIGN OF GATING SYSTEMS 9

Gating systems and their characteristics; the effects of gates on aspiration; turbulence and dross trap; recent trends. Chvorinov's Rule Riser design; risering curves; NRL method of riser design; feeding distance; risering of complex casting

UNIT IV RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 9

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry –Computer aided design of casting.

UNIT V TESTING OF CASTINGS 9

Causes and remedies for casting defects –Destructive testing – NDT – Dye penetrant – magnetic particle – X-ray, ultrasonic cell – studies in testing of joints & castings. Methods of elimination and control of dissolved gases in castings. use of statistical quality control in foundry

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Jain P.L.," Principles of Foundry Technology", Tata McGraw Hill Publishers, 2015

2 Heime, Looper and Rosenthal,"Principle of metal casting", Tata McGraw Hill, 2010

REFERENCE

1 Heime, Looper and Rosenthal, "Principle of metal casting" , Tata McGraw Hill, 5th edition 2010

2 Taylor H.F., Fleming.M.C.,, "Foundry Engineering" M.C. & Wiley Eastern Ltd., 1993

3 Alfred John Murphy, The Science of Melting and Casting Non-Ferrous Metals and Alloys, Non-Ferrous Foundry Metallurgy

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WEB SOURCES

1 https://www.foundrymag.com/

2 https://www.waupacafoundry.com/en/foundry-101

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Students will be able to Correlate various type of metal casting processes	Understand
CO2	Students will be able to choose the particular materials for the specific casting process	Understand
CO3	Students will be able to design the different elements of Gating system	Apply
CO4	Students will be able to understand the future needs in the casting and foundry layout	Understand
CO5	To perform different testing to study the defect in the casting and apply engineering skills to minimize the defects.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	1	-	-	-	-	-	-	1	-
CO2	3	3	-	-	-	1	-	-	-	-	-	-	1	-
CO3	3	2	-	-	-	1	-	-	-	-	-	-	1	-
CO4	3	3	-	-	-	1	-	-	-	-	-	-	1	-
CO5	3	3	-	-	-	2	-	-	-	-	-	-	1	-
CO	3	3	-	-	-	1	-	-	-	-	-	-	1	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

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PROFESSIONAL ELECTIVE

KPRIET

U19MEP40	LEAN SUPPLY CHAIN MANAGEMENT	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand of the individual processes of supply chain management and their interrelationships within individual companies and across the lean supply chain.
- Understand of the management components of lean supply chain management.
- Understand of the tools and techniques useful in implementing lean supply chain management.

UNIT I LEAN SUPPLY CHAIN 9

Lean opportunities in supply chain and logistics, Examples of JIT in the Supply chain, competitive strategy, logistics and customer value, measuring logistics cost and performance

UNIT II INVENTORY MANAGEMENT 9

Traditional inventory management versus lean inventory management, kanban sizing, WIP inventory: FIFO management, lot sizing in lean, one-piece, Every Part Every Interval, lot sizing as part of scheduling, reducing pipeline inventory: kanban, visual car, inventory reduction through reducing lot sizes, point of sales data.

UNIT III LEAN SUPPLY CHAIN DESIGN 9

Principles, lean layouts, lean production schedules, lean service, traditional physical control of inventories, traditional relationships packaging, preparing an item for shipment, overall warehouse setup and item locations. Contractor management: Selection of contractors, induction, onsite management, risk management, lean logistics: product availability and its effect on logistics, collaboration: visibility and reliability, the impact of globalization, enterprise resource planning, leveraging enterprise resource planning in the supply chain, sales and operations planning, lean supply chain tools for the perfect order

UNIT IV LEAN SUPPLY CHAIN EXECUTION 9

E-Commerce, QR, ECR, and CPFR, collaborative planning, forecasting, replenishment, vendor-managed inventory, other potential areas for collaboration, future opportunities, logistics of a global supply chain, value stream mapping to identify waste, areas to reduce waste policies and procedures, relevant lean supply chain and logistics metrics, balanced scorecard, display and control metrics, barriers to supply chain integration, trends in the lean supply chain, data analytics, supply chain analytics and lean, potential obstacles to lean thinking in the supply chain.

UNIT V CASE STUDIES 9

Reverse logistics, warehouse management using lean concept, lean supply chain management of an automobile component manufacturing industry, introducing lean concept in E-procurement.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Sunil Chopra, Peter Meindl and Kalra, Supply Chain Management, Strategy, Planning, and Operation, Pearson Education, 2010.

2 Paul Myerson "Lean Supply Chain and Logistics Management", McGraw-Hill Education, 2012.

REFERENCE

1 Robert Jacobs F,Richard B Chase "Operations and Supply Chain Management" McGraw- Hill Irwin, 2012.

2 Martin Christopher, "Logistics and Supply Chain Management, Pearson publications, 2011.

3 Bill Kerber, Brian J Dreckshage, "Lean Supply Chain Management Essentials: A Framework for Materials Managers", CRC Press, 2011

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	The student would understand the framework and scope of supply chain networks and functions	Understand
CO2	The student would understand the framework and scope of inventory management	Understand
CO3	The student would able to design a supply chain models using different tools	Analyze
CO4	The student would able to execute the designed models	Apply
CO5	The student would able to design and execute for the case studies	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	1	-	2	1
CO2	3	2	-	-	-	-	-	-	-	-	1	-	2	1
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	1
CO4	3	2	2	-	-	-	-	-	-	-	1	-	2	1
CO5	3	3	2	-	-	-	-	-	-	-	1	-	2	1
CO	3	2	2	-	-	-	-	-	-	-	1	-	2	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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U19MEP41	POWER PLANT ENGINEERING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.
- Understand the layouts of various power plants and efficiency calculations.
- Understand the Non - conventional power plants and their needs.

UNIT I STEAM POWER PLANTS 9

The general layout of the steam power plant-critical and supercritical boilers, Fluidized bed boilers, boilers mountings and accessories-Different systems such as coal handling system, pulverizers, and coal burners-combustion system, draft, ash handling system, -Turbine auxiliary systems such as governing, flange heating and gland leakage-Operation and maintenance of steam power plant-heat balance and efficiency-Site selection of a steam power plant.

UNIT II DIESEL AND GAS TURBINE POWER PLANTS 9

General Layout-Components of Diesel Power Plant-Performance of diesel power plant-fuel system, lubrication system, air intake, and admission system, supercharging system, exhaust system-diesel plant operation, and efficiency-heat balance, Site selection. -Comparative study of diesel power plant with the steam power plant. Elements of gas turbine power plants-Gas turbine fuels, cogeneration, -operation and maintenance-Combined cycle power plants-Site selection.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering-Layout and subsystems of Nuclear Power Plants- 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. Nuclear waste disposal, Site selection of nuclear power plants-Offshore nuclear power plant.

UNIT IV HYDROELECTRIC AND NON CONVENTIONAL POWER PLANTS 9

Hydroelectric station Hydrology-Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, runoff size of plant and choice of units, operation, and maintenance, hydro systems, interconnected systems.Non-Conventional Power Plants Introduction to non-conventional power plants (wind, geothermal, tidal,Biogas,fuel cell,MHD)

UNIT V ELECTRICAL SYSTEM, INSTRUMENTATION AND ECONOMICS 9

Generators, transformers and their cooling-Power Plant Instrumentation-Purpose, classification, selection and application, DCS, recorders and their use,listing of various control rooms-Economics of power plants-Actual load curves-Cost of electric energy-Types of Tariffs-Load distribution- Comparison of economics of various power plants.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

2 R.K.Hegde "Power Plant Engineering", Pearson Education India, 2015.

REFERENCE

1 El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.

2 Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 2012.

3 Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2012.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Discuss various components of the steam power plant and the factors influencing the site selection for the plant.	Understand
CO2	Describe the working of various components of the diesel power plant and gas turbine power plant.	Understand
CO3	Explain the components, principles, and working of the nuclear power plant and the factors influencing the site selection for the plant.	Understand
CO4	Illustrate the working of a hydroelectric and nonconventional power plant and its components.	Understand
CO5	Describe the electrical, instrumentation & economics of various power plants.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	3	-	-	-	-	-	1	-
CO2	3	-	-	-	-	2	3	-	-	-	-	-	1	-
CO3	3	-	-	-	-	2	3	-	-	-	-	-	1	-
CO4	3	-	-	-	-	2	3	-	-	-	-	-	1	-
CO5	3	-	-	-	-	2	3	-	-	-	-	-	1	-
CO	3	-	-	-	-	2	3	-	-	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

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U19MEP42	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To present a problem oriented in depth knowledge of Artificial Intelligence and Robotics.
- To address the underlying concepts, methods and application of different Artificial Intelligence and Robotics.
- To understand machine learning concepts such as fuzzy logic, generic algorithms, neural network.

UNIT I SCOPE OF AI 9

Games theorem, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction.

UNIT II PROBLEM SOLVING 9

State space search; Production systems, search space control: depth first, breadth-first search, heuristic search - hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis.

UNIT III KNOWLEDGE REPRESENTATION 9

Predicate Logic: unification, modus pones, resolution, dependency directed backtracking. Rule based Systems: forward reasoning, conflict resolution, backward reasoning, use of no backtracks. Structured Knowledge Representation: semantic net slots, exceptions and default frames, conceptual dependency, scripts.

UNIT IV HANDLING UNCERTAINTY AND LEARNING 9

Non-monotonic reasoning, probabilistic reasoning, use of certainty factors, fuzzy logic, Concept of learning, learning automation, genetic algorithm, learning by inductions, neural network.

UNIT V ROBOTICS AND AI 9

Robot Classification, Robot Specification, notation Direct and Inverse Kinematics: Coordinates, Frames, Rotations, Homogeneous Coordinates.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Robin R Murphy, Introduction to AI Robotics PHI Publication, 2000

2 Saeed B Niku, "Introduction to Robotics Analysis, Systems, Applications", Pearson Education (Singapore) Pte. Ltd., 2002

REFERENCE

1 R. J. Schalkoff, "Artificial Intelligence - an Engineering Approach", McGraw Hill Int. Ed., Singapore, 1992.

2 Deb S R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd., 2012.

3 E. Rich and K. Knight, "Artificial intelligence", MH, 2nd ed., 1992.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	To discuss the importance of AI in the field of robotics	Remember
CO2	To demonstrate the approaches regarding the problem-solving concepts related to AI	Understand
CO3	To explain the logics and rules that governs knowledge representation	Understand
CO4	To demonstrate the algorithms related to the entropic nature on reasoning	Understand
CO5	To illustrate the extent of influence of AI in the most fundamental concepts of Robotics	Remember

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	3	-	-	-	2	-	-	-	3	-
CO2	3	2	-	-	3	-	-	-	2	-	-	-	3	-
CO3	3	-	2	-	3	-	-	-	2	-	-	-	3	-
CO4	3	-	2	-	3	-	-	-	2	-	-	-	3	-
CO5	3	-	2	-	3	-	-	-	2	-	-	-	3	-
CO	3	2	1	-	3	-	-	-	2	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP43	VEHICLE BODY ENGINEERING	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Have a sound knowledge for the design of the vehicles body to give maximum comfort for the passengers
- Exposed to the methods of streamlining the vehicles body to minimize drag
- To have an insight about aerodynamic effects

UNIT I CAR BODY DETAILS 9

Types: saloon, convertibles, limousine, estate car, racing and sports car. Visibility: regulations, driver's visibility, tests for visibility, methods of improving visibility and space in cars. Safety: safety design, safety equipment for cars. Car body construction; design criteria, prototype making, initial tests, crash tests on full scale model, Dummies and Instrumentation

UNIT II VEHICLE AERODYNAMICS 9

Objectives. Vehicle drag and types; various types of forces and moments, effects of forces and moments, side wind effects on forces and moments, Various body optimization techniques for minimum drag, wind tunnel testing: flow visualization techniques, scale model testing, component balance to measure forces and moments.

UNIT III BUS BODY DETAILS 9

Types: mini bus, single decker, double-decker, two level and articulated bus. Bus body layout; floor height, engine location, entrance and exit location, seating dimensions. Constructional details: frame construction, double skin construction, types of metal sections used, Regulations, Conventional and integral type construction.

UNIT IV COMMERCIAL VEHICLE DETAILS 9

Types of body; flat platform, drop side, fixed side, tipper body, tanker body, Light commercial vehicle body types. Dimensions of driver's seat relation to controls. Drivers cab design.

UNIT V BODY MATERIALS, TRIM AND MECHANISM 9

Steel sheet, timber, plastic, GRP, properties of materials; Corrosion, anti-corrosion methods. Selection of paint and painting process. Body trim items. Body mechanisms.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 J.Powloski - "Vehicle Body Engineering" - Business Books Ltd, London -1989

2 Giles.J.C. - "Body construction and design" - Liiffe Books Butterworth & Co. - 1971.

REFERENCE

1 John Fenton - "Vehicle Body layout and analysis" - Mechanical Engg. Publication Ltd., London – 1982.

2 Braithwaite.J.B. - "Vehicle Body building and drawing" - Heinemann Educational Books Ltd., London – 1977.

3 Sri. P.L.N. PRAKASA RAO PATNAIK, Automobile Chassis and Body Engineering,

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the various profiles on the car body	Understand
CO2	Understand the aerodynamic effects faced by the vehicles	Understand
CO3	Explain the various profiles on the bus body	Understand
CO4	Explain the types of body needed for commercial vehicles	Understand
CO5	Understand the mechanisms used for body building	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	1	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	1	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	1	-	-	-	-	-	-	-	2	-
CO	3	2	-	-	1	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP44	SMALL BUSINESS MANAGEMENT	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Impart knowledge on the key aspects of small business management.
- Highlight the strategies to be adopted to run a small business.
- Familiarize on the financial aspects of a small business.

UNIT I INTRODUCTION AND STRATEGIC MANAGEMENT 9

Evolution and development of Small Business, Definition and concept of Small Business, Importance of Small Business. Views of leading thinkers on strategy, Levels of strategy - corporate, business and functional, Environmental analysis -PEST framework, Porter's five forces model, Internal environment analysis - SWOT framework, Pointers for prospects in Small Business Management, Competitive strategies - Principles of competitive advantage, Value chain analysis.

UNIT II MANAGERIAL ASPECTS 9

Managerial traits, Nature of managerial qualities, Pros and cons of managerial qualities, Gap analysis, Bridging the gaps, Honing the skills, Tools and techniques of enhancing managerial skills, long range perspective and best models for start-up.

UNIT III MARKETING ASPECTS 9

Approaches to marketing, Core concept of marketing, Assessment of needs & wants of customers, Understand buyer behaviour, Competitor analysis, Marketing strategy, Market segment analysis, Marketing opportunities, Pricing strategies, Marketing channels, advertising & sales promotion.

UNIT IV FINANCIAL AND COST ASPECTS 9

Sources of funding, Cost and benefits of various funding options, Assessment of investment strategies, Profitability planning, Classification of assets & liabilities, Working capital management – cash, inventory, receivables management , Financial statement - balance sheet, profit & loss A/c, funds flow & cash flow statements, Cost management: Elements of cost, Classification of costs - Fixed & variable, product & period, functional, Apportionment & allocation of costs, Product costing - absorption costing, marginal costing, standard costing, Activity based costing, target costing.

UNIT V TECHNICAL ASPECTS 9

Productivity improvement, Material and machines, Alternate modes of operation, Importance of selection process and technologies, Balancing the resources to optimise costs, Maintaining quality for customer's acceptability.

TOTAL HOURS 45

TEXT BOOKS

1 Poornima M. Charantimath, "Entrepreneurship Development and Small Business Enterprise", Pearson Education India, 2005.
2 Ritwik Haldar, "A Textbook of Business Management", Himalaya Publishing House, 2011.

REFERENCE

1 Liraz Meir, "Small Business Management: Essential Ingredients for Success",Liraz Publishing, 2013.
2 Johan Wilhelm Strydom, "Principles of Business Management", Oxford University Press Southern Africa, 2018.
3 P. C. Tulsian, Vishal Pandey, "Business Organisation & Management", Pearson Education Limited, 2009.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the strategic management aspects of a small business	Understand
CO2	Understand the managerial skills for small business enterprise	Understand
CO3	Develop the marketing strategies for a small business enterprise	Apply
CO4	Estimate the various costs in a small business enterprise	Apply
CO5	Discuss the technical aspects involved in a small business enterprise	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO	3	3	3	-	-	-	-	-	-	-	-	-	3	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP45	ENTREPRENEURSHIP AND BUSINESS MODELS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Equip the students with entrepreneurial skills and business mindsets.
- Discuss and deliver about the various business models of top MNCs.
- Understand the basic unit economics, cost and profitability.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Meaning and concept of entrepreneurship, the history of entrepreneurship development, role of entrepreneurship in economic development, Myths about entrepreneurs, agencies in entrepreneurship management and future of entrepreneurship types of entrepreneurs; Why to become entrepreneur, the skills/ traits required to be an entrepreneur, Creative and Design Thinking, the entrepreneurial decision process, skill gap analysis.

UNIT II E-CELL AND BUSINESS ORGANIZATION 9

Meaning and concept of E-cells, advantages to join E-cell, significance of E-cell, various activities conducted by E-cell. Introduction to various forms of business organization (sole proprietorship, partnership, corporations, Limited Liability company), mission, vision and strategy formulation.

UNIT III EXPLORING BUSINESS OPPORTUNITY 9

Natural born entrepreneur, the reluctant entrepreneur, the hidden traits; Sources of business ideas, how to find & assess ideas? Where to find data for ideation? What is a good problem? Opportunity recognition; Design thinking for finding solutions, prototyping, idea evaluation, entrepreneurial Outlook, value proposition design, customer insight, ideas development, capstone project presentation.

UNIT IV INTRODUCTION TO BUSINESS MODEL/ PLAN 9

Finding your team, art of team formation, teamwork planning, chief mentor/ founder & Co founders, team formation, and delegation of work; Meaning and significance of a business plan, components of a business plan, and feasibility study, Iterating the MVP, Digital Presence for Ventures, Clarifying the value proposition, Guidelines for writing BP, pre- requisites from the perspective of investor.

UNIT V BUSINESS MODEL AND MARKET FIT 9

The importance and diversity of business model, business model emergence, fatal flaws of business models, effective business model, core strategy, strategic resources, partnership network, customer interface; Understand basics of unit economics, cost and profitability, Refining the product/service; Evaluate the efficiency of capturing customers, Other Stakeholder Validation, Customer Development and Experience. Case Studies of business models.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Ramachandran , "Entrepreneurship Development", McGraw Hill, 2007.

2 Fayolle. A," Entrepreneurship and new value creation", Cambridge, Cambridge University Press, 2007.

REFERENCE

1 Katz , "Entrepreneurship Small Business", McGraw Hill, 2009.

2 Lowe R & S Marriott Enterprise: Entrepreneurship & Innovation. Burlington, Butterworth Heinemann, 2006.

3 Hougaard S. The business idea. Berlin, Springer, 2005.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Develop awareness about entrepreneurship and characteristics required to be a successful entrepreneur.	Understand
CO2	Attain an entrepreneurial mind-set by learning key skills such as design, personal selling, and Understand the various types of business organizations.	Understand
CO3	Discover and Identify gaps in terms of qualities and traits along with a personal action plan to be an entrepreneur.	Apply
CO4	Acquire the skills and knowledge related to the various phases in the venture creation process such as creating a business model and building a prototype.	Understand
CO5	Transform their business idea into a Business Model and compare it with the available standard models.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	2	-	2	1	2	3	-	-
CO2	3	-	-	-	-	3	2	-	2	1	2	3	-	-
CO3	3	-	-	-	-	3	2	-	2	1	2	3	-	-
CO4	3	-	-	-	-	3	2	-	2	1	2	3	-	-
CO5	3	-	-	-	-	3	2	-	2	1	2	3	-	-
CO	3	-	-	-	-	3	2	-	2	1	2	3	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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U19MEP46	ADDITIVE MANUFACTURING	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To know the principle, methods, possibilities and limitations as well as environmental effects of Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing technologies.
- To understand the 3D printing processes and its applications.

UNIT I INTRODUCTION 9

Overview – Need - Development of Additive Manufacturing Technology -Principle – AM Process Chain- Classification –Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications- Benefits –Case studies.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

Data processing - CAD model preparation – Part orientation and support structure generation – Model slicing –Tool path generation- Design for Additive Manufacturing: Concepts and objectives- AM unique capabilities – DFAM for part quality improvement- Customized design and fabrication for medical application

UNIT III PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA - Photo curable materials – Process - Advantages and Applications. Powder Bed Fusion: SLS - Process description – powder fusion mechanism – Process Parameters– Typical Materials and Application. Electron Beam Melting.

UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction – Basic Principle – Materials – Applications and Limitations – Bio Extrusion. Sheet Lamination Process: LOM- Gluing or Adhesive bonding – Thermal bonding

UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Three-Dimensional Printing (3DP) - Droplet formation technologies – Continuous mode – Drop on Demand mode – 3DP Advantages – Bioplotter - Beam Deposition Process: LENS- Process description – Material delivery – Process parameters – Materials – Benefits – Applications.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.

2 Ian Gibson, David W.Rosen, Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer , 2010

REFERENCE

1 Andreas Gebhardt "Understand Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing" Hanser Gardner Publication 2011

2 Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006

3 Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Gain knowledge about overview of additive manufacturing along with integration of product development.	Remember
CO2	Explain the various designing techniques involved in additive manufacturing	Understand
CO3	Familiarize with the manufacturing method of photopolymerization and powder bed fusion processes	Understand
CO4	Familiarize with the manufacturing method of extrusion based and sheet lamination processes	Understand
CO5	Familiarize with the manufacturing method of printing processes and beam deposition processes	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	1	-	-	-	-	-	-	-	3	-
CO2	2	2	3	1	2	-	-	-	-	-	-	-	3	-
CO3	2	2	3	1	2	-	-	-	-	-	-	-	3	-
CO4	2	2	3	1	2	-	-	-	-	-	-	-	3	-
CO5	2	2	3	1	2	-	-	-	-	-	-	-	3	-
CO	2	2	3	1	1	-	-	-	-	-	-	-	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

KPRIET
Learn Beyond

U19MEP47	LEAN SIX SIGMA	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To gain insights about the importance of lean manufacturing and six sigma practices
- To apply Lean manufacturing and six sigma concepts for eliminating non-value-added activities in the various processes.
- To resolve the various modern industrial world problem using lean six sigma concepts

UNIT I INTRODUCTION TO LEAN MANUFACTURING AND SIX SIGMA 9

Definition of quality – six sigma definition and introduction -lean manufacturing and six sigma- TQM and Six sigma -six sigma and process tolerance – Six sigma and cultural changes –six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ)

UNIT II TOOLS AND TECHNIQUES 9

Tools Definition - SIPOC diagram, Flow diagram, CTQ Tree, Project Charter - Statistical Process Control (SPC) and SPC Quality tools - Process Capability - Lean tools - SWOT, PESTLE, Five Whys, interrelationship diagram, OEE, SMED, 5S, mistake proofing, Value stream Mapping, PDCA cycle, Gantt chart, Activity network diagram, Radar chart.

UNIT III SIX SIGMA METHODOLOGIES 9

Design for Six Sigma (DFSS), Design for Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder.

UNIT IV SIX SIGMA IMPLEMENTATION AND CHALLENGES 9

Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics

UNIT V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS 9

Evaluation strategy – the economics of six sigma quality, Return on Six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 Roderick A. Munro and Govindarajan Ramu, "The Certified Six Sigma Green Belt Handbook". ASQ, 2015.

2 Warren Brussee, "Statistics for Six Sigma Made Easy! Revised and Expanded" Mcgraw Hill, Second Edition. 2012.

REFERENCE

1 Michael L.George, David Rownalds, Bill Kastle, "What is Lean Six Sigma", McGraw – Hill 2003

2 James P. Womack, Daniel T.Jones, "Lean Thinking", Free Press Business, 2003

3 Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, "Managing Six Sigma:A Practical Guide to Understand, Assessing, and Implementing the Strategy That Yields Bottom-Line Success", John Wiley & Sons, 2000

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	To understand the history and importance of Lean and six sigma concepts	Understand
CO2	To apply various lean six sigma tools and techniques to solve the industrial problems	Apply
CO3	To analyze the failures and problems in various process using Failure Modes and Effects Analysis (FMEA) technique	Analyze
CO4	To analyze the various cultural and implementation challenges while implementing Six sigma practices in the industry	Analyze
CO5	To apply tools and techniques of lean six sigma for continuous improvement in the industries	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	1	-	3	-	-	2	-	3
CO2	2	2	2	-	3	-	1	-	3	-	-	2	-	3
CO3	2	2	2	-	3	-	1	-	3	-	-	2	-	3
CO4	2	2	2	-	3	-	1	-	3	-	-	2	-	3
CO5	2	2	2	-	3	-	1	-	3	-	-	2	-	3
CO	2	2	2	-	3	-	1	-	3	-	-	2	-	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP48	RENEWABLE ENERGY RESOURCES & SYSTEMS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Understand of renewable energy sources.
- Knowledge of the working principle of various energy systems.
- Equip the students working with projects and to take up research work in connected areas.

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 9

Introduction, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario. ENERGY STORAGE: Sizing and Necessity of Energy Storage.

UNIT II SOLAR THERMAL AND ELECTRIC SYSTEMS 9

Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Solar-Electrical Power Generation, general Solar Photovoltaic (SVP) system, Different configurations, SPV system components and their characteristics, Stand- Alone and Grid Connected SPV systems, other Miscellaneous Applications of Solar Energy.

UNIT III ENERGY FROM OCEAN 9

Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitations of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitations of OTEC.

UNIT IV WIND ENERGY SYSTEMS 9

Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Advantages and Disadvantages of WECS.

UNIT V ENERGY FROM BIOMASS AND INTEGRATED ENERGY SYSTEMS 9

Biomass Energy: Introduction, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, types of biogas plants – KVIC and Janata model. Integrated Energy Systems: Introduction, Integrated Smart infrastructure, Integrated Energy system Modeling, Various Integrated energy schemes, their cost benefit analysis.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS

1 D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.

2 Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition, 2013

REFERENCE

1 Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning, 2011.

2 Khan B. H., Non-Conventional Energy Resources, Tata McGraw Hill, 2009.

3 Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education, 2015.

COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Acquire basic knowledge about renewable Energy Sources and technologies.	Understand
CO2	Explain various solar thermal and electric systems and their applications.	Understand
CO3	Understand the various modes of energy extraction from ocean and compare based on various criterions	Understand
CO4	Describe various wind energy systems and their applications in electrical power generation.	Understand
CO5	Recognize the need of biogas energy and concept of integrated energy systems in efficient electricity generation	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	3	-	-	-	-	-	2	-
CO2	3	-	-	-	-	2	3	-	-	-	-	-	2	-
CO3	3	-	-	-	-	2	3	-	-	-	-	-	2	-
CO4	3	-	-	-	-	2	3	-	-	-	-	-	2	-
CO5	3	-	-	-	-	2	3	-	-	-	-	-	2	-
CO	3	-	-	-	-	2	3	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

		Category: PE			
		L	T	P	C
U19MEP49	MACHINE VISION	3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To learn basic Image processing operations and concepts.
- To learn multi resolution analysis.
- To understand Real time image and video processing.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction - Steps in image processing systems - Image acquisition - Sampling and Quantization -Pixel relationships - Color fundamentals and models, File formats, Image operations – Arithmetic and Morphological.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level Transformations - Histogram processing - Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain - DFT, FFT, DCT - Smoothing and sharpening filters – Homomorphic Filtering.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

Detection of Discontinuities - Edge operators - Edge linking and Boundary Detection - Thresholding - Region based segmentation - Morphological Watersheds - Motion Segmentation.

UNIT IV OBJECT RECOGNITION 9

Introduction – Pattern and Pattern Class – Selection Measurement Parameters – Approaches – Types of Classification – Bayes, Template matching, Non parametric density estimation, Neural, Network approach – Applications.

UNIT V VIDEO PROCESSING 9

Real time image and Video processing – parallelism – Algorithm simplification strategy – Hardware platforms – DSP, FPGA, GPU, General purpose processors.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson, 2007.

2 Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Eduction, 2009.

REFERENCE

1 Nasser Kehtarnavaz, Mark Noel Gamadia, "Real-time image and video processing: from research to reality", Morgan Claypool publishers, 2006.

2 S. Jayarman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw Hill, 2010.

3 Roya Hassankhani ,Potato Sorting in Machine Vision System

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able

COs	Statements	K-Level
CO1	To Understand the Fundamentals of Image Processing	Understand
CO2	To Understand the Spatial Domain and Frequency Domain in Image Enhancement	Understand
CO3	To Understand the Edge Detection and Segmentation	Understand
CO4	To Understand the Various Approaches of Object Recognition	Understand
CO5	To Understand the Algorithms and Hardware Platforms in Video Processing	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	3	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	3	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	3	-	-	-	-	-	-	-	-	2
CO5	3	-	-	-	3	-	-	-	-	-	-	-	-	2
CO	3	-	-	-	3	-	-	-	-	-	-	-	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP50	ELECTRIC AND HYBRID VEHICLES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Introduce the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles.
- Learn various aspects of hybrid and electric drive train such as configuration, types of electric machines and energy storage devices.
- Analyze various electric drives suitable for hybrid electrical vehicles.

UNIT I ELECTRIC VEHICLES 9

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design

UNIT II BATTERY TECHNOLOGY 9

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries

UNIT III ELECTRICAL POWER TRAINS 9

Motor and Engine rating, Requirements, DC machines, three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV ELECTRIC VEHICLE DRIVETRAIN 5

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V HYBRID ELECTRIC VEHICLES 9

Types – series, parallel and series, parallel configuration – Design – Drivetrain, sizing of components. Case Studies: Design of a Hybrid Electric Vehicle (HEV) and Battery Electric Vehicle (BEV).

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.

2 James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003

REFERENCE

1 Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.

2 Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000.

3 Mi, M. Abul Masrur, Hybrid Electric Vehicles: Principles and Applications with Practical , Second Edition

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand working of different configurations of electric vehicles,	Understand
CO2	Comprehend the properties of batteries and its types	Understand
CO3	Design the electric vehicle drive systems.	Apply
CO4	Develop a logical progression for hybrid electric vehicle systems with up-to-date information.	Apply
CO5	Assess various aspects of hybrid and electric drivetrain that can be used.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO	3	2	1	-	-	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE

U19MEP51	BUSINESS IDEA GENERATION AND SUPPORT INSTITUTIONS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- Introduce the concept of idea generation.
- Equip the learners with the details about the support extended to entrepreneurs.
- Developing personal creativity and entrepreneurial initiative.

UNIT I CREATING AND STARTING THE VENTURE 9

Sources of new Ideas, Methods of generating ideas, creating problem solving, product planning and development process.

UNIT II THE BUSINESS PLAN 9

Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, Using and implementing business plans. Marketing plan, financial plan and the organizational plan, Launching formalities.

UNIT III NEW VENTURE EXPANSION STRATEGIES AND ISSUES 9

Features and evaluation of joint ventures, acquisitions, merges, franchising. Public issues, rights issues, bonus issues and stock splits, case studies.

UNIT IV INSTITUTIONAL SUPPORT TO ENTREPRENEURSHIP 9

Role of Directorate of Industries, District Industries, Centers (DICs), Industrial Development Corporation (IDC), State Financial corporation (SFCs), Commercial banks Small Scale Industries Development Corporations (SSIDCs), Khadi and village Industries Commission (KVIC), National Small Industries Corporation (NSIC), Small Industries Development Bank of India (SIDBI).

UNIT V BUSINESS INCUBATORS 9

Introduction to business incubators and its types, role of Business incubators in Entrepreneurship development - Business incubation policies - support to Business incubators in our country. Case study.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS	
1	Poornima M. Charantimath, "Entrepreneurship Development and Small Business Enterprises", Pearson Education, 2011
2	Peter Hollins, "Rapid Idea Generation: How to Create, Innovate, Conceive, and invent from Scratch", 2nd edition, 2020

REFERENCE	
1	Khanka S.S, "Entrepreneurial Development", S Chand publications, 2006.
2	Ramachandran, "Entrepreneurship Development", Tata Mc Graw Hill Publications, 2008.
3	Fayolle. A," Entrepreneurship and new value creation", Cambridge, Cambridge University Press, 2007.

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain the process of idea generation and venture creation	Understand
CO2	Develop a complete business plan and launching formalities	Apply
CO3	Elaborate on methods to expand a new venture.	Understand
CO4	Enumerate the support measures that has been extended by government to entrepreneurs	Understand
CO5	Explain about the operational procedures of Business incubators	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	-	-	-	-	-
CO2	-	-	-	-	-	-	-	2	2	3	3	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	2	-	-	-
CO4	-	-	-	-	-	3	-	2	2	-	-	-	-	-
CO5	-	-	-	-	-	2	-	2	2	-	-	-	-	-
CO	-	-	-	-	-	3	-	2	2	3	3	-	-	-
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE

U19MEP52	INTELLECTUAL PROPERTY RIGHTS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVE

- To give an idea about IPR and know who to register various forms of IP's
- To understand various agreements and legislation involved in IPR's and provide insight about the digital products and law
- To understand the enforcement involved in IPR's

UNIT I INTRODUCTION TO IPR 10

Introduction to IPRs, Basic concepts and need for Intellectual Property, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations, Important examples of IP.

UNIT II REGISTRATION OF IPRs 9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration.

UNIT III PATENT SEARCH 9

Fundamental search, keyword refinement, keyword search, search with IPC, Various databases to search (WIPO, INPASS, USPTO), Paid and free database, Landscape Analysis.

UNIT IV PATENT DRAFTING 9

Contents of complete specification, Draft of patent – Title, Field, Prior art, Background, Summary, Brief description of drawing, detailed description and claims.

UNIT V PATENT FILING 8

Various forms to file, Filling forms – 1,2,3,5,9 and 18 – Case study.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS

1 V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012

2 S. V. Satakar, —Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCE

1 Deborah E. Bouchoux, —Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.

2 Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.

3 Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

STANDARDS

1 Patent Act 1970 – Manual

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COURSE OUTCOMES (CO)

Upon completion of the course, the student will be able to

COs	Statement	K-Level
CO1	Comprehend various forms of IPR's	Understand
CO2	Recognize registration of various forms of IPR's in India and Aboard	Understand
CO3	Learn how to carry out the patent search in database	Understand
CO4	Understand to draft the patent	Understand
CO5	Know the filing procedures.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	3	1	-	2	3		-
CO2	-	-	-	-	-	-	-	3	1	-	2	3		-
CO3	-	-	-	-	-	-	-	3	1	-	2	3		-
CO4	-	-	-	-	-	-	-	3	1	-	2	3		-
CO5	-	-	-	-	-	-	-	3	1	-	2	3		-
CO	-	-	-	-	-	-	-	3	1	-	2	3	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Learn Beyond

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