SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.
MECHANICAL ENGINEERING

ACADEMIC REGULATIONS 2019
(R-2019)

CURRICULUM AND SYLLABI
Volume - III

COLLEGE VISION AND MISSION

VISION

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

MISSION

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation:

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

VISION

The Mechanical Engineering department strives to be recognized as an excellent academic and research center for creating outstanding Engineers, Entrepreneurs and Leaders

MISSION

M1: Professional Skills:

To provide quality education to enhance students inter-personal and intra-personal skills

M2: State-of-art facilities:

To render excellent infrastructure facilities and laboratories to excel as skilled professionals

M3: Research Exposure:

To Strengthen Research and Development within the department through industrial associations

M4: Employability:

To put enthusiastic exertions to enhance employability and entrepreneurship skills of students

M5: Human Values:

To empower students with professional ethics and human values to serve the society

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PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

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

PO2: Problem analysis:

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

PO3: Design/development of solutions:

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

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

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

PO6: The engineer and society:

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

PO7: Environment and sustainability:

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

PO8: Ethics:

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

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

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

PO11: Project management and finance:

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

PO12: Life-long learning:

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

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical knowledge

To foster our young graduates with cogent technical knowledge so as to make them employable

PEO2: Real-Time Applications

To apply the acquired knowledge in the field of Mathematics, Science and Engineering in developing real-time projects

PEO 3: Design Ability

To design a system, component or process to meet the desired needs within realistic constraints such as manufacturing, economy, environmental sustainability, social, health and safety

PEO 4: Ethics

To prepare the students to become entrepreneurs with professional attitude in the broader ethical perspective

PEO 5: Life - Long Learning

To craft curiosity among students for life-long learning through self-study

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Solving real time problems

To develop capability to identify, analyze and solve engineering problems in concern to mechanical engineering along with associated engineering streams.

PSO 2: Pursue Professional career

To bestow quality learning environment to pursue professional career in mechanical engineering with integrated knowledge

PSO 3: Concentrating on skill development

To enflame the student's technical capabilities in engineering design process, intra and inter personnel, linguistic and higher level professional skills required in engineering.

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STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Science (HS)	09
2	Basic Sciences(BS)	40
3	Engineering Sciences (ES)	30
4	Professional Core (PC)	65
5	Professional Electives (PE)	18
6	Open Electives (OE)	09
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
	Total	**183**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	AICTE Suggested Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	4	-	-	-	3	1	1	9
2	Basic Sciences (BS)	14	16	3	3	4	-	-	-	40
3	Engineering Sciences (ES)	16	10	4	-	-	-	-	-	30
4	Professional Core (PC)	-	-	14	12	12	15	9	3	65
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	9
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	02
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
	Total	**30**	**30**	**21**	**21**	**22**	**21**	**20**	**18**	**183**

** EEC and MC credits are not included for CGPA calculation*

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SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T101	Mathematics– I	BS	3	1	0	4	25	75	100
2	T102	Physics	BS	4	0	0	4	25	75	100
3	T103	Chemistry	BS	4	0	0	4	25	75	100
4	T104	Basic Electrical and Electronics Engineering	ES	3	1	0	4	25	75	100
5	T105	Engineering Thermodynamics	ES	3	1	0	4	25	75	100
6	T106	Computer Programming	ES	3	1	0	4	25	75	100
Practical										
7	P101	Computer Programming Lab	ES	0	0	3	2	50	50	100
8	P102	Engineering Graphics	ES	2	0	3	2	50	50	100
9	P103	Basic Electrical and Electronics Lab	ES	0	0	3	2	50	50	100
							30	300	600	900

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T107	Mathematics–II	BS	3	1	0	4	25	75	100
2	T108	Material Science	BS	4	0	0	4	25	75	100
3	T109	Environmental Science	BS	4	0	0	4	25	75	100
4	T110	Basic Civil and Mechanical Engineering	ES	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	T112	Communicative English	HS	4	0	0	4	25	75	100
Practical										
7	P104	Physics Laboratory	BS	0	0	3	2	50	50	100
8	P105	Chemistry Laboratory	BS	0	0	3	2	50	50	100
9	P106	Workshop Practice	ES	0	0	3	2	50	50	100
Mandatory Course										
10	P107	NSS/NCC*	MC	0	0	0	-	-	-	-
							30	300	600	900

** To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation*

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SEMESTER – III

Sl. No.	Course Code	Course Title	Category	Periods L	Periods T	Periods P	Credits	Max. Marks CAM	Max. Marks ESM	Max. Marks Total
Theory										
1	U19MET31	Complex Analysis and Applications of Partial Differential Equations	BS	2	2	0	3	25	75	100
2	U19MET32	Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
3	U19MET33	Mechanics of Solids	PC	2	2	0	3	25	75	100
4	U19MET34	Applied Thermodynamics	PC	2	2	0	3	25	75	100
5	U19MET35	Fluid Mechanics and Machinery	PC	2	2	0	3	25	75	100
6	U19MET36	Engineering Metallurgy	PC	3	0	0	3	25	75	100
Practical										
7	U19MEP31	Electrical and Electronics Engineering Lab	ES	0	0	2	1	50	50	100
8	U19MEP32	Material Testing and Metallurgy Lab	PC	0	0	2	1	50	50	100
9	U19MEP33	Fluid Mechanics and Machinery Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MEC3X	Certification Course – I **	EEC	0	0	4	-	100	-	100
11	U19MES31	Skill Development Course 1: General Proficiency - I	EEC	0	0	2	-	100	-	100
12	U19MES32	Skill Development Course 2 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19MEM31	Physical Education	MC	0	0	2	-	100	-	100
							21	700	600	1300

SEMESTER – IV

Sl. No.	Course Code	Course Title	Category	Periods L	Periods T	Periods P	Credits	Max. Marks CAM	Max. Marks ESM	Max. Marks Total
Theory										
1	U19MET41	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U19MET42	Kinematics of Machinery	PC	2	2	0	3	25	75	100
3	U19MET43	Heat and Mass Transfer	PC	2	2	0	3	25	75	100
4	U19MET44	Machining Processes	PC	3	0	0	3	25	75	100
5	U19MEE4X	Professional Elective - I #	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective – I $	OE	3	0	0	3	25	75	100
Practical										
7	U19MEP41	Computer Aided Machine Drawing Lab	PC	0	0	2	1	50	50	100
8	U19MEP42	Heat Transfer Lab	PC	0	0	2	1	50	50	100
9	U19MEP43	Manufacturing Processes Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MEC4X	Certification Course – II **	EEC	0	0	4	-	100	-	100
11	U19MES41	Skill Development Course 3: General Proficiency - II	EEC	0	0	2	-	100	-	100
12	U19MES42	Skill Development Course 4 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19MEM41	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

 # Professional Electives are to be selected from the list given in Annexure I

$ Open electives are to be selected from the list given in Annexure II

**** Certification courses are to be selected from the list given in Annexure III**

*** Skill Development Courses (2 and 4) are to be selected from the list given in Annexure IV**

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SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET51	Numerical Methods and Statistics	BS	2	2	0	3	25	75	100
2	U19MET52	Design of Machine Elements	PC	2	2	0	3	25	75	100
3	U19MET53	Dynamics of Machinery	PC	2	2	0	3	25	75	100
4	U19MET54	Metrology and Measurement	PC	3	0	0	3	25	75	100
5	U19MEE5X	Professional Elective - II [#]	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective – II [$]	OE	3	0	0	3	25	75	100
Practical										
7	U19MEP51	Numerical Methods Lab	BS	0	0	2	1	50	50	100
8	U19MEP52	Metrology and Measurements Lab	PC	0	0	2	1	50	50	100
9	U19MEP53	Dynamics Lab	PC	0	0	2	1	50	50	100
10	U19MEP54	CAD/CAM Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U19MEC5X	Certification Course – III [**]	EEC	0	0	4	-	100	-	100
12	U19MES51	Skill Development Course 5: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
13	U19MES52	Skill Development Course 6: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U19MEM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							22	750	650	1400

SEMESTER – VI										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET61	Thermal Engineering	PC	2	2	0	3	25	75	100
2	U19MET62	Design of Transmission Systems	PC	2	2	0	3	25	75	100
3	U19MET63	Finite Element Analysis	PC	3	0	0	3	25	75	100
4	U19MET64	Advanced Manufacturing Technology	PC	3	0	0	3	25	75	100
5	U19MEE6X	Professional Elective - III [#]	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III [$]	HS	3	0	0	3	25	75	100
Practical										
7	U19MEP61	Thermal Engineering lab	PC	0	0	2	1	50	50	100
8	U19MEP62	Computational Fluid Dynamics Lab	PC	0	0	2	1	50	50	100
9	U19MEP63	Manufacturing Technology Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19MEC6X	Certification Course – IV [**]	EEC	0	0	4	-	100	-	100
11	U19MES61	Skill Development Course 7: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U19MES62	Skill Development Course 8: Technical Seminar	EEC	2	0	0	-	100	-	100
13	U19MES63	Skill Development Course 9: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U19MEM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

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SEMESTER – VII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET71	Production Planning and Cost Estimation	PC	3	0	0	3	25	75	100
2	U19MET72	Industrial Automation and Robotics	PC	3	0	0	3	25	75	100
3	U19MEE7X	Professional Elective – IV [#]	PE	3	0	0	3	25	75	100
4	U19XXO7X	Open Elective – IV [$]	OE	3	0	0	3	25	75	100
Practical										
5	U19MEP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19MEP72	Automation and Robotics lab	PC	0	0	2	1	50	50	100
7	U19MEP73	Product Development Lab	PC	0	0	2	1	50	50	100
8	U19MEP74	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U19MEW71	Project Phase - I	PW	0	0	4	2	50	50	100
10	U19MEW72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							20	500	500	1000

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19MET81	Power Plant Engineering	PC	3	0	0	3	25	75	100
2	U19MEE8X	Professional Elective – V [#]	PE	3	0	0	3	25	75	100
3	U19MEE8X	Professional Elective – VI [#]	PE	3	0	0	3	25	75	100
Practical										
4	U19MEP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U19MEW81	Project Phase - II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U19MES81	Skill Development Course 10: NPTEL / MOOC -II	EEC	0	0	0	-	100	-	100
							18	315	285	600

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Annexure - I

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE41	Gas Dynamics and Jet propulsion
2	U19MEE42	Computer Aided Design
3	U19MEE43	Product design and Development
4	U19MEE44	Industrial Casting Technology
5	U19MEE45	Non-Conventional Energy Sources
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE51	Turbo machinery
2	U19MEE52	Powder Metallurgy and Surface Coating
3	U19MEE53	Green Manufacturing
4	U19MEE54	Fluid Power Automation
5	U19MEE55	IOT and Smart Manufacturing
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE61	Automobile Engineering
2	U19MEE62	Computational Fluid Dynamics
3	U19MEE63	Fuzzy Logic And Neural Networks
4	U19MEE64	Additive Manufacturing
5	U19MEE65	Energy and Climate Change
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE71	Industrial Tribology
2	U19MEE72	Advanced Welding Technology
3	U19MEE73	Artificial Intelligence and Machine Learning
4	U19MEE74	Nano Technology
5	U19MEE75	Modelling and Simulation of Manufacturing Systems
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE80	Lean Manufacturing
2	U19MEE81	Cryogenic Engineering
3	U19MEE82	Autotronics
4	U19MEE83	Optimization Techniques in Engineering Design
5	U19MEE84	Total Quality Management
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19MEE85	Composites Material
2	U19MEE86	Alternative Fuels
3	U19MEE87	Electric and Hybrid Vehicles
4	U19MEE88	Maintenance and Safety Engineering
5	U19MEE89	Non-Destructive Evaluation and Testing

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Annexure - II

OPEN ELECTIVE COURSES

Sl. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U19EEO41	Solar Photovoltaic Fundamentals and Applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics
2	U19EEO42	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE
3	U19ECO41	Engineering Computation with MATLAB	ECE	ICE, EEE, MECH, CIVIL, BME, Mechatronics
4	U19ECO42	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO41	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19CSO42	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19CSO43	Programming in JAVA	CSE	ECE, MECH, Mechatronics
8	U19ITO41	Database System: Design & Development	IT	EEE, ECE, ICE, BME
9	U19ITO42	R programming	IT	EEE, ECE, ICE, BME, MECH, Mechatronics
10	U19ICO41	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL
11	U19ICO42	Control System Engineering	ICE	CSE, IT, MECH
12	U19MEO41	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME
13	U19MEO42	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
14	U19MEO43	Power Plants for Electrical Engineering	MECH	EEE
15	U19CEO41	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics
16	U19CEO42	Building Science and Engineering	CIVIL	EEE, MECH, BME
17	U19BMO41	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
18	U19BMO42	Telemedicine	BME	EEE, ECE, CSE, IT, ICE
19	U19CCO41	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19CCO42	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
Open Elective – II / Open Elective – III				
1	U19HSO51 / U19HSO61	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics**)
2	U19HSO52 / U19HSO62	Intellectual Property and Rights	MBA	
3	U19HSO53 / U19HSO63	Marketing Management and Research	MBA	
4	U19HSO54 / U19HSO64	Project Management for Engineers	MBA	
5	U19HSO55 / U19HSO65	Finance for Engineers	MBA	

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Open Elective – II / Open Elective – III
(Offered in Semester V for **CSE, IT, MECH, Mechatronics**)
(Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME**)

1	U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19EEO54 / U19EEO64	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics
3	U19ECO53 / U19ECO63	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE MECH, BME, Mechatronics
4	U19ECO54 / U19ECO64	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U19CSO54 / U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
6	U19CSO55 / U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
7	U19ITO53 / U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U19ITO54 / U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
9	U19ITO55 / U19ITO65	Data Structures	IT	MECH
10	U19ICO53 / U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
11	U19ICO54 / U19ICO64	Measurement and Instrumentation	ICE	ECE, Mechatronics
12	U19MEO54 / U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
13	U19MEO55 / U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
14	U19CEO53 / U19CEO63	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19CEO54 / U19CEO64	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
16	U19BMO53 / U19BMO63	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
17	U19BMO54 / U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL , Mechatronics
18	U19CCO53 / U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
19	U19CCO54 / U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19ADO51 / U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL
21	U19ADO52 / U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics

Open Elective – IV (Offered in Semester VII)

1	U19EEO75	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U19EEO76	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
3	U19ECO75	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL
4	U19ECO76	Sensors for Industrial Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO76	Artificial Intelligence	CSE	EEE, ICE, CIVIL, MECH

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6	U19CSO77	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19ITO76	Automation Techniques & Tools-DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics
8	U19ITO77	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, BME
9	U19ICO75	Industrial Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics.
10	U19ICO76	Ultrasonic Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U19MEO76	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U19MEO77	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U19CEO75	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U19CEO76	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19MCO71	Building Automation	Mechatronics	MECH, CIVIL
16	U19MCO72	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U19BMO75	Internet of Things for Healthcare	BME	EEE, ECE, ICE
18	U19BMO76	Telehealth Technology	BME	EEE, ECE, ICE
19	U19CCO75	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
20	U19CCO76	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
21	U19ADO73	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
22	U19ADO74	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME

Annexure - III

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No	Course Code	Course Title
1	U19MECX1	Python Programming
2	U19MECX2	AutoCAD for Mechanical
3	U19MECX3	CATIA
4	U19MECX4	CREO
5	U19MECX5	Solid works
6	U19MECX6	Fusion 360
7	U19MECX7	ANSYS
8	U19MECX8	Automation – I
9	U19MECX9	Automation – II

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Annexure - IV

EMPLOYABILITY ENHANCEMENT COURSES – (B). SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U19MES31	Skill Development Course 1: General Proficiency - I
2	U19MES32	Skill Development Course 2*
		1) Two wheeler Troubleshooting
		2) Troubleshooting of CNC Milling machine
		3) Troubleshooting of CNC lathe machine
3	U19MES41	Skill Development Course 3 : General Proficiency - II
4	U19MES42	Skill Development Course 4*
		1) Four wheeler Troubleshooting
		2) Electronic Troubleshooting for Mechanical Engineers
		3) Hardware Networking
5	U19MES51	Skill Development Course 5 : Foreign Language/ IELTS -I
6	U19MES52	Skill Development Course 6 : Presentation Skills using ICT
7	U19MES61	Skill Development Course 7 : Foreign Language/ IELTS - II
8	U19MES62	Skill Development Course 8 : Technical Seminar
9	U19MES63	Skill Development Course 9 : NPTEL / MOOC - I
10	U19MES81	Skill Development Course 10 : NPTEL / MOOC - II

** Any one course to be selected from the list*

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SEMESTER - I

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T101 **MATHEMATICS - I** (Common to all branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To introduce the idea of applying calculus concepts to problems in Engineering.
- To understand the concept of partial differentiation
- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.

Course Outcomes

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

CO1 - Understand the concept of curvature. **(K2)**
CO2 - Solve different types of partial differential equation. **(K3)**
CO3 - Understand the concept of double and triple integrals. **(K2)**
CO4 - Solve differential equations. **(K3)**
CO5 - Solve higher order differential equations.**(K3)**

UNIT I CALCULUS **(12 Hrs)**

Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.

UNIT II FUNCTIONS OF SEVERAL VARIABLES **(12 Hrs)**

Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of variables, Jacobians and their properties, Taylor's series for functions of two variables, Maxima and Minima, Lagrange's method of undetermined multipliers.

UNIT III MULTIPLE INTEGRALS AND APPLICATIONS **(12 Hrs)**

Multiple integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT IV DIFFERENTIAL EQUATIONS **(12 Hrs)**

Exact equations, First order linear equations, Bernoulli's equation, orthogonal trajectories, growth, decay and geometrical applications. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT V DIFFERENTIAL EQUATIONS (HIGHER ORDER) **(12 Hrs)**

Linear differential equations of higher order – with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method – simple application to electric circuits.

Text Books

1. Venkatraman M.K, Engineering Mathematics – First year, National publishing company, Chennai, 2010.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011.

Reference Books

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Kandasamy P. et al, Engineering Mathematics, Vol.1 & 2,S. Chand & Co., New Delhi.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & sons, New Delhi, 8th Edition.
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

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1. https://www.youtube.com/watch?v=rAof9Ld5sOg
2. https://nptel.ac.in/courses/111/104/111104092/
3. https://nptel.ac.in/courses/111/107/111107108/
4. https://www.youtube.com/watch?v=BJ_0FURo9RE
5. https://www.youtube.com/watch?v=p_di4Zn4wz4

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	2	2	-
2	3	2	1	1	-	1	1	-	-	-	-	1	2	2	--
3	2	1	-	-	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	1	1	-	-	-	-	1	3	1	-
5	3	2	1	1	-	1	1	-	-	-	-	1	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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T102

PHYSICS

(Common to all branches)

L	T	P	C	Hrs
4	0	0	4	45

Course Objectives

- To understand the concepts of acoustics and NDT and its significant contributions in the advancement of technology and invention of new products that dramatically transformed modern-day society.
- To expose the students to different areas of physics which have optics direct relevance and applications to different Engineering disciplines.
- To understand the concepts of optical devices, Lasers and Fiber optics.
- To understand the concepts of wave mechanics.
- To understand the concepts of Nuclear energy sources.

Course Outcomes

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

CO1 - Understand the basic concepts of sound Engineering and ideas to get good audibility inside a hall. Also gain knowledge about the production, propagation, properties and application of ultrasonic waves. **(K2)**

CO2 - Interpret the different characteristic behavior of light waves with air, glass, lens, grating, prism etc., Gain adequate knowledge about the interference, diffraction and polarization phenomenon of light waves and their applications. **(K2)**

CO3 - Understand the principle mechanism of laser light; distinguish between ordinary light and laser light. Basic idea about the various laser sources. Also gain knowledge about the optical fibers and their importance in communication. **(K3)**

CO4 - Understand the basic concept of quantum mechanics, dual nature of matter, and importance of energy of electrons associated with the properties of the materials. Also able to calculate energy of electron in an energy level by solving Schrodinger's equation. **(K1)**

CO5 - Gain knowledge about the structure of nucleus its constituents, nature. Understanding the nuclear energy fission and fusion concepts. Basic ideas of nuclear reactors to produce energy. **(K3)**

UNIT I ACOUSTICS & NDT **(9 Hrs)**

Ultrasonics – Ultrasonic Waves productions (piezoelectric & Magnetostriction method) - Detections (Acoustic Grating) NDT applications – Ultrasonic pulse echo Method - liquid penetrant Method

Acoustics - Factors affecting Acoustic of buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies – Sabine's formula for Reverberation Time – Doppler effect and its applications to Radars. (elementary ideas)

UNIT II OPTICS **(9 Hrs)**

Interference - Air wedge – Michelson's Interferometer - wavelength determination –Interference Filter – Antireflection Coatings.

Diffraction - Diffraction Grating – Dispersive power of grating – Resolving power of grating & Prism.

Polarization - Basic concepts of double refraction – Huygens Theory of Double Refraction – Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polarimeter.

UNIT III LASERS & FIBER OPTICS **(9 Hrs)**

Lasers - Principles of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients – Population Inversion and Laser Action – types of Optical resonators(qualitative ideas) – Types of Lasers - NdYAG, CO_2 laser, GaAs Laser- applications of lasers

Fiber Optics - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode) – applications to sensors and Fiber Optics Communication.

UNIT IV WAVE MECHANICS **(9 Hrs)**

Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrodinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional Potential Box – Quantum Mechanical Tunneling – Tunnel Diode

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UNIT V NUCLEAR ENERGY SOURCE **(9 Hrs)**

General Properties of Nucleus (Size, Mass, Density, Charge) – Mass Defect – Binding Energy - Disintegration in fission – Nuclear Reactor: Materials Used in Nuclear Reactors. – PWR –BWR – FBTR. Nuclear fusion reactions for fusion reactors - D-D and D-T reactions, Basic principles of Nuclear fusion reactors.

Text Books

1. V Rajendran, Engineering Physics, 2nd Edition TMH, New Delhi 2011.
2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi reprinted 2008.
3. Optics, K D Meller, (Oxford University Press)
4. Essentials of Quantum Mechanics, B.N.Srivastava, Pragathi Prakasan, 2014.
5. Avadhanulu M N, Engineering Physics, S. Chand & Co, 2009.

Reference Books

1. Ajay Ghatak, Optics, 5th Edition TMH, New Delhi, 2012.
2. K. Thyagarajan and Ajoy Ghatak, Laser Fundamentals and Applications, 2nd Edition, Springer 2010.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006.
4. K.R.Nambiar, Laser, New Age International, New Delhi, 2008.
5. Science of Engineering Materials, 2nd Edition, C.M. Srivastava and C. Srinivasan, New Age Int. (P) Ltd, New Delhi, 1997.

Web References

1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/preview
3. https://www.journals.elsevier.com/nuclear-physics-a
4. http://www.industrial-electronics.com/laser_15.html
5. https://www.britannica.com/science/crystal

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	-	-	-	-	-	-	2	3	1
2	3	3	2	2	3	-	-	-	-	-	-	-	2	2	2
3	3	3	2	3	3	-	-	-	-	-	-	-	2	2	3
4	3	3	3	3	2	-	-	-	-	-	-	-	1	-	-
5	3	3	3	1	3	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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T103	CHEMISTRY (Common to all branches)	L	T	P	C	Hrs
		4	0	0	4	45

Course Objectives

- Know the fundamental principles of Engineering Chemistry required solving engineering problems.
- Practical implementation of fundamental theory concepts.
- Introducing new techniques and latest information that motivates the students to bring out his or her views and work effectively.
- To enable the students understand the role of engineering materials such as polymers, energy production, electrical field basic concepts of material behaviour and study the environmental applications in the field of engineering and technology
- To acquire knowledge of engineering materials and about fuels and batteries

Course Outcomes

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

CO1- Understand the basic concept of hardness of water, the chemicals responsible for it, measurement of hardness, its disadvantages and its removal. **(K2)**

CO2 - Understand the synthesis of various organic and inorganic polymer **(K3)**

CO3 - Understand the application of the concept of oxidation and reduction reaction to various cells **(K2)**

CO4 - Understand the application of electrochemistry in corrosion of metals and also about different types of corrosion control methods **(K3)**

CO5 - Understand the concept of phase equilibrium and its application to different types of heterogeneous equilibrium system like eutectic alloys **(K3)**

UNIT I WATER **(9 Hrs)**

Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water- EDTA method. Disadvantages of hardwater-boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening method – internal & external conditioning – lime-soda process, zeolite process and ion exchange process. Desalination – reverse osmosis & electrodialysis.

UNIT II POLYMERS **(9 Hrs)**

Classification, types of polymerization reactions – mechanism of radical, ionic and Ziegler-Natta polymerizations. Polymer properties – Chemical resistance, crystallinity and effect of temperature, Mn and Mw. Thermoplastics and thermosets. Preparation, properties and uses of PVC, TEFLON, Nylons, Bakelite, Polyurithane, rubber – vulcanization, synthetic rubber, BuNa-S, BuNa-N, Silicone and butyl rubber. Conducting Polymers – classification and applications. Polymer composites – FRP – laminar composites. Moulding constituents of plastics, moulding techniques – compression, injection, transfer and extrusion moulding.

UNIT III ELECTROCHEMICAL CELLS **(9 Hrs)**

Galvanic cell, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes - hydrogen, calomel, Ag/AgCl & glass electrodes. Batteries - primary and secondary cells, Leclanche cell, Lead acid storage cell, Ni-Cd battery & alkaline battery. Fuel cells – H2-O2 fuel cell.

UNIT IV CORROSION AND ITS CONTROL **(9 Hrs)**

Chemical & electrochemical corrosion-Galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion-corrosion control methods - cathodic protection and corrosion inhibitors. Protective coating - types of protective Coatings - metallic coating - tinning and galvanizing, cladding, electroplating and anodizing.

UNIT V PHASE RULE **(9 Hrs)**

Definition and derivation of phase rule. Application to one component system - water and sulphur systems. Thermal analysis, condensed phase rule. Two component systems – Pb - Ag, Cu-Ni and Mg-Zn systems.

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Text Books

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi 15th Ed, 2010.
2. B.Sivasankar, "Engineering Chemistry ", Tata McGraw Hill, India 2018.
3. Shaley Oberoi & Monica Malik, "Engineering Chemistry made easy", Cengage Learning, Delhi, 2009.
4. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, New Delhi, 2016.
5. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi, 2015.

Reference Books

1. S. S. Dara, A Textbook of Engineering Chemistry, 11th Ed, S. Chand & Co., Ltd. New Delhi, 2008.
2. B. K. Sharma, Engineering Chemistry, 3rd edition Krishna Prakashan Media (P) Ltd., Meerut, 2001.
3. P. Kannan and A. Ravi Krishnan "Engineering Chemistry" Hi-Tech Sri Krishna Publications, Chennai, 9th Ed, 2009.
4. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2nd Ed, PHI Learning PVT., LTD, New Delhi, 2008.
5. C.V.Agarwal, C.P.Naidu, "A text book of Engineering Chemistry", BS Publication, Hyderabad, 2012.

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1. https://water.usgs.gov/edu/hardness.html
2. https://www.polymer-project.org/
3. www.materials.unsw.edu.au/tutorials/online-tutorials/corrosion
4. www.electrochem.org/redcat-blog/4-useful-electrochemistry-websites-2/
5. https://serc.carleton.edu/research_education/equilibria/phaserule.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	-	1	1
2	2	1	-	-	-	1	1	-	-	-	-	1	-	1	1
3	2	1	-	-	-	1	1	-	-	-	-	1	-	1	1
4	2	1	-	-	-	1	1	-	-	-	-	1	-	1	1
5	2	1	-	-	-	1	1	-	-	-	-	1	-	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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T104

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to all branches)

L	T	P	C	Hrs
4	0	0	4	60

Course Objectives

- To understand and gain basic knowledge about magnetic and electrical circuits
- To gain basic knowledge about single phase and three phase power measurement
- To understand the operating principles of stationary and rotating machines
- To understand the characteristics and applications of semiconductor devices
- To provide the basic knowledge in Digital electronics
- To understand the purpose of communication and acquire knowledge on different communication systems

Course Outcomes

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

CO1 - Analyze the basic concepts, various laws and theorems used in DC circuits. **(K3)**

CO2 - Analyze and solve the AC circuits and develop resonance circuits for transmitter and receiver. **(K4)**

CO3 - Gain the knowledge of power production in power system and application of transformers and motors in real time. **(K2)**

CO4 - Understand the operations of semiconductor diode, BJT, FET and its applications. **(K2)**

CO5 - Summarize the digital electronics concepts for sequential and combinational circuits. **(K2)**

CO6 - Explain and Relate different Communication Systems. **(K2)**

PART A – ELECTRICAL

UNIT I DC CIRCUITS (10 Hrs)

Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchhoff's law & its applications – simple problems – division of Current in series & parallel circuits – star/delta conversion – node and mesh methods of analysis of DC circuits.

UNIT II AC CIRCUITS (10 Hrs)

Concepts of AC circuits – rms value, average value, form and peak factors – simple RLC series circuits – concept of real and reactive power – power factor – introduction to three phase system – power measurement by two wattmeter method

UNIT III ELECTRICAL MACHINES AND POWER PLANTS (10 Hrs)

Law of Electromagnetic induction, Fleming's Right & Left hand rule – Principle of DC rotating machine, Single Phase transformer and single phase induction motor (Qualitative approach only) – simple layout of thermal and hydro generation (block diagram approach only). Fundamentals of fuses and circuit breakers

PART B – ELECTRONICS

UNIT IV ELECTRONIC CIRCUITS (10 Hrs)

V-I characteristics of diode – Half-wave rectifier and full-wave rectifier – with and without capacitor filter – Transistor – Construction & working – input and output characteristics of CB and CE configuration – Transistor as an Amplifier – Principle and working of Hartley oscillator and RC phase shift oscillator – Construction and working of JFET & MOSFET.

UNIT V DIGITAL ELECTRONICS (10 Hrs)

Boolean algebra – reduction of Boolean expressions – De-Morgan's theorem – Logic gates – Implementation of Boolean expressions – Flip flops – RS, JK, T and D. Combinational logic – Half adder, Full adder and Subtractors. Sequential logic – Ripple counters and shift registers.

UNIT VI COMMUNICATION AND COMPUTER SYSTEMS (10 Hrs)

Model of communication system – Analog and digital – Wired and wireless channel. Block diagram of various communication systems – Microwave, satellite, optical fiber and cellular mobile system.

Network model – PAN, LAN, MAN and WAN – Circuit and packet switching – Overview of ISDN.

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Text Books

1. Kothari D P and Nagrath I J, Basic Electrical Engineering, Tata McGraw Hill, 2009. (For Units I to III)
2. Rajendra Prasad , "Fundamentals of Electronic Engineering", Cengage learning, New Delhi, first Edition, 2011 (For Unit IV)
3. Morris Mano, "Digital Design", PHI learning, Fourth Edition, 2008 (For Unit V)
4. Wayne Tomasi, "Electronic Communication Systems-Fundamentals Theory Advanced", Sixth Edition, Pearson Education, 2004.(For Unit VI)

Reference Books

1. R. Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004.
2. J.B.Gupta, A Course in Electrical Power, Katson Publishing House, New Delhi, 1993.
3. David.A Bell, "Electronic Devices and Circuits", PHI Learning Private Ltd, India Fourth Edition, 2008.
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, "digital Principles and Applications" 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.
5. S.K. Sahdev, Fundamentals of Electrical Engineering and Electronics, Dhanpat Rai & Co, 2013.
6. Jacob Millman and Christos C. Halkias, "Electronic Devices and Circuits" Tata McGraw Hill, 2008.
7. R.L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", PHI Learning Private Limited, Ninth edition, 2008.
8. M.S.Sukhija and T.K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford University Press, 2012.

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1. https://nptel.ac.in/courses/108/108/108108076/
2. https://www.electrical4u.com/
3. https://nptel.ac.in/courses/108/102/108102146/
4. http://electrical-engineering-portal.com/
5. http://www.electronics-tutorials.ws
6. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
7. https://nptel.ac.in/courses/117/102/117102059/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	3	-	-	-	-	-	-	-	-	-	1
2	3	3	2	2	3	-	-	-	-	-	-	-	-	-	1
3	3	3	2	2	3	-	-	-	-	-	-	-	2	2	2
4	3	1	2	2	-	-	-	-	-	-	-	-	-	-	1
5	3	2	2	2	-	-	-	-	-	-	-	-	-	-	1
6	3	-	2	-	-	-	-	-	-	-	-	-	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

T105

ENGINEERING THERMODYNAMICS

(Common to all branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To understand the basics of the thermodynamic principles
- To establish the relationship of these principles to thermal system behaviors
- To develop methodologies for predicting the system behavior
- To establish the importance of laws of thermodynamics applied to energy systems
- To explain the role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

Course Outcomes

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

CO1- Understand the fundamental thermodynamic concepts and its basic laws. **(K2)**

CO2 - Apply first law of thermodynamics concepts to calculate the system work for closed and open systems. **(K3)**

CO3 - Apply Second Law of Thermodynamics and entropy concepts to evaluate the performance of heat engine, heat pump and refrigerator. **(K3)**

CO4 - Apply the principles of gas power cycles to calculate its thermal performance. **(K3)**

CO5 - Understand the basic working principle of refrigeration systems. **(K2)**

UNIT I BASIC CONCEPTS AND DEFINITIONS (12 Hrs)

Energy conversion and efficiencies - system, property and state – Thermal equilibrium – Temperature – Zeroth law of Thermodynamics – Pure substance – P, V and T diagrams – Thermodynamic diagrams.

UNIT II FIRST LAW OF THERMODYNAMICS (12 Hrs)

The concept of work and adiabatic process – First law of thermodynamics – conservation of Energy Principle for closed and open systems – Calculation of work for different processes of expansion of gases

UNIT III SECOND LAW OF THERMODYNAMICS (12 Hrs)

Equilibrium and the second law – Heat engines – Kelvin-Plank statement of second law of thermodynamics – Reversible and irreversible processes – Carnot principle – Clausius inequality – Entropy

UNIT IV GAS POWER CYCLES (12 Hrs)

Air standard cycles: The air standard carnot cycle – Air standard Otto cycle, Diesel cycle, Dual cycle and Braylon cycles and their efficiencies

UNIT V REFRIGERATION CYCLES AND SYSTEMS (12 Hrs)

Reverse Carnot cycle – COP – Vapor compression refrigeration cycle and systems (only theory) – Gas refrigeration cycle – Absorption refrigeration system – Liquefaction – Solidification (only theory).

Text Books

1. P.K.Nag, "Engineering Thermodynamics", 4th edition, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2008.
2. R. K. Singal, Mridul Singal "A text book of Engineering Thermodynamics", I.K. International Publishing House Pvt. Limited, 2010.
3. Er.S.K.Gupta. "Engineering Thermodynamics", S. Chand publishers, 2013.

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1. Arora, C.P., "Thermodynamics", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2010.
2. Burghardt, M.D., "Engineering Thermodynamics with Applications", 4th edition, Harper & Row, N.Y., 2009.
3. Huang, F.F., "Engineering Thermodynamics" 2nd edition, Macmillan Publishing Co. Ltd., N.Y., 2011.
4. Cengel, Y.A. and Boles, M.A., "Thermodynamics – An Engineering approach", 5th edition, Mc Graw Hill, 2008.
5. Wark, K., "Thermodynamics", 4th edition Mc-Graw Hill, N.Y., 2009.

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3. https://nptel.ac.in/courses/112/103/112103275/
4. https://www.linkedin.com/company/heat-transfer-and-process-design-htpd
5. https://www.udemy.com/course/an-introduction-to-heat-transfer/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	-	-	-	-	-	-	3	2	2	1
2	3	2	2	2	2	-	-	-	-	-	-	3	2	2	1
3	3	2	3	3	2	-	-	-	-	-	-	3	2	2	1
4	3	2	3	3	-	-	-	-	-	-	-	3	2	2	1
5	3	2	3	3	-	-	-	-	-	-	-	3	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

T106

COMPUTER PROGRAMMING

(Common to all branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To introduce the basics of computers and information technology.
- To educate problem solving techniques.
- To impart programming skills in C language.
- To practice structured programming to solve real life problems.
- To study the basic concepts of File operations.

Course Outcomes

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

CO1 - Identify and understand the working components of a computer system. **(K1)**

CO2 - Understand, analyze and implement like algorithm, pseudo codes and programming structures. **(K2)**

CO3 - Analyze and make use of logical structure of a C program. **(K3)**

CO4 - Make use of pointers, memory allocation and data handling to implement C programs. **(K3)**

CO5 - Understand the working of files and directives. **(K3)**

UNIT I INTRODUCTION TO COMPUTERS (12 Hrs)

History of computers – Block diagram of a computer – Components of a computer system – Classification of computers – Hardware – Software – Categories of Software – Operating System – Applications of Computers – Network structure – Internet and its services – Intranet – Study of word processor – Preparation of worksheets.

UNIT II INTRODUCTION TO C (12 Hrs)

Problem solving techniques – Program – Program development cycle – Algorithm design – Flowchart – Pseudo code.

Introduction to C – History of C – Importance of C – C tokens – Data types – Operators and expressions – I/O functions.

UNIT III DECISION MAKING AND ARRAYS (12 Hrs)

Decision making statements – branching and looping – arrays – multidimensional arrays – Functions – Recursion – Passing array to functions. Storage classes – Strings – String library functions.

UNIT IV STRUCTURES AND POINTERS (12 Hrs)

Structures – Arrays and structures – nested structures – passing structures to functions – user defined date types – Union.

Pointers – pointers and arrays – pointers and functions – pointer and strings – pointer and structures.

UNIT V FILE MANAGEMENT AND PREPROCESSORS (12 Hrs)

Files – operations on a file – Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books

1. Balagurusamy. E, "Programming in ANSI C", Tata Mc-Graw Hill, sixth edition, 2012.
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Kenneth A. Reek, "Pointers on C", Pearson Education, 2007

Reference Books

1. Vikas Verma, "A Workbook on C ", Cengage Learning, Second Edition, 2012.
2. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2008.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
5. Stephen G. Kochan, "Programming in C", Third Edition, Pearson Education, 2007.

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Web References

1. https://www.geeksforgeeks.org/classification-of-computers/
2. http://www.btechsmartclass.com/c_programming/C-Program-Development-Life-Cycle.html
3. https://www.learn-c.org/en/Multidimensional_Arrays
4. https://www.tutorialspoint.com/cprogramming/c_structures.htm
5. https://www.w3schools.in/c-tutorial/command-line-arguments/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
2	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

P101	COMPUTER PROGRAMMING LAB (Common to all branches)	L	T	P	C	Hrs
		0	0	3	2	30

Course Objectives

- To study and understand the use of OS commands
- To gain a hands on experience of compilation and execution of 'C' programs
- To understand the working of control statements
- To design functional methods.
- To make use pointers in various programs

Course Outcomes

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

CO1 - Apply and practice logical ability to solve the problems. Understand C programming development, environment, compiling, debugging, linking and executing a program using the development environment. **(K2)**

CO2 - Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs. **(K2)**

CO3 - Understand and apply the in-built functions and customized functions for solving the problems. **(K3)**

CO4 - Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems. **(K3)**

CO5 - Document and present the algorithm's, flowcharts and programs in form of user-manuals. **(K3)**

LIST OF EXERCISES

1. Study of OS Commands
2. Write a C program to find the area of Triangle.
3. Write a C program to find the total and average percentage obtained by a student of 6 subjects.
4. Write a C program to read a three digit number and produce output like
   1 hundreds
   7 tens
   2 units
   for an input of 172.
5. Write a C program to check whether a given character is vowel or not using switch – Case statement.
6. Write a C program to print the number from 1 to 10 along with their squares.
7. Write a C program to find the sum of 'n' numbers using for, do – while statements.
8. Write a C program to find the factorial of a given number using Functions.
9. Write a C program to swap two numbers using call by value and call by reference.
10. Write a C program to find the smallest and largest element in an array.
11. Write a C program to perform matrix multiplication.
12. Write a C program to demonstrate the usage of local and Global variables.
13. Write a C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a C program to remove all characters in a string except alphabets.
15. Write a C program to find the sum of an integer array using pointers.
16. Write a C program to find the Maximum element in an integer array using pointers.
17. Write a C program to create student details using Structures.
18. Write a C program to display the contents of the file on the monitor screen.
19. Create a file by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a C program to pass the parameter using command line arguments.

Text Books

1. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, Sixth edition, 2012.
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Kenneth A. Reek, "Pointers on C", Pearson Education, 2007.

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Reference Books

1. VikasVerma, "A Workbook on C ", Cengage Learning, SecondEdition,2012
2. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2008.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007
5. Stephen G. Kochan, "Programming in C", Third Edition, Pearson Education, 2007

Web References

1. https://www.javatpoint.com/factorial-program-in-c
2. https://www.studytonight.com/c/programs/array/largest-and-smallest-element-in-array
3. https://www.programiz.com/c-programming/examples/information-structure-array
4. https://www.geeksforgeeks.org/c-program-print-contents-file/
5. https://www.studytonight.com/c/command-line-argument.php

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
2	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

P102

ENGINEERING GRAPHICS

(Common to all branches)

L	T	P	C	Hrs
2	0	3	2	60

Course Objectives

- To convey the basics of engineering drawing
- To explain the importance of an engineering drawing
- To teach different methods of making the drawing
- To establish the importance of projects and developments mode in drawing that are used in real systems
- To develop the role of computer aided design Auto Cad and significance of using these drawings

Course Outcomes

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

CO1 - Understand the basic concepts of engineering drawings. **(K2)**
CO2 - Apply various concepts like dimensioning, conventions and BIS codes, the theory and methods of projection. **(K3)**
CO3 - Improve their imagination and visualization skills to design new products. **(K4)**
CO4 - Create engineering drawing of physical object representing engineering systems. **(K4)**
CO5 - Analysis the different views and computer aided drafting tools. **(K3)**

Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning

UNIT I **(12 Hrs)**

Conic sections, Involutes, Spirals, Helix. Projection of Points, Lines and planes

UNIT II **(12 Hrs)**

Projection of Solids and Sections of solids.

UNIT III **(12 Hrs)**

Development of surfaces – Intersection of surfaces (Cylinder-Cylinder, cylinder-cone)

UNIT IV **(12 Hrs)**

Isometric projections and Orthographic projections

UNIT V **(12 Hrs)**

Computer Aided Drafting: introduction to computer Aided Drafting hardware- overview of application software – 2D drafting commands (Auto CAD) for simple shapes – Dimensioning.

Text Books

1. K.R. Gopalakrishna and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.
2. Dhananjayan A. Jolhe, Engineering Drawing with introduction to Autocad, Tata McGrawHill Publishing company limited, 2008.
3. Basant Agrwal and Agarwal C W., Engineering Drawing, Tata Tata McGrawHill Publishing company limited, 2008.

Reference Books

1. N.D. Bhatt, Engineering Drawing, 49th edition, Chorotar Publishing House, 2006.
2. K. Venugopal, Engineering Drawing and Graphics + Auto CAD, 4th edition, New Age International Publication Ltd., 2004.
3. David I cook and Robert N Mc Dougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edn. 1985.
4. James D Bethune and et. al., Modern Drafting, Prentice Hall Int., 1989.
5. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
6. BIS, Engineering Drawing practice for Schools & Colleges, 1992.

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Web References

1. http://nptel.ac.in/courses/112103019
2. https://en.wikipedia.org/wiki/Engineering drawing
3. https://nptel.ac.in/courses/105/104/105104148/
4. https://onlinecourses.nptel.ac.in/noc20_me79/preview
5. https://www.btechguru.com/courses--nptel--engineering-drawing----video-lecture.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	-	-	-	-	3	1	2	3
2	3	1	-	-	3	-	-	-	-	-	-	3	1	2	3
3	3	1	-	-	3	-	-	-	-	-	-	3	1	2	3
4	3	1	-	-	3	-	-	-	-	-	-	3	1	2	3
5	3	1	-	-	3	-	-	-	-	-	-	3	1	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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P103

BASIC ELECTRICAL AND ELECTRONICS LAB

(Common to all branches)

L	T	P	C	Hrs
0	0	3	2	30

Course Objectives

- To get an exposure on the basic electrical tools, applications and precautions
- To gain training on different types of wiring used in domestic and industrial applications
- To detect and find faults in electrical lamp and ceiling fan
- To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junctions diode and transistor
- To gain a practical knowledge on the functions and applications of basic logic gates and flip flops

Course Outcomes

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

CO1 - Follow the safety procedures when working with electricity and various tools. **(K4)**
CO2 - Do line diagram and wiring practices for domestic application. **(K5)**
CO3 - Use the protection circuits for electrical networks. **(K3)**
CO4 - Design and verify the kirchoff's law. **(K4)**
CO5 - Analyze the characteristics of PN diode and use it for rectifier applications. **(K4)**
CO6 - Gain knowledge on digital electronics to solve problems related to boolean algebra. **(K4)**

LIST OF EXPERIMENTS

ELECTRICAL LAB

1. Electrical Safety, precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor's room wiring.
6. Bed room wiring
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuits breakers and A.C and D.C meters

ELECTRONICS LAB

1. Study of CRO.
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou's figures)

2. Verification of Kirchhoff' s Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchhoff's laws theoretically and verify the laws experimentally.

3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter.

4. Frequency response of RC Coupled Amplifiers.
   Determination of frequency response of given RC coupled amplifier- Calculation of bandwidth.

5. Study of logic gates.
   a) Verification of Demorgan's theorems.
   b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and flip-flops – JK, RS, T and D
   c) Implementation of digital functions using logic gates and universal gates

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Reference Books

1. Kothari D P and Nagrath I J, Basic Electrical Engineering, Tata McGraw Hill, 2009.
2. R.Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004
3. Sudhakar and S. P. Shyam Mohan, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th Edition, 2010.
4. Rajendra Prasad, "Fundamentals of Electronic Engineering", Cengage learning, New Delhi, First Edition, 2011.
5. Donald P Leach, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications," 6th edition, Tata McGraw Hill Publishing Company Ltd.,New Delhi,2008
6. Morris Mano, "Digital design", PHI Learning, Fourth Edition, 2008.
7. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, "Electrical and Electronics Technology", Pearson Education Limited, New Delhi, 10th Edition, 2010.

Web References

1. https://www.electrical4u.com/
2. https://www.allaboutcircuits.com/
3. https://www.circuitlab.com/
4. http://www.electronics-tutorials.ws
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
6. https://nptel.ac.in/courses/117/102/117102059/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	-	-	-	3	-	-	-	-	2	2
2	3	3	3	3	3	-	-	-	3	-	-	-	-	-	2
3	3	3	2	3	3	-	-	-	3	-	-	-	-	1	2
4	3	3	2	3	2	-	-	-	3	-	-	-	-	-	1
5	3	3	2	3	2	-	-	-	3	-	-	-	-	-	1
6	3	3	2	3	2	-	-	-	3	-	-	-	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Divya
(R.VELMURUGAN)

SEMESTER – II

(K.VELMURUGAN)

T107	MATHEMATICS - II (Common to all branches)	L	T	P	C	Hrs
		3	1	0	4	60

Course Objectives

- To familiarize the concept of matrices.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus
- To equip themselves familiar with Laplace transform
- To solve the differential equations using Inverse Laplace transform techniques.
- To gain good knowledge in application of Fourier transform.

Course Outcomes

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

CO 1 - Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix. **(K2)**
CO 2 - Understand the use of vector calculus. **(K2)**
CO 3 - Apply Laplace transform of simple function. **(K3)**
CO 4 - Apply inverse Laplace transform of simple functions. **(K3)**
CO 5 - Compute Fourier transforms of various functions. **(K3)**

UNIT I MATRICES (12 Hrs)

Eigenvalues and Eigen vectors of a real matrix, characteristic equation, Properties of Eigenvalues and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadratic forms.

UNIT II VECTOR CALCULUS (12 Hrs)

Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke's theorem (without proof). Simple application problems.

UNIT III LAPLACE TRANSFORM (12 Hrs)

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems.

UNIT IV APPLICATIONS OF LAPLACE TRANSFORM (12 Hrs)

Methods for determining inverse Laplace transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integral by Laplace transforms.

UNIT V FOURIER TRANSFORM (12 Hrs)

Fourier integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval's identity.

Text Books

1. Venkataraman. M. K., Engineering Mathematics, National Publishing Company, Chennai, 2012.
2. Kandasamy P. et al, Engineering Mathematics, vol.2 & 3, S. Chand & Co., New Delhi.

Reference Books

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
5. Bali N. & Goyal M. Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

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Web References

1. https://www.youtube.com/watch?v=1wjXVdwzgX8
2. http://www.snggdcg.ac.in/pdf/study-material/mathematics/SMch18.pdf
3. https://www.youtube.com/watch?v=MLSfh33ZCwE
4. https://www.khanacademy.org/math/differential-equations/laplace-transform/convolution-integral/v/the-convolution-and-the-laplace-transform
5. http://www-users.math.umn.edu/~mille003/fouriertransform.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	3	1	-
2	2	1	-	-	-	1	1	-	-	-	-	1	1	-	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	1	-	-	-	-	-	1	2	1	-
5	3	2	1	1	-	1	-	-	-	-	-	1	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

T108	MATERIAL SCIENCE (Common to all branches)	L	T	P	C	Hrs
		4	0	0	4	45

Course Objectives

- To understand the importance of Material Science as a subject that revolutionized modern day technologies
- To understand the significance of material science in the development of new materials and devices for all branches of Engineering
- To impart knowledge to the Engineering students about some of the important areas of Magnetic Materials so as to enable them perceive the significant contributions of the subject in Engineering and Technology
- To understand the concepts of Semiconductor and Superconductor.
- To understand the concepts of Advanced Materials.

Course Outcomes

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

CO1 - Identify crystal lattices and their structures, crystalline planes and directions in a crystal lattice in terms of Miller Indices. To interpret X-ray diffraction studies and different types of lattice defects and their impact. **(K2)**

CO2 - To identify the nature of polarization in a dielectric material and to explain the various dielectric material and their characterization. **(K2)**

CO3 - Understand the source of a materials magnetic behaviour and be able to distinguish types of magnetism. Having Basic idea about the read/ write mechanism of various magnetic storage devices. **(K3)**

CO4 - Differentiate semiconductors; calculate the intrinsic carrier concentration in semiconductors. Understand the phenomenon of superconductivity: Student is able to define basic properties of superconducting materials and identify potential areas of their applications. **(K1)**

CO5 - Able to differentiate between nanomaterials and conventional materials. Have a broad understanding of the techniques used to synthesize nanomaterials, evaluate the properties of nanomaterials, identify the role of nanomaterials in current nanotechnology revolution, be prepared for more advanced courses in Materials Science and Engineering. **(K3)**

UNIT I CRYSTAL STRUCTURE AND LATTICE DEFECTS (9 Hrs)

Crystal Structure – Bravais Lattices, Crystal Systems – Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices– Powder X Ray Diffraction Method. Lattice defects – Qualitative ideas of point, line, surface and volume defects

UNIT II DIELECTRIC PROPERTIES (9 Hrs)

Dielectric Polarization and Mechanism – Temperature dependence of Polarization, Internal or local Field - Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications.

UNIT III MAGNETIC PROPERTIES (9 Hrs)

Origin of atomic magnetic moment – Bohr magneton - Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording

UNIT IV SEMICONDUCTORS AND SUPERCONDUCTORS (9 Hrs)

Semiconductors- Derivation of Carrier concentration in intrinsic Semiconductors – Basic ideas of electrical conductivity in intrinsic and extrinsic semiconductors (without derivation) - temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in semiconductors - Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V) Superconductivity - Basic concepts – transition temperature – Meissener effect – Type I and II superconductors – high temperature superconductors – 123 superconductor- applications of superconductors.

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UNIT V ADVANCED MATERIALS (9 Hrs)

Liquid Crystals – Types – Application as Display Devices. Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications. Shape Memory Alloys (SMA), shape memory effect, properties and applications of SMA.

Nanomaterials - Nano materials (one, two & three dimensional) –Methods of synthesis (PVD,CVD,laser Ablation, Solgel, Ball-milling Techniques), properties and applications of nanomaterials. Carbon nanotubes- synthesis, Properties and applications.

Text Books

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.
2. J.P.Srivastava, Elements of Solid State Physics,2 nd Ed.(PHI, 2007)
5. Murugesan, Modem Physics, (S.Chand & Co.)

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1. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, John Wiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th edition, John Wiley and sons, Singapore, 2007.
4. V Raghavan, Materials Science and Engineering- A First Course, 5th edition Prentice Hall of India, 2008.
5. B.S Murthy, P. Shankar, Baldev Raj, B.B.Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012.
6. M.N. Avadhanulu, Engineering Physics- Volume-II, S.Chand &Co, New Delhi, 2009
7. Pillai S.O, Solid State Physics, 6TH Edition- New Age International, 2005.

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1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/preview
3. https://onlinelibrary.wiley.com/journal/15214095
4. https://www.first4magnets.com/magnetic-materials-i156
5. https://www.electrical4u.com/dielectric-materials/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	3	1	1	1	2	3	3	1	2	-
2	3	3	3	1	2	3	1	1	1	2	1	3	2	1	1
3	3	3	3	1	3	3	2	1	1	2	1	3	3	1	2
4	3	3	3	1	3	3	2	1	1	2	2	3	2	1	-
5	3	1	3	1	3	3	2	1	1	2	3	3	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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T109	ENVIRONMENTAL SCIENCE (Common to all branches)	L	T	P	C	Hrs
		4	0	0	4	45

Course Objectives

- To know about the environment
- To understand about environmental pollution
- To apply the knowledge in understanding various environmental issues and problems
- communicate clearly and competently matters of environmental concern and understanding to a variety of audiences in appropriate forms
- evaluate and interpret various forms of evidence, including text, data, and other media about the environment

Course Outcomes

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

CO1 - Understand the various environmental segments, its significance to life, also about various natural resources, effects of over utilization and its protection which can lead to sustainable development. **(K2)**

CO2 - Understand the study of ecology of various systems of nature and also about the diverse species present and its protection. **(K3)**

CO3 - Understand various sources of air pollution, the scientific basis behind it and its effect on nature. **(K2)**

CO4 - Understand the various ways of water pollution, its sources and effects, different water pollution monitoring technique, treatment of waste water and also the effects of solid waste and its management. **(K3)**

CO5 - Understand the concept of spectroscopy and its application to monitor pollution. **(K3)**

UNIT I ENVIRONMENT AND ENERGY RESOURCES (9 Hrs)

Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers. Pollution definition and classification. Pollutants classification. Forest resources - use and over exploitation, deforestation, forest management. Water resources - use and conflicts over water, dams-benefits and problems. Mineral resources - mineral wealth of India, environmental effects of extracting and using mineral resources. Food resources - world food problems, environmental impact of modern Agriculture - fertilizer and pesticides. Energy resources-growing needs, renewable and non-renewable energy resources and use of alternate energy sources. From unsustainable to sustainable development.

UNIT II ECOSYSTEM AND BIODIVERSITY (9 Hrs)

Concept of an ecosystem - structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, estuarine and marine) ecosystem. Biodiversity - definition-genetic species and ecosystem diversity. Value of biodiversity – consumptive use, productive use, social, ethical, aesthetic and option values. Hot spots of biodiversity. Threats to biodiversity, habitat loss, poaching of wildlife, human wildlife conflicts. Endangered and endemic species. Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.

UNIT III AIR POLLUTION (9 Hrs)

Definition and classification. Chemical and photochemical reaction in different layers of atmosphere. Causes, sources, effects, and control measures of air pollutants – oxides of Nitrogen, oxides of Carbon, oxides of Sulfur, hydrocarbons, chloro – fluoro carbons and particulates. Mechanism and effects of air pollution phenomenon – Global warming, Ozone Depletion, Acid rain, Sulfurous Smog and Photochemical Smog.

UNIT IV WATER AND LAND POLLUTION (9 Hrs)

Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants, causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb, Cr, & Cu. Water pollution control and monitoring – DO, COD, BOD & TOC. Land pollution – solid waste management – causes, effect and control measures of urban and industrial wastes. Thermal and radioactive pollution.

(K. VELMURUGAN)

UNIT V POLLUTION CONTROL AND MONITORING (9 Hrs)

Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas Chromatography and Conductometry. Analysis of air pollutants – NOX, COX, SOX, H2S, Hydrocarbons and particulates.

Text Books

1. K. Raghavan Nambiar, "Text Book of Environmental studies" 2nd Ed, Scitech Publications (India) Pvt Ltd, India, 2010.
2. A. K. De, "Environmental Chemistry" 7th Ed; New age International (p) Ltd, New Delhi, 2010.
3. G. S. Sodhi, Fundamental concepts of environmental chemistry, I Ed, Alpha Science International Ltd, India, 2000.
4. Essentials of Ecology and Environmental Science, S. V. S. Rana , PHI learning, 2009
5. Basics of Environmental Science and Engineering, Sivashanmugam, P., new publishing book house, 2007.

Reference Books

1. B.K. Sharma, "Environmental chemistry" 11th Ed, KRISHNA Prakashan Media (P) Ltd, Meerut, 2007.
2. S.S. Dara, and D.D. Mishra "A text book of environmental chemistry and pollution control, 5th Ed, S.Chand and Company Ltd, New Delhi, 2012.
3. Richard T. Wright, Environmental Science: Toward a sustainable future, 10th edition, Prentice Hall, 2008.
4. Environmental Science, P N Palanisamy , Pearson publications,2012
5. Fundamentals of Environmental Studies, Mahua Basu, Xavier Savarimuthu, SJ, Cambridge University Press-2017

Web References

1. www.ifpri.org/topic/environment-and-natural-resources
2. https://www.iucn.org/content/biodiversity
3. http://www.world.org/weo/pollution
4. www.water-pollution.org.uk/
5. https://guides.library.illinois.edu/c.php?g=347044&p=2349046

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	3	-	-	-	-	2	2	1	2
2	2	1	1	1	-	1	3	-	-	-	-	2	2	1	2
3	3	1	1	1	-	1	3	-	-	-	-	2	2	1	2
4	3	1	1	1	-	1	3	-	-	-	-	2	2	1	2
5	3	1	1	1	-	1	3	-	-	-	-	2	2	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

T110	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C	Hrs
		4	0	0	4	45

Course Objectives

- To be able to differentiate the type of buildings according to national building code.
- To understand building components and their functions.
- Discuss the different types of roads, bridges and dams.
- To describe different types of combustion systems such as Internal and External Combustion systems
- To discuss various Energy Resources available for power generation.
- To explain the working of various different manufacturing process.

Course Outcomes

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

CO1 - Understand the basic concepts of different types of buildings and building materials. **(K3)**
CO2 - Learn various types of building components and their functions. **(K3)**
CO3 - Describe the importance of the basic infrastructure. **(K3)**
CO4 - Understand the classification of engines, low pressure Steam generators, its mounting and accessories. **(K2)**
CO5 - Apply the knowledge of thermal systems and equipment's in power plants and analyze the way of harnessing the renewable energies and its utilization. **(K3)**
CO6 - Understand the basic principles of machining, manufacturing and metal joining processes such as Lathe machine, Drilling, Grinding, Welding, green sand moulding foundry process. **(K2)**

PART – A CIVIL ENGINEERING

UNIT I BUILDINGS, BUILDING MATERIALS **(8 Hrs)**

Buildings-Definition-Classification according to NBC-plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick , cement, cement-mortar, concrete, steel-their properties and uses.

UNIT II BUILDINGS AND THEIR COMPONENTS **(8 Hrs)**

Buildings: Various Components and their functions. Soils and their classification. Foundation : function and types. Masonry-function and types. Floors: definition and types of floors. Roofs: definition and types.

UNIT III BASIC INFRASTRUCTURE **(7 Hrs)**

Surveying: classification, general principles, types, Uses, instruments used. Roads- types: components, types and their advantage and disadvantages. Bridges: components and types of bridges. Dams: purpose, types of dams. Water supply- sources and quality requirements, need and principles of rainwater harvesting.

PART- B MECHANICAL ENGINEERING

UNIT – IV INTERNAL AND EXTERNAL COMBUSTION SYSTEMS **(7 Hrs)**

IC engines – Classification – Working principles – Diesel and petrol engines: two stroke and four stroke engines – Merits and demerits.

Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

UNIT – V POWER GENERATION SYSTEMS **(7 Hrs)**

Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear Power plants – Schemes and layouts (Description only)

Solar – Wind – Geothermal – Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).

UNIT – VI MANUFACTURING PROCESS **(8 Hrs)**

Machines – Lathe – Drilling – Bending – Grinding – Shearing (Description only) Machine Process – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filling – Sawing – Grinding.

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Moulding and Metal Joining – Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only).

Text Books

1. Natarajan, K V, Basic Civil Engineering, 11th edition, Dhanalakshmi publications Chennai, 2011.
2. Venugopal , K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012.
3. K.Pravin Kumar, Basic Mechanical Engineering, Pearson Publications, 2009.
4. Shanmugam G, Palanichamy MS, Basic Civil and Mechanical Engineering, 1st Edition, McGraw Hill Education, 2018.
5. R.Vaishnavi, M.Prabhakaran,V.Vijayan, Basic Civil and Mechanical Engineering, S. Chand Publisher, 2013.

Reference Books

1. Purushothama Raj.P., Basic civil engineering, 3rd Edn., Dhanam Publications, Chennai, 2001
2. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New delhi, 2012.
3. Punmia, B.C., et. al., surveying, Vol-1, Laxmi publishers, New Delhi, 2012.
4. Punmia, B.C., et. al., Building Construction, Laxmi publishers, New Delhi, 2012
5. El. Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co., 1985.
6. Hajra Choudhry, et. al., Workshop Technology Vol I and II, Media promoters publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg, R.A. Process and Materials of Manufacture, PHI, 1999.
8. H.N.Gupta, R.C. Gupta and Arun Mittal, Manufacturing Process, New Age Publications, 2001.
9. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

Web References

1. https://nptel.ac.in/courses/112107291/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/ lecture-notes/
4. https://nptel.ac.in/courses/105102088/
5. https://nptel.ac.in/courses/105104101/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
2	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
3	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
4	3	2	1	-	-	1	2	-	-	-	-	3	3	2	1
5	3	2	2	2	2	2	2	-	-	-	-	3	3	2	1
6	3	2	2	2	2	2	2	-	-	-	-	3	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

T111

ENGINEERING MECHANICS

(Common to all branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions.
- To comprehend the effect of friction on equilibrium
- To analysis of trusses and friction
- To understand the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation
- To emphasis the concepts through solved examples

Course Outcomes

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

CO1 - understand the concepts of Equilibrium of a body, Moment of a force and to convert multiple forces into a single resultant force **(K2)**

CO2 - Apply the principles of internal forces, support reactions on Trusses/beams and friction between two surfaces. **(K3)**

CO3 - Interpret the knowledge of Centroid and center of gravity for different sections to calculate the moment of inertia for sections. **(K3)**

CO4 - Analyze and compare the principle of conservative forces, conservation of energy and D'Alembert's principle **(K4)**

CO5 - Analyze and compare the kinematics and kinetics of rigid bodies.**(K4)**

UNIT I FUNDAMENTAL OF MECHANICS (12 Hrs)

Basic Concepts Force System and Equilibrium, Definition of force, Moment and Couple, Principle of Transmissibility, Varignon's theorem, Resultant of force system – Concurrent and non concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

UNIT II PRACTICAL APPLICATION OF FORCE SYSTEM (12 Hrs)

Structural member: Definition, degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of trusses-method of joints, method of sections.

Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

UNIT III PROPERTIES OF SURFACES (12 Hrs)

Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product of moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

UNIT IV KINEMATICS AND KINETICS OF PARTICLES (12 Hrs)

Equations of motion – Rectilinear motion, curvelinear motion, relative motion, D'Alembert's principle, work-Energy equation – conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact

UNIT V KINEMATICS AND KINETICS OF RIGID BODIES (12 Hrs)

Plane motion, absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum

Text Books

1. Rajesekaran, S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2002.
2. Dr.I.S.Gujral, "Engineering Mechanicas" second edition, Lakshmi Publication (P), Ltd., 2011.
3. Dr. Sadhu Singh, A Textbook Of Engineering Mechanics, SChand & company Pvt Ltd., 2013.

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Reference Books

1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill, 2011.
2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw - Hill International Edition, 1997.
3. Bhavikatti,S.S and K.G. Rajashekarappa, Engineering Mechanics, New Age International (p) Ltd, New Delhi, 2010.
4. Arthur P. Boresi and Richard J. Schmidt, "Engineering Mechanics: Statics and Dynamics", Thomson Asia Private Limited, Singapore, 2010.
5. D.P.Sharma "Engineering Mechanics", Dorling Kindersley India Pvt. Ltd, New Delhi, 2010.

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR / Engineering mechanics / Table of Contents.html
3. https://nptel.ac.in/courses/112/106/112106286/
4. https://www.coursera.org/learn/engineering-mechanics-statics
5. https://nptel.ac.in/courses/122/104/122104014/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	1	3	2	2
2	3	2	2	3	-	-	-	-	-	-	-	1	2	2	2
3	3	2	2	3	-	-	-	-	-	-	-	1	2	2	2
4	3	2	2	3	-	-	-	-	-	-	-	1	2	2	2
5	3	2	2	3	-	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

T112

COMMUNICATIVE ENGLISH
(Common to all Branches)

L	T	P	C	Hrs
4	0	0	4	45

Course Objectives
- To improve the LSRW skills of I B.Tech students
- To instil confidence and enable the students to communicate with ease
- To equip the students with the necessary skills and develop their language prowess
- To sequence the thought of writing with cohesion and coherence
- To extend knowledge on varied aspects of business correspondence

Course Outcomes
After completion of the course, the students will be able to

CO1- Procure holistic development of LSRW skills **(K2)**
CO2 - Gain efficacies to compete confidently in the interviews **(K3)**
CO3 - Effectively enhances the oral communication skills **(K3)**
CO4 - Select, compile and synthesize information for written mode of communication **(K2)**
CO5 - Familiarize and excel in different business correspondence in work place **(K3)**

UNIT I BASIC COMMUNICATION THEORY (9 Hrs)
Importance of Communication – stages of communication, modes of communication –barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective listening skills.

UNIT II COMPREHENSION AND ANALYSIS (9 Hrs)
Comprehension of technical and non-technical material – skimming, scanning, inferring-Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing

UNIT III WRITING (9 Hrs)
Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, definitions, practice in summary Writing – Four modes of writing – Use of dictionaries, indices, library references – making bibliographical entries with regard to sources from books, journals, internet etc.

UNIT IV BUSINESS WRITING / CORRESPONDENCE (9 Hrs)
Report writing – Memoranda – Notice – Instruction – Letters – Resumes – Job applications

UNIT V ORAL COMMUNICATION (9 Hrs)
Basics of phonetics – presentation skills – Group discussions – Dialogue writing – Short Extempore – Debates-Role Plays – conversation Practice

Text Books
1. Ashraf M.Rizvi., Effective Technical Communication. Tata-McGraw, 2005.

Reference Books
1. Robert J.Dixson. , Complete Course in English, Prentice-Hall of India Pvt. Ltd., NewDelhi, 2006.
2. Boove, courtland R et al., Business Communication Today. Delhi. Pearson Education, 2002.
3. Meenakshi Raman and Sangeeta Sharma., Technical Communication Principles And Practice, OUP, 2007.
4. Robert J. Dixson., Everday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
5. Sethi, J and Kamalesh Sadanand., A Practical course in English Pronunciation, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

Web References
1. https://books.google.co.in/books/about/Effective_Tech_Communication.html
2. http://www.prenhall.com/bov

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3. https://global.oup.com/academic/product/technical-communication
4. https://www.amazon.in/Everyday-Dialogues-English-Dixson-R-J/dp
5. https://www.sapnaonline.com/books/practical-course-english-pronunciation-w-sethi-j-812032594x-9788120325944

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
2	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

P104	PHYSICS LABORATORY (Common to all branch)	L	T	P	C	Hrs
		0	0	3	2	30

Course Objectives

- To provide a practical understanding of some of the concepts learnt in the theory course on Physics.
- Evaluate the process and outcomes of an experiment quantitatively and qualitatively.
- Extend the scope of an investigation whether or not results come out as expected.
- Conduct an experiment collaboratively and ethically.
- Collect data and revise an experimental procedure iteratively and reflectively.

Course Outcomes

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

CO1 - Ability to operate optical equipments like Spectrometer, Polarimeter. **(K1)**

CO2 - To find the optical properties like dispersive power, Resolving power and specific rotatory power. **(K2)**

CO3 - Capable of handling screw gauge, venire caliper and travelling microscope to calculate the required parameters. **(K4)**

CO4 - Acquired basic knowledge about Thermal conduction and magnetic field due to a current carrying coil.**(K3)**

CO5 - Ability to prepare formal laboratory reports describing the results of experiments and to interpret the data from the experiments. **(K5)**

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Thermal conductivity – Lee's DISC
2. Thermal conductivity – radial flow
3. Spectrometer – Prism or Hollow prism
4. Spectrometer – Transmission grating
5. Spectrometer – Ordinary & Extraordinary rays
6. Newton's rings
7. Air – wedge
8. Half shade polarimeter – determination of specific rotatory power
9. Jolly's experiment – determination of α
10. Magnetism: i-h curve
11. Field along the axis of coil carrying current
12. Vibration magnetometer – calculation of magnetic moment & pole strength
13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination
14. Determination of optical absorption coefficient of materials using laser
15. Determination of numerical aperture of an optical fiber
16. Electrical conductivity of semiconductor – two probe / four probe method
17. Hall effect in semiconductor

Reference Books

1. Practical Physics C.C Ouseph, V.J.Rao and V.Vijayendran
2. Practical Physics M.N.Srinivasan, Sultan son Pub.
3. D P Khandelwal, Laboratory Manual of Physics for UG classes (Vani Pub. House, New Delhi)
4. B Saraf et al, Physics through Experiments, Vol. 1, Mechanical Systems, (Vikas Publication House, New Delhi)
5. Verma, Ahluwalia, Sharma, Computational Physics, an Introduction (New Age Int. (P) Ltd.)
6. V Y Rajopadhye and V L Purohit, Text book of experimental Physics.

Web References

1. http://www.iiserpune.ac.in/~bhasbapat/phy221_files/Gratings%20and%20Prism%20Spectrometer.pdf
2. https://www.tec-science.com/thermodynamics/heat/experimental-setup-for-determining-the-thermal-conductivity/
3. https://spark.iop.org/interference-air-wedge#gref
4. https://www.phywe.com/en/physics/
5. https://apniphysics.com/tag/laurents-half-shade-polarimeter/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	3	3	2	2	3	3	2	3	2	2	1
2	3	3	1	1	3	3	1	2	3	3	2	3	1	1	-
3	3	3	2	1	3	3	2	2	3	3	2	3	-	1	1
4	3	3	2	1	-	3	2	3	3	3	2	3	1	-	1
5	3	3	2	1	-	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

P105

CHEMISTRY LABORATORY

(Common to all branch)

L	T	P	C	Hrs
0	0	3	2	30

Course Objectives

- To gain a practical knowledge of Engineering Chemistry in relevance to Industrial applications
- To enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.
- To understand and explain scientifically the various chemistry related problems in the industry
- To develop experimental skills for building technical competence.
- To learn the laboratory skills needed to design, safely conduct and interpret chemical research.

Course Outcomes

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

CO1 - Understand about titrimetric analysis which can be used to estimate the amount of metal in a mineral. **(K2)**

CO2 - Understand about titrimetric analysis which can be used to estimate the amount of chemical present in a sample **(K3)**

CO3 - Understand about titrimetric analysis which can be used to estimate the quality of any sample **(K2)**

CO4 - Perform conductometric titration and its uses to analyze any sample **(K3)**

CO5 - Perform experiments by using colorimeter From which concentration of a sample can be determined from absorbance value **(K3)**

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
5. Estimation of magnesium by EDTA.
6. Estimation of acetic acid in vinegar.
7. Estimation of ferrous by permanganometry.
8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
9. Estimation of available chlorine in bleaching powder.
10. Estimation of copper in copper sulphate solution.
11. Estimation of calcium by permanganometry.
12. Estimation of iron by colorimetry.

Demonstration Experiments (Any Two Of The Following)

1. Determination of COD of water sample.
2. Determination of lead by conductometry.
3. Percentage composition of sugar solution by viscometry.

Reference Books

1. Vogel's Text book of Macro and Semimicro Qualitative Analysis G. Svehla, Longman Inc., Newyork. 1997
2. Basic Principles of Practical Chemistry, Venkateswaran. V, Veeraswmay. R, Kulandaivelu. A.R., Pearson Education. 1989.
3. Vogel's Text book of Quantitative Analysis, Mendham. J, Denney. R.C, Barnes. J.D, and Thomas, M. Pearson Education. 1989.
4. Practical Chemistry, D. N Bajpai, S. Giri and O P Pandey, Chand Publishing 2013
5. Allied Practical Chemsitry, A R Kulandaivelu , V Venkateswaran & R Veeraswamy, Chand Publications, 2001

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2. https://edu.rsc.org/resources/aspirin-screen-experiment/1644.article
3. https://www.stem.org.uk/resources/collection/3959/practical-chemistry
4. https://www.scienceinschool.org/2010/issue14/practical
5. http://www.chemlabs.bris.ac.uk/outreach/resources/Teachers_Websites.html

Deepa
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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	2	2	-	-	1	3	1	-	-	-	-	1
2	-	-	-	2	2	-	-	1	3	1	-	-	-	-	1
3	-	-	-	2	2	-	-	1	3	1	-	-	-	-	1
4	-	-	-	2	2	-	-	1	3	1	-	-	-	-	1
5	-	-	-	2	2	-	-	1	3	1	-	-	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

P106	WORKSHOP PRACTICE	L	T	P	C	Hrs
		0	0	3	2	30

Course Objectives

- To convey the basics of mechanical tools used in engineering
- To establish hands on experience on the working tools
- To develop basic joints and fittings using the hand tools
- To establish the importance of joints and fitting in engineering applications
- To explain the role of basic workshop in engineering and underlying physical mechanism used in mechanical machines.

Course Outcomes

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

CO1 - Understand the functioning and usage of basic hand tools of fitting, welding and carpentry. **(K2)**

CO2 - Apply the knowledge of fitting tools and machineries to perform the exercise on fitting joints like symmetric asymmetric and angular fitting. **(K3)**

CO3 - Apply the knowledge of gas and Arc welding principles to perform to join the metal with joints like Lap and V- Butt joints. **(K3)**

CO4 - Apply the knowledge of metal joining process using sheet metals and to perform to make tray and frustum. **(K3)**

CO5 - Apply the knowledge of carpentry tools and equipment's to perform the joints like mortise and half lap joint. **(K3)**

Sl. No.	Trade	List of Exercises
1	Fitting	Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle.
2	Welding	Study of arc and gas welding equipment and tools – Edge preparation – Exercise on lap joint and V Butt joints – Demonstration of gas welding
3	Sheet metal work	Study of tools and Machineries – Exercise on simple products like Office tray and waste collection tray.
4	Carpentry	Study of tools and Machineries – Exercises on Lap joints and Mortise joints

LIST OF EXERCISES

I - FITTING

1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II - WELDING

1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3.M Single V butt welding (Arc)

III - SHEET METAL WORK

1. Study of tools and machineries
2. Frustum
3. Waste collection tray

IV - CARPENTRY

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint.

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Reference Books

1. HS Bawa, Workshop Practices, Tata Mc Graw Hill Publishing Co Ltd, 2015
2. S.K. Hajra Choudhury, A. K. Hajra Choudhury, "Elements of Workshop Technology", Vol I:Manufacturing Processes, 15th Edition Reprinted, Media Promoters & Publishers Pvt Ltd.,2013
3. D.Sathish, Engineering Workshop Practices Laboratory Manual, Notion press publisher, 2019
4. R.K. Rajput, Workshop Practice, Published by Laxmi Publications Pvt. Ltd. 2011
5. RS Khurmi and JK Gupta, Basics of Workshop Practice, S Chand Publisher, 2011

Web References

1. http://www.nptelvideos.in/2012/12/manufacturing-processes-ii.html
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3804
3. https://www.tpctraining.com/collections/machine-shop-practices-training
4. https://www.vlab.co.in/broad-area-mechanical-engineering
5. https://nptel.ac.in/courses/112/107/112107219/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	1	1	-	-	-	-	-	-	3	2	1
2	3	2	1	1	1	2	-	-	-	-	-	-	3	2	1
3	3	2	1	1	1	1	-	-	-	-	-	-	3	2	1
4	3	2	1	1	1	1	-	-	-	-	-	-	3	2	1
5	3	3	3	3	1	2	-	-	-	-	-	-	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

P107

NCC / NSS

NCC / NSS training is compulsory for all the Undergraduate students

1. The above activities will include Practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 30 hours.
4. The above activities will be monitored by the respective faculty in-charge.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years.
6. Pass in this course is mandatory for the award of degree

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SEMESTER – III

(K.VELMURUGAN)

U19MET31

COMPLEX ANALYSIS AND APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

(Common to EEE, ICE, MECH, MECHATRONICS)

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the analytic functions of complex variables.
- To apply the analytic function techniques to transform irregular geometry into regular geometry.
- Expose to the concept of complex integration.
- To understand the nature of wave equations.
- To know the solutions of one dimensional and two-dimensional heat flow equations.

Course Outcomes

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

CO1- Understand the concepts of function of a complex variable. **(K2)**
CO2 - Transform complex functions from one plane to another plane. **(K3)**
CO3 - Apply the concepts of complex integration over contour. **(K3)**
CO4 - Understand the concept of initial and boundary value problems **(K2)**
CO5 - Solve the one- and two-dimensional heat equation using Fourier series. **(K3)**

UNIT I FUNCTION OF A COMPLEX VARIABLE (12 Hrs)

Continuity, derivative and analytic functions – Necessary conditions – Cauchy-Riemann equations and sufficient conditions – Harmonic and orthogonal properties of analytic function – Construction of analytic function

UNIT II CONFORMAL MAPPINGS (12 Hrs)

Conformal mapping – Simple and standard transformations like $w = z+c$, cz, z^2, e^z, $\sin z$, $\cosh z$ and $z+1/z$ – Bilinear transformation and cross ratio property - Taylor's and Laurent's theorem – Series expansion of complex valued functions – classification of singularities.

UNIT III COMPLEX INTEGRATION (12 Hrs)

Cauchy's integral theorem and its application – Cauchy's integral formula and problems – Residues and evaluation of residues – Cauchy's residue theorem – Contour integration: Cauchy's and Jordan's Lemma – Application of residue theorem to evaluate real integrals – unit circle and semicircular contour.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solutions of one dimensional wave equation – Transverse vibration of an elastic string.

UNIT V ONE- AND TWO-DIMENSIONAL HEAT EQUATIONS (12 Hrs)

Fourier series solutions of one dimensional heat flow equation – Fourier series solutions of two dimensional heat flow equation under steady state conditions.

Text Books

1. B. S. Grewal., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2020.
2. N.P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
3. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearsons Publications, New Delhi, 4th Edition, 2017.

Reference Books

1. C. Gupta, B. Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 1st Edition, 2015.
2. H.K. Dass & Dr. Rama Verma, "Introduction to Engineering Mathematics – Volume II", S. Chand & Co, New Delhi, 9th Edition, 2019.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019.

(K.VELMURUGAN)

4. Ravish R. Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 1st Edition, 2016.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 3rd Edition, 2018.

Web References

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111107119/
3. https://youtu.be/W3HXK1Xe4nc
4. https://youtu.be/Mwpz1zjPlzI
5. https://youtu.be/CnrAlvf9l6o

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	1	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-
4	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K. VELMURUGAN)

U19MET32	ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To get familiar with the performance characteristics of single and three phase transformer.
- To equip the students to understand and analyze the characteristics of single and three phase induction motor.
- To get the clear knowledge of alternator and analyze its characteristics.
- To familiarize the characteristics of OP AMP 741 and its basic application circuits.
- To impart knowledge on the fundamental blocks and applications of IC 555.

Course Outcomes

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

CO1 - Familiar with the performance of single phase transformers using phasor diagrams and equivalent circuits. **(K3)**

CO2 - Analyze the performance of AC machines and special machines.**(K3)**

CO3 - Analyze the Performance and characteristics of alternator and to compute the voltage regulation with different methods.**(K4)**

CO4 - Design and analyze the OP AMP based circuits and its characteristics. **(K4)**

CO5 - Design the multi-vibrators and counters using IC 555 timer. **(K4)**

UNIT I TRANSFORMERS **(9 Hrs)**

EMF Equation – Equivalent circuit – Voltage regulation - Open Circuit and Short Circuit Test – Efficiency – condition for maximum efficiency – All day efficiency – Autotransformer – introduction to three phase Transformer.

UNIT II AC MACHINES **(9 Hrs)**

Theory and operation of 3 phase Induction motor - constructional details – starting methods – speed control methods – principle of operation of single – phase Induction motor – stepper motor – AC series motor – Applications.

UNIT III ALTERNATORS **(9 Hrs)**

Alternators - construction - Operating principle - alternators on No load – Alternators on Load - Phasor diagram - voltage regulation – Losses – Efficiency – Parallel operation of alternators.

UNIT IV ELECTRONICS **(9 Hrs)**

Op. amp. – Characteristics – Inverting amplifier - Non-inverting amplifier – differentiation integration I/V converter - V/I converter - Instrumentation amplifier – adder – substractor – First order low pass filter and High pass filter using op. Amp.

UNIT V IC 555 **(9 Hrs)**

Advantages of ICs - pin configurations of 555 IC - Design of astable and mono-stable multivibrator using 555 IC - design of counters using FF-UP/DOWN counters BCD counters shift Registers – simple applications.

Text Books

1. I.J.Nagrath and D.P.Kothari, "Electric Machines", Tata McGraw Hill, New Delhi, 5th Edition, 2017.
2. R.K.Rajput, "Electrical Machines",Laxmi publications Pvt.Ltd, New delhi, 6th Edition, 2008.
3. Ramakant A Gayakward, Operational Amplifiers and Linear Integrated circuits, Person Education (Singapore) Pvt. Ltd., Delhi, 2015.

Reference Books

1. A.Malvino and P.Leach, "Digital principles and Applications", IV edition, Tata McGraw Hill, 1998.
2. B.L.Theraja & A.K.Theraja, "Electrical Technology", Vol. - II, Nirja Construction & Development Co. (P) Ltd., New Delhi, 1995.
3. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw Hill, 1st Edition, 2018.

(K.VELMURUGAN)

4. David A. Bell, "Op-amp and Linear ICs", Oxford Higher Education, 3rd Edition, 2013.
5. SK Sahdev, Electrical Technology, Pearson Publication, 2009.

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1. http://electrical-engineering-portal.com/
2. https://nptel.ac.in/courses/108/105/108105131/
3. http://www.electrical4u.com
4. https://www.tutorialspoint.com/semiconductor_devices/semiconductor_devices_operational_amplifiers.htm
5. https://www.allaboutcircuits.com/video-lectures/op-amp-applications/
6. https://www.electronicsforu.com/electronics-projects/555-timer-working-specifications

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	-	-	-	-	2	3	3
2	3	3	3	3	2	-	-	-	-	-	-	-	2	3	3
3	3	3	3	3	-	-	-	-	-	-	-	-	2	3	3
4	3	3	3	2	2	-	-	-		-	-	-	2	3	3
5	3	3	3	2	2	-	-	-		-	-	-	2	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K. VELMURUGAN)

U19MET33	MECHANICS OF SOLIDS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the fundamental concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To compute slopes and deflections in determinate beams by various methods.
- To understand the effect of torsion on shafts and springs
- To learn about the buckling failure in columns and calculate the stresses, deformations induced in thin and thick shells.

Course Outcomes

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

CO1 - Compute the concepts of stress and strain in simple and compound bars and understand the importance of principal stresses and principal planes.**(K2)**

CO2 - Comprehend the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.**(K2)**

CO3 - Calculate the slope and deflection in beams using different methods.**(K3)**

CO4 - Estimate the effect of torsion in shafts and helical spring.**(K3)**

CO5 - Calculate the stresses and strains associated with thin and thick cylinder.**(K3)**

UNIT I STRESSES AND STRAINS (12 Hrs)

Stress and Strain: Basic of stress & strain, Elastic constant, Stress-strain diagram - Hook's law- Factor of safety- stresses and strain in uniformly varying sections- stresses in composite bar- Relation between three modulus and Poisson's ratio – Thermal stresses.

Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress.

UNIT II BEAMS AND SIMPLE BENDING (12 Hrs)

Beams: Cantilever, Simply supported: Shear Force and Bending Moment Diagrams. Theory of simple bending – Bending stress and shear stress in beams.

UNIT III DEFLECTION OF BEAMS (12 Hrs)

Deflection of beams: Cantilever and simply supported beam by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams.

UNIT IV TORSION & SPRING (12 Hrs)

Torsion: Introduction - Derivation of torsion equation - stresses and deformations in circular and hollow shafts - Shafts in Series and parallel - Combined bending and torsion- Strain energy due to axial force – Resilience.

Spring: Open and closed coil helical springs, Leaf Springs, Application of Torsion springs.

UNIT V COLUMNS AND CYLINDERS (12 Hrs)

Theory of columns – Long column and short column - Euler's formula – Rankine's formula.

Thin cylinders and shells – Deformation of thin cylinders and shells; Thick Cylinders, Compound Cylinder.

Text Books

1. R.K. Bansal, "Strength of Materials", Laxmi Publications, 6th edition 2019.
2. D.S. Bedi, "Strength of Materials", Khanna Publishing, 6th edition 2019.
3. R.K. Rajput, "Strength of Materials", S. Chand Publications, 7th edition 2018.

Reference Books

1. Punmia, Jain and Jain, "Mechanics of Materials" , Laxmi Publications .2019
2. R.C.Hibbeler, "Mechanics of Materials", Pearson Education, 9th Edition, 2018
3. Egor. P.Popov "Mechanics of Materials" Pearson Education, 2nd Edition, 2016.

(R.VELMURUGAN)

4. S.S. Rattan " Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2016
5. U.C.Jindal., "Strength of Materials", Asian Books Pvt. Ltd., 2nd edition New Delhi, 2018.

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2. https://nptel.ac.in/courses/112/102/112102284/
3. https://www.iitk.ac.in/me/research/specialization-areas/solid-mechanics-and-design/mechanics-of-solids
4. http://www.facweb.iitkgp.ac.in/~jeevanjyoti/teaching/mechsolids/2019/
5. https://www.coursera.org/courses?query=mechanics%20of%20materials

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
3	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET34 **APPLIED THERMODYNAMICS**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- Understand the concepts of ideal and real gases, gas mixtures and properties of pure substances.
- Identify the first law, second law and entropy concepts in the energy systems.
- Recognize the concepts of exergy and its applications in energy systems.
- Analyze the basics of thermodynamic property relations.
- Review the basic concepts of the combustion.

Course Outcomes

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

CO1 - Describe the concepts of ideal and real gases, gas mixtures and pure substances. **(K2)**
CO2 - Illustrate the first law, second law and entropy concepts in the thermodynamic devices. **(K3)**
CO3 - Apply the basic concepts of exergy for solving problems in open and closed system. **(K3)**
CO4 - Categorize thermodynamic property relations for different thermodynamic applications. **(K4)**
CO5 - Solve problems of combustion in thermodynamic systems. **(K5)**

UNIT I IDEAL AND REAL GASES, GAS MIXTURES AND PURE SUBSTANCES (12 Hrs)

Ideal and Real gases: Laws of perfect gases – Boyle's law – Charle's law – Gay Lussac law – Joule's law – Avogadro's law – state equation of gases – specific heat of gases. Vander Walls equation, Redlich Kwong equation, Dieterici equation, compressibility charts.
Gas mixtures: Mole fraction, mass fraction – calculation of mixture properties.
Pure substances: Phase change, 2D and 3D thermodynamic charts of pure substances – properties of steam – property tables – Mollier diagram.

UNIT II ENERGY AND ENTROPY (12 Hrs)

I law of thermodynamics – energy balance of closed and open systems. Steady and unsteady flow systems. II Law of thermodynamics – Entropy generation principle, its application, entropy balance of closed and open systems.

UNIT III EXERGY (12 Hrs)

Introduction to exergy – reversible work – useful work – decrease of exergy in processes – dead state – availability – irreversibility – exergy balance of closed and open systems – second law efficiencies of thermal equipments.

UNIT IV THERMODYNAMIC PROPERTY RELATIONS (12 Hrs)

General thermodynamic property relations: Maxwell equations – Tds equations –property relations of gases – Clausius - Clapeyron equation – Joule-Thomson coefficient – Gibbs phase rule – equilibrium condition.

UNIT V COMBUSTION (12 Hrs)

Combustion: Stoichiometry – reactant and product quantities – Enthalpy of formation– Steady flow analysis of reacting mixtures – Adiabatic Flame temperature – Enthalpy of reaction and heating values – availability in chemical reactions – combustion analysis.

Text Books

1. Cengel.Y and M.Boles, "Thermodynamics - An Engineering Approach", 9th Edition, McGraw Hill, 2019.
2. P.K Nag, "Engineering Thermodynamics", 6th Edition, McGraw-Hill, New Delhi, 2017.
3. R.K Rajput, "Thermal Engineering, Laxmi Publications (P) Ltd. 9th Edition, 2013.

Reference Books

1. S. K. Gupta Engineering Thermodynamics s chand & Company Limited 2013
2. C.P Arora, "Thermodynamics", 25th Reprint, McGraw-Hill, New Delhi, 2013.
3. C.Borgnakke, R.E. Sonntag, "Fundamentals of Thermodynamics, 10th Edition, John Wiley & Sons, Inc., 2019.
4. M.J.Moran, H.N.Shapiro, D.D.Boettner and M.B. Bailey., "Fundamentals of Engineering Thermodynamics, 9th Edition, John Wiley & Sons, Inc., 2018.

(R.VELMURUGAN)

5. E.Rathakrishnan, "Fundamentals of Engineering Thermodynamics", 2nd Edition, 10th Reprint, Prentice- Hall of India Pvt. Ltd, 2013.

Web References

1. https://nptel.ac.in/courses/112105266/
2. https://nptel.ac.in/courses/112108148/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://www.coursera.org/courses
5. https://www.udemy.com/course/applied-thermodynamics/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	3	-	-	1	1	-	1	-	1	1	-	1
2	3	3	1	3	-	-	1	1	-	1	-	1	1	-	1
3	3	3	1	3	-	-	-	1	-	1	-	1	2	-	1
4	3	3	1	3	-	-	-	1	-	1	-	1	1	-	1
5	3	3	2	3	-	-	1	1	-	1	-	1	2	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VELMURUGAN)

U19MET35	FLUID MECHANICS AND MACHINERY	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the properties of the fluid and flow characteristics.
- To emphasize the concept of dimensional analysis.
- To understand the concept of flow through circular pipes and boundary layer flows.
- To provide knowledge on the working principle and performance curves of hydraulic turbines.
- To educate the working principles and performance analysis of fluid pumps.

Course Outcomes

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

CO1 - Understand the basic fluid property and its application. **(K2)**
CO2 - To apply the concepts of dimensional analysis on the fluid structure. **(K3)**
CO3 - To calculate the rate of flow and energy losses in flow through pipes. **(K5)**
CO4 - To evaluate the operating characteristics of hydraulic turbines. **(K5)**
CO5 - Understand the working principles of hydraulic pumps and performances**(K2)**

UNIT I FLUID PROPERTIES AND FLUID STATICS (12 Hrs)

Units and dimensions - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity, fluid statics, manometers, Hydrostatic Forces, buoyancy, forces on submerged bodies, stability of floating bodies

UNIT II FLUID KINEMATICS AND FLUID DYNAMICS (12 Hrs)

Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation. Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis -Buckingham's π theorem applications - similarity laws and models.

UNIT III INCOMPRESSIBLE FLUIDS & FLOW THROUGH PIPES (12 Hrs)

Viscous flow - laminar flow between parallel plates, - Laminar and Turbulent flow, Reynold's experiment flow through Circular pipes - Darcy - Weisbach equation - friction factor minor losses – flow through pipes in series and in parallel - power transmission - boundary layer flows, boundary layer thickness, boundary layer separation.

UNIT IV HYDRAULIC MACHINE & TURBINES (12 Hrs)

Principles of Turbo Machinery: Fluid Machines – Classification – Introduction to Impact of jet Stationary plates, Moving Plates and Vanes - Construction of Velocity Vector Diagram– Unit and Specific Quantities. Turbine - Classification – Impulse Turbine – Pelton Wheel – Reaction Turbines – Francis and Kaplan Turbines – Draft Tube Theory – Velocity Triangle – Estimation of force, Power and efficiency – General Characteristics of Turbine – Similarity Study – Governing of Turbine – Cavitation in Turbine.

UNIT V HYDRAULIC PUMPS (12 Hrs)

Classification - Centrifugal Pump – Velocity Triangle – Estimation of Power Required and efficiency – General characteristics - Similarity study – Cavitation in Pump – Reciprocating Pump – Air Vessels – Ideal and Actual Indicator Diagram – Estimation of Power Required, percentage Slip and Efficiency – Cavitation - special purpose pumps.

Text Books

1. R.K.Bansal, "Fluid Mechanics and Hydraulics Machines", Laxmi publications (P) Ltd., New Delhi, 10th Edition, 2018
2. V.L. Streeter and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9thEdition, 2010.
3. K.L.Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 8thEdition, 2009.

Reference Books

1. S.S.Rattan - Fluid Mechanics and Hydraulic Machines- Khanna Publishers, 2019
2. S.M. Yahya, Turbine, Fans and Compressors, Tata McGraw-Hill- 4th Edition 2017.

(K.VELMURUGAN)

3. Yunus Çengel, John M. Cimbala - Fluid Mechanics Fundamentals and Applications-Mc Graw Hill, 4th Edition, 2017
4. F.M.White, "Fluid Mechanics", Tata McGraw-Hill, New Delhi, 8th Edition, 2016.
5. P.N.Modi and S.M.Seth "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 20th Edition, 2015.

Web References

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2. https://nptel.ac.in/courses/112104118/
3. http://fm-nitk.vlabs.ac.in
4. https://www.coursera.org/courses?query=fluid%20mechanics
5. https://apm.iitm.ac.in/fluid_mechanics.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	-	2	2	2
2	3	3	2	3	-	-	-	-	-	-	-	-	2	2	2
3	3	3	2	3	-	-	-	-	-	-	-	-	2	2	2
4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
5	3	2	2	3	-	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET36 **ENGINEERING METALLURGY**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To learn solidification structure, solid solution and allotropy of metals
- To learn the phase diagrams, various reactions and properties of steel
- To learn about the heat treatment and its importance real applications.
- To learn about Recovery, Recrystallization and Grain Growth
- To learn the deformation and failures of metals.

Course Outcomes

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

CO1 - Understand the fundamentals of solidification, metal structure, solid solution metals. **(K2)**
CO2 - Recognize the phase diagram and equilibrium diagram with reactions. **(K1)**
CO3 - Understand the basic fundamentals of heat treatment and importance in metals. **(K2)**
CO4 - Recognize crystal structure, nucleation, recovery and grain growth. **(K1,K3)**
CO5 - Understand and analysis the behavior of engineering materials and prevention the failures. **(K2,K34)**

UNIT I SOLIDIFICATION AND THEORY OF ALLOYS (9 Hrs)

Mechanism of crystallization, solidification of metals: pure metals and alloys, concept of super cooling, Nucleation: homogenous nucleation and heterogeneous nucleation. Solid solutions : Substitution solid solution-Interstitial solid solution, Hume-Rothery Rule, Lever Rule-Allotropy

UNIT II PHASE DIAGRAM AND IRON- CARBON EQUILIBRIUM DIAGRAM (9 Hrs)

Construction and interpretation of binary phase diagrams – Types – Eutectic, Eutectoid, Peritectic and Peritectoid systems – Iron Carbon equilibrium diagrams – classification of steels and alloy steels – types, manufacturing methods, properties and applications of cast irons.

UNIT III HEAT TREATMENT OF STEELS (9 Hrs)

Introduction to heat treatment- Classifications, Heat treatment of ferritic steels: constant temperature transformation-Continuous cooling curves-Important of heat treatment of steels- Surface Hardening process: classifications- Martempering and Austempering - Heat treatment of stainless steel: austenite stainless steel and Duplex stainless steel- shot peening-laser peening

UNIT IV RECOVERY , RECRYSTALLIZATION AND GRAIN GROWTH (9 Hrs)

Introduction to recovery and recrystallization , recrystallization of time and temperature, Degree of cold work and hot work, recrystallization of original grain growth, laws of recrystallization, Factors affecting rate of recrystallization - Grain growth - normal grain growth and abnormal grain growth- grain orientation- Factors affecting rate of grain growth

UNIT V DEFORMATION AND FAILURES OF METALS (9 Hrs)

Introduction deformation- types-strengthening mechanism of alloys, - ductile and brittle behavior of metals-Ductile to brittle transition- fracture modes – mechanism creep behavior- creep life predictions- fatigue behavior-S-N Curve-design against creep and fatigue

Text Books

1. A.Lavakumar, Concept of in physical metallurgy, Morgan & clay publication,2017
2. Srinivasan, Engg Materials And Mettalurgy, Tata McGraw-Hill Education,2nd edition,2015
3. S. K. Mandal, Steel Metallurgy: Properties, Specifications and Applications, McGraw-Hill Education,2014

Reference Books

1. Romesh C. Sharma, Principles of heat treatment of steels, New Age International, 2010
2. Sidney H. Avner, Introduction to Physical Metallurgy, Tata Mcgraw-Hill Publishing company Ltd, 2nd Edition 2008
3. Kannadi Palankeezhe Balan, Metallurgical Failure Analysis, Elsevier,2018

(K.VELMURUGAN)

4. L. Krishna reddy, Principles of Engineering Metallurgy, New Age Publishing Company Ltd, 10th Edition 2011
5. William E. Hosford, Physical Metallurgy, Taylor and Francis , 1st Edition 2018

Web References

1. https://nptel.ac.in/courses/113106088/
2. https://nptel.ac.in/courses/113104074/
3. https://fractory.com/heat-treatment-methods/
4. http://www.phase-trans.msm.cam.ac.uk/2005/growth.html
5. https://www.vssut.ac.in/lecture_notes/lecture1450443095.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	1	1	-	1	-	1	-	1	1	1	1
2	3	1	-	-	-	-	-	1	-	1	-	1	-	1	1
3	3	-	-	-	-	1	-	-	-	1	-	2	-	-	-
4	3	1	1	1	-	1	1	1	-	1	1	2	1	-	1
5	3	2	1	1	2	1	-	1	2	2	1	2	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEP31	ELECTRICAL AND ELECTRONICS ENGINEERING LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn and predetermine the equivalent circuits of single phase transformer.
- To equip the students to test and evaluate the performance and characteristics of single and three phase transformer.
- To learn the performance characteristics of single phase and three phase induction motor.
- To analyze and calculate the three phase power measurement and predetermine the voltage regulation of alternator.
- To understand and analyze the characteristics of electronic circuits using IC741 and IC 555

Course Outcomes

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

CO1 - Predetermine the equivalent circuits of single phase transformer. **(K4)**
CO2 - Analyze the different performance characteristics of single phase and three phase transformers.**(K4)**
CO3 - Experiment and analyze the performance of single phase and three phase rotating transformer.**(K4)**
CO4 - Predetermine the voltage regulation of alternator by using different methods. **(K4)**
CO5 - Design and test various waveform generation circuits using IC 741 and IC 555.**(K4)**

List of Experiments

1. Open Circuit and Short Circuit Test on Single Phase Transformer
2. Load Test on Single Phase Transformer
3. Load Test on 3 Phase Transformer
4. Load Test on Single Phase Induction Motor
5. Two Wattmeter Method of Power Measurement
6. Load test on three phase squirrel cage induction motor.
7. Predetermine the voltage regulation of alternator by using EMF method.
8. Inverting and Non-Inverting Amplifier Using IC 741
9. Astable Multivitbrator Using IC 555
10. Adder / Substractor Using IC 741

Reference Books

1. D. P. Kothari, B. S. Umre, "Laboratory Manual for Electrical Machines", I.K. International Publishing House, New Delhi, 2nd Edition, 2017.
2. D.R Kohli & S.K Jain, "A laboratory course in electrical machines", New Chand & Bros, Roorkee, 2nd Edition, 2000.
3. Dr. DK. Chaturvedi, "Electrical Machines Lab Manual with MATLAB Programs", Laxmi Publications Pvt Limited, 1st Edition 2015.
4. E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", Tata McGraw Hill, New Delhi, 7th Edition, 2013.
5. Irving. L. Kosow, "Electrical Machines and Transformers", PHI, 2nd Edition, 2007.
6. Ramakant A. Gayakward, "Op-amps and Linear Integrated Circuits", Pearson Education, 5th Edition, 2015
7. James M. Fiore, "OPAMP's and Linear Integrated Circuits Concepts and Applications", Cengage learning, 1st Edition, 2010.

Web References

1. http://electrical-engineering-portal.com/
2. http://em-coep.vlabs.ac.in/
3. http://www.electrical4u.com
4. https://www.tutorialspoint.com/semiconductor_devices/semiconductor_devices_operational_amplifiers.htm
5. https://www.allaboutcircuits.com/video-lectures/op-amp-applications/
6. https://www.electronicsforu.com/electronics-projects/555-timer-working-specifications

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	1	3	-	-	-	2	-	-	-	2	3	3
2	2	3	2	1	3	-	-	-	2	-	-	-	2	3	3
3	2	2	2	1	3	-	-	-	2	-	-	-	2	3	3
4	2	2	2	1	3	-	-	-	2	-	-	-	2	3	3
5	2	3	2	1	3	-	-	-	2	-	-	-	2	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP32	MATERIAL TESTING AND METALLURGY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To make student familiar with modem and conventional tools for material testing.
- To present real world engineering examples of solid mechanics.
- To understand mechanical behavior of various engineering materials by conducting standard tests.
- To perform the characterization of materials like microstructures.
- To leam the concepts of improving the mechanical properties of materials by different methods like heat treatment process.

Course Outcomes

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

CO1 - Evaluate the strength and behavior of materials. **(K3)**
CO2 - Examine the hardness of materials. **(K3)**
CO3 - Develop the theoretical understanding of the mechanical properties of materials. **(K3)**
CO4 - Analysis the procedure of microstructure studies of various materials. **(K3)**
CO5 - Execute the various heat treatment processes for different stages. **(K3)**

List of Experiments

Materials Testing Laboratory

1. Tension test
2. Torsion test
3. Compression test
4. Impact test on a metallic specimen - Izod test
5. Impact test on a metallic specimen - Charpy test
6. Hardness test on metallic specimen - (Brinell, Rockwell)
7. Ductility test: Sheet metals (Al, GI and MS)

Metallurgy Laboratory

8. Identification of the Metals using optical microscope
9. Jominy end quenching test

References Books

1. C.Ravichawla ,Kukreja, K.Kishore, Material Testing Laboratory, by standard publishers, 2016
2. R K Rajput, Engineering Materials and Metallurgy, S. Chand Publishing,2006
3. ASM Handbook Volume 8: Mechanical Testing and Evaluation, Published by ASM International, 2000.
4. A K Bhargava, C P Sharma, Mechanical Behaviour and Testing of Materials by PHI Learning Pvt Ltd, New Delhi, 2014.
5. R Balasubramaniam, Callister Material Science and Engineering, 2nd Edition, Willey Publishers, 2014.

Web References

1. https://virtlabs.tech/strength-of-materials/
2. http://sm-nitk.vlabs.ac.in/index.html
3. https://www.labtesting.com/services/materials-testing/
4. https://nptel.ac.in/courses/112/106/112106293/
5. https://nptel.ac.in/courses/113/107/113107078/

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(K.VELMURUGAN)

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	-	-	2	2	1	-	1	3	3	1
2	3	3	2	2	1	-	-	2	2	1	-	1	3	3	1
3	3	3	2	2	1	-	-	2	2	1	-	1	3	3	1
4	3	2	1	2	1	-	-	2	2	1	-	1	3	3	1
5	3	2	1	2	1	-	-	2	2	1	-	1	3	3	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP33	FLUID MECHANICS AND MACHINERY LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the properties of the fluid.
- To impart training to use various flow measuring devices.
- To understand the conservation of laws to flow through pipes.
- To understand the principles and working of hydraulics machines and its applications.
- To provide practice in estimating friction losses.

Course Outcomes

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

CO1 - Analyse and Interpret fluid flow parameters by conducting experiments on venture and orifice experimental setups. **(K4)**
CO2 - Interpret the flow structures through various models. **(K2)**
CO3 - Analyse the performance characteristic of various types of pumps. **(K4)**
CO4 - Correlate the characteristics curves of gear and turbine pump. **(K4)**
CO5 - Evaluate the performance characteristic of various types of turbine. **(K5)**

List of Experiments

1. Determination of the coefficient of discharge of given Orifice meter.
2. Determination of the coefficient of discharge of given Venturi meter.
3. Visualizing the flow structures through various models.
4. Conducting experiments and drawing the characteristics curves of centrifugal pump.
5. Conducting experiments and drawing the characteristics curves of submersible pump.
6. Conducting experiments and drawing the characteristics curves of jet pump.
7. Conducting experiments and drawing the characteristics curves of pump in series and parallel.
8. Conducting experiments and drawing the characteristics curves of reciprocating pump.
9. Conducting experiments and drawing the characteristics curves of Gear pump.
10. Conducting experiments and drawing the characteristics curves of Turbine pump
11. Conducting experiments and drawing the characteristics curves of Pelton wheel.
12. Conducting experiments and drawing the characteristics curves of Francis turbine.

Reference Books

1. CWR, Hydraulics Laboratory Manual,2004
2. N. Kumarasamy, Fluid Mechanics and Machinery laboratory manual, Charotar Publishing House Pvt. Ltd. 2008.
3. SC Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Education India, 2006.
4. Modi P.N, & Seth S.M, "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 20th Edition, 2015.
5. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, New Delhi, 8th Edition, 2016.

Web References

1. http://fmc-nitk.vlabs.ac.in.
2. https://nptel.ac.in/courses/112/103/112103290/
3. https://apm.iitm.ac.in/fluid_mechanics.html
4. https://virtlabs.tech/fluid mechcanics/
5. https://www.iitk.ac.in/me/fluid-mechanics-laboratory.

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	3	-	-	-	3	-	2	-	3	1	1
2	3	3	2	2	3	-	-	-	3	-	2	-	3	1	1
3	3	3	2	2	3	-	-	-	3	-	2	-	3	1	1
4	3	3	2	2	3	-	-	-	3	-	2	-	3	1	1
5	3	3	2	2	3	-	-	-	3	-	2	-	3	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEC3X	**CERTIFICATION COURSE - I**	**L**	**T**	**P**	**C**	**Hrs**
		0	**0**	**4**	**-**	**50**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U19MES31

SKILL DEVELOPMENT COURSE 1: GENERAL PROFICIENCY – I

(Common to all branches)

L	T	P	C	Hrs
0	0	2	-	30

Course Objectives

- To enrich strong vocabulary and decoding skills through comprehension analysis.
- To advance communication and leadership skills pragmatically.
- To pronounce English sounds in isolation and in connected speech.
- To expand effective written communication skills to meet organizational goals.
- To extend knowledge on verbal aptitude and prepare for interviews.

Course Outcomes

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

CO1 - Interpret *meaning and apply reading* strategies in technical and non-technical context. ***(K2)***

CO2 - Develop interpersonal communication skills professionally. ***(K3)***

CO3 - Infer the distinct speech sounds and overcome native language influence. ***(K2)***

CO4 - Demonstrate various forms of formal writing. ***(K2)***

CO5 - Apply the techniques of verbal aptitude in competitive exams. ***(K3)***

UNIT I COMPREHENSION ANALYSIS (6 Hrs)

Listening: Listening Comprehension (IELTS based) – Speaking: Break the iceberg - Reading: Reading technical passage (IELTS based) - Writing: Writing Task: 1 (IELTS: Graph/ Process /Chart Description) Vocabulary: Synonyms (IELTS)

UNIT II PERSONALITY DEVELOPMENT (6 Hrs)

Listening: Interview Videos- Speaking: Extempore& Presentation (Soft Skills) - Reading: British & American Vocabulary, Read and review (Books, Magazines) - Writing: SWOT Analysis Vocabulary: Idioms (IELTS)

UNIT III INFERENTIAL LEARNING (6 Hrs)

Listening: Listening Speech sounds to overcome Mother Tongue Influence, Anecdotes– Speaking: Interpersonal Interaction & Situational attribution–Reading: Distinguish between facts & opinions - Writing: Writing Conversation to different context Vocabulary: Phrasal Verbs (IELTS)

UNIT IV INTERPRETATION AND FUNCTIONAL WRITING (6 Hrs)

Listening: Group Discussion videos - Speaking: Group Discussion Practice - Reading: Interpretation of data - Graph, table, chart, diagram (IELTS based) -Writing: Writing Task: 2 (IELTS) Vocabulary: Collocations (IELTS)

UNIT V APTITUDE (6 Hrs)

Language Enhancement: Articles, Preposition, Tenses

Verbal Ability Enhancement: Blood Relation, Completing Statements - Cloze test, Spotting Errors –Sentence Improvement, One Word Substitution, Word Analogy, Word Groups(GATE)

Reference Books

1 Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, New Delhi, 2012.
2 Mn,Taylor, and Grant Taylor. "English Conversation Practice". Tata McGraw-Hill Education, 1975.
3 Bailey, Stephen. "Academic writing: A practical guide for students". Psychology Press, 2003.
4 Aggarwal, R. S. "A Modern Approach to Verbal & Non Verbal Reasoning". S. Chand, 2010.
5 Wren, Percival Christopher, and Wren Martin. "High School English Grammar and Composition". S Chand, 2005.

Web References

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
2	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MES32	**SKILL DEVELOPMENT COURSE 2**	L	T	P	C	Hrs
	(Choose anyone of the below three courses)	0	0	2	-	30

1. TWO WHEELER TROUBLESHOOTING

Course Content:

The main objective of this programme is to build students familiar with the Workshop situation and as well as to afford the opportunities to know about the basics of the two wheeler servicing workshop and its environment to make qualified and skilled man power for the two wheeler service sector. And also to create an opportunity for the students to have practical knowledge and to increase their employability. The course has the detailed explanation on the classification of two wheelers, working principles, its components functions. To make the students familiarize with the procedure of troubleshooting of two wheelers with both theoretical and practical approach.

2. TROUBLESHOOTING OF CNC MILLING MACHINE

Course Content:

CNC milling machines are most durable, long lasting pieces of equipment that can be relied upon for their redundancy. But in spite of their reliability, programming complexity and other components contained in the CNC machine often lead to small, but frustrating problems. This course provides a wide knowledge on the CNC Milling troubleshooting with tips on vibration issues, chip jamming, re-cutting of chips, un-satisfactory surface finish, burr formation, machine power and tool wear . The common CNC machine problems, such as improper tool setting, irregular maintenance and poor programming were focused and its remedial measures were provided to the students.

3. TROUBLESHOOTING OF CNC LATHE MACHINE

Course Content:

This course covers Fundamental concepts of CNC machining centers, NC part programming, Programming through CAD/CAM, Maintenance and Troubleshooting the CNC machine tools. This course offers more hands on experience through which the students will be developing CNC programming skills and machining complicated shapes by using the CNC machine tools. As a part of this programme, the students will be able to handle different type of machine maintenance. Best maintenance practices followed by CNC machines. Tools and accessories used in CNC machine tools maintenance work. Problems related to mechanical system in CNC machines. Meaning of the term "Backlash", how to identify and measure Backlash. Causes of failure of electronic system in CNC machines and precautions to be observed. Problems relates to pneumatic system in CNC machines and the Causes of excessive noise in CNC Machines and how to eliminate it.

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U19MEM31	PHYSICAL EDUCATION	L	T	P	C	Hrs
		0	0	2	-	30

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 30 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

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SEMESTER – IV

(K.VELMURUGAN)

U19MET41	PROBABILITY AND QUEUING THEORY (Common to MECH, BME)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- Apply fundamental knowledge of the basic probability concepts.
- To introduce knowledge of standard discrete distributions.
- To acquire knowledge on Probability Distributions.
- To understand strengths and weaknesses of Queuing model.
- To gain strong knowledge in principles of Queuing theory.

Course Outcomes

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

CO1 - Understand the fundamental knowledge of the probability concepts. **(K2)**
CO2 - Apply the basic rules of discrete random variables. **(K3)**
CO3 - Apply the fundamentals of probability theory and random processes. **(K3)**
CO4 - Understand and extend Queuing models to analyze real world systems. **(K2)**
CO5 - Apply the knowledge of Queuing theory in computer field. **(K3)**

UNIT I PROBABILITY AND RANDOM VARIABLE (12 Hrs)

Axioms of probability - Conditional probability - Total probability – Baye's theorem– Moments–Moment generating functions and their properties

UNIT II DISCRETE RANDOM VARIABLES (12 Hrs)

Random Variables and their event spaces, Random variable – Probability mass function – Probability density function - Distribution functions, Binomial, Geometric, Negative Binomial, Poisson.

UNITIII CONTINUOUS RANDOM VARIABLES (12 Hrs)

Some important distributions: Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties – Functions of a random variable.

UNIT IV QUEUING MODELS (12 Hrs)

Markovian queues – Birth and Death processes – Single and multiple server queuing models – Little's formula – Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.(M/M/I):(∞/FIFO), (M/M/I):(N/FIFO), (M/M/C):(∞/FIFO), (M/M/C):(N/FIFO)

UNIT V ADVANCED QUEUING MODELS (12 Hrs)

Finite source models – M/G/1 queue – PollaczekKhinchin formula – M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

Text Books

1. N. P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
2. T. Veerarajan, " Probability and Statistics, Random Process and Queuing Theory", McGraw Hill Education, 2018.
3. P. Sivaramakrishna Das, C. Vijayakumari,"Probability and Queuing Theory", Pearson Education, 6th Edition, 2019

Reference Books

1. C. B. Gupta, Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I and II", Tata McGraw Hill, New Delhi, 2015
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, New Delhi,10th Edition, 2019
3. John F. Shortle, James M. Thomson, Donald Gross, "Fundamental of Queuing theory", 5th Edition, Wiley series, 2018
4. M. Bhatt and Ravish R. Singh, "Probability and Statistics", McGraw Hill Education, 2017.
5. P. Kandasamy, K. Thilagavathi and K. Gunavathi, "Probability and Queuing Theory", S. Chand and Co. Pvt. Ltd, 2015.

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Web References

1. http://www.maths.qmul.ac.uk/~pjc/notes/prob.pdf
2. https://nptel.ac.in/courses/117/103/117103017/
3. https://youtu.be/COI0BUmNHT8
4. https://nptel.ac.in/courses/111107119/
5. https://youtu.be/Yf3RZ-zW_2M

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	-	-	-	-	-	1	1	1	-
2	3	2	1	1	-	1	-	-	-	-	-	1	1	1	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
4	2	1	-	-	-	1	-	-	-	-	-	1	3	3	-
5	3	2	1	1	-	1	-	-	-	-	-	1	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET42 **KINEMATICS OF MACHINERY**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the basics components and layout of linkages in the assembly of a system and machine to visualize simple mechanisms and its applications
- To Illustrate students about Kinematic Analysis (Instantaneous center method and relative velocity method) of simple mechanisms
- To provide students an understanding of different types of mechanisms.
- To teach students about different types of specified contour and derived contour cams and its kinematic analyses.
- To explain about kinematic advantages, problems and explain about epicyclic gear train and its speed calculation.

Course Outcomes

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

CO1 - Demonstrate an understanding of the concepts of various mechanisms and pairs. **(K2)**
CO2 - Solve velocity and acceleration in simple mechanism by Graphical Method. **(K3)**
CO3 - Develop a simple mechanism such as Four Bar and slider crank Mechanism. **(K4)**
CO4 - Design a layout of cam for specified motion. **(K4)**
CO5 - Solve problem on gears and gear Train. **(K4)**

UNIT I BASICS OF MECHANISMS **(12 Hrs)**

Mechanisms and machines; Elements of kinematic chain, mobility and range of movements, Definition and Concept - inversion of single and double slider chain and four bar chain and its applications Mechanism with lower pairs -Pantograph, Straight line mechanism- exact and approximate Motion-Mini projects.

UNIT II KINEMATIC ANALYSIS OF MECHANISMS **(12 Hrs)**

Analysis of displacement, velocity and acceleration diagrams of simple planar mechanisms by graphical (Instantaneous center method and relative velocity method), analytical and computer aided methods (for four-bar and slider crank mechanism only.

UNIT III KINEMATIC SYNTHESIS OF MECHANISMS **(12 Hrs)**

Kinematic synthesis, graphical method using relative pole method, Inversion method and overlay 3 point synthesis problems - Motion, path and function generation, Chebyshev's spacing of accuracy points - Freudenstein Method of 3 point synthesis of four link mechanism and slider crank Mechanism- Coupler curves.

UNIT IV CAMS **(12 Hrs)**

Classification-Displacement diagrams-Uniform velocity, SHM, uniform acceleration and retardation and cycloidal motions-layout of profile of plate cams of the above types with reciprocating, oscillating, knife edge, roller and flat faced followers.

UNIT V GEARS AND GEAR TRAIN **(12 Hrs)**

Classification and terminology used Fundamental law of gearing – friction wheel, teeth for positive action and condition for constant velocity ratio. Conjugate profiles cycloidal and involute teeth profiles. Involute construction, properties and computation of path of contact and contact ratio. Interference and undercutting- Minimum number of teeth to avoid Interference, methods to avoid Interference. Introduction, classification, examples, gear ratio in simple and compound gear trains.

Text Books

1. S S.Rattan - Theory of Machines, McGraw Hill, 5th Edition, 2019
2. J.J. Uicker, Jr., G.R. Pennock, and J.E. Shigley - Theory of Machines and Mechanisms, Oxford University Press, 5th Edition, 2016
3. Amitabh Ghosh, Ashok Kumar Malik - Theory of Mechanisms and Machines, Edition, 3. Publisher Affliated East, 1998

(K.VELMURUGAN)

Reference Books

1. Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", Second Edition, Pearson Education India, 2015
2. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2014.
3. P.L. Ballaney - Mechanics of Machines, Khanna Publishers, 2012
4. Thomas Bevan - Theory of Machines, 3rd Edition, Pearson education, 2009
5. R.S.Khurmi, Gupta,.J.K., "Theory of Machines", S.Chand and Company, 2009

Web References

1. http://mm-nitk.vlabs.ac.in/
2. https://nptel.ac.in/courses/112104114
3. https:/ ocw.mit.edu
4. https://easyengineering.net/me6401-kinematics-of-machinery/
5. https://link.springer.com/book/10.1007/978-94-007-1156-3

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	1	2	-	2	-	-	-	2	2	1
2	3	2	2	-	-	1	-	-	2	-	-	-	2	2	1
3	3	2	2	-	2	1	-	-	2	-	-	-	2	2	1
4	3	2	3	-	-	1	-	-	2	-	-	-	2	2	1
5	3	2	2	-	-	1	-	-	2	-	-	-	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

Deepa
(K.VELMURUGAN)

U19MET43 **HEAT AND MASS TRANSFER**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the conduction type of heat transfer in steady and transient condition.
- To enable the students to expose the mechanisms of free and forced convection type of heat transfer.
- To develop the radiation shape factor for black and grey body radiations.
- To demonstrate the phase change heat transfer and calculate the performance of heat exchanging devices.
- To provide the knowledge on diffusion and convective mass transfer.

Course Outcomes

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

CO1 - Understand the basic concepts of heat transfer and solve steady and unsteady conduction heat transfer problems. **(K2)**

CO2 - Determine the temperature variation and rate of heat flow in convection heat transfer problems. **(K4)**

CO3 - Explain basic laws for Radiation and Determine the radiation properties of a black and grey body Radiation. **(K2)**

CO4 - Integrate the concepts of phase change heat transfer and compare the thermal performance of heat exchangers using LMTD and NTU approach. **(K5)**

CO5 - Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications. **(K3)**

UNIT I CONDUCTION (12 Hrs)

Introduction of heat transfer – conduction - convection and radiation – Laws – General equation of heat conduction – Derivation in Cartesian - cylindrical and spherical coordinates – One dimensional steady state heat conduction in simple geometries – plane wall - cylinder and sphere – Heat transfer composite walls - composite cylinders and composite spheres – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT II CONVECTION (12 Hrs)

Boundary layer theory – Hydrodynamic and Thermal Boundary Layer- Dimensional Analysis-Flow over a flat– Flow over cylinders -spheres - tube bank – Internal flow through pipes in forced heat transfer – Natural convection in vertical - inclined and horizontal surfaces – Mixed convection.

UNIT III RADIATION (12 Hrs)

Radiation heat transfer –Thermal radiation – Laws of radiation – Black body concept – Grey body radiation - Emissive power – Radiation shape factor-radiation heat exchange between surfaces – Electrical Analogy – Radiation Shields-Radiation through gases.

UNIT IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS (12 Hrs)

Condensation and Boiling – Film wise and drop wise condensation – Film condensation on a Vertical plate – Regimes of Boiling – Forced convection boiling. Heat Exchangers – Types and practical applications – Use of LMTD – Effectiveness – NTU method – Compact heat exchangers – Plate heat exchangers – Fouling factor.

UNIT V MASS TRANSFER (12 Hrs)

Introduction of Mass Transfer – 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-Evaporation of water into air.

Text Books

1. R. C. Sachdeva, Fundamentals of Heat and Mass Transfer, New Age International Publishers, 2017.
2. C. P. Kothandaraman and S. Subramanyan, Fundamental of Heat and Mass Transfer, New Age International Publishers, 2012.
3. P. K. Nag, Heat and Mass Transfer, McGraw Hill Education India Pvt. Ltd. 2011.

(R. VELMURUGAN)

References Books

1. C. P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers, 2018.
2. P.Frank, Incropera and David P. Dewitt, Incropera's principles of Heat and Mass Transfer, Wiley India Edition, 2018
3. A.Yunus, Cengel, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education, 2016.
4. P. S. Ghoshdastidar, Heat Transfer, Oxford University Press. 2012
5. J. P. Holman, Heat Transfer, 10th Edition, McGraw-Hill Publishing Company Limited. 2011

Web References

1. https://nptel.ac.in/courses/112108149
2. https://nptel.ac.in/courses/112106170
3. https://nptel.ac.in/courses/112105248
4. http://ceng.tu.edu.iq/ched/images/lectures/chem-lec/st3/c3/Lectures-Mass%20Transfer-1.pdf
5. http://www.ht.energy.lth.se/fileadmin/ht/Kurser/MMV031/Introduction-HEX.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
2	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
3	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
4	3	3	3	2	2	-	-	-	-	-	-	-	3	3	3
5	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET44	MACHINING PROCESSES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand terminology and geometry of tools and various operations on lathe
- To understand operations carried out on drilling and boring machines
- To understand the various machining processes such as Shaping, Planar and Slotting.
- To understand various milling and grinding operations
- To learn about the nomenclature of cutting tools, cutting fluids, types and tool materials.

Course Outcomes

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

CO1 - Select the correct tool and performing the various operations on lathe. **(K2)**
CO2 - Acquire the knowledge of operations to be carried on drilling and boring machines. **(K2)**
CO3 - Perform various operations on Shaper, planar and slotting Machines. **(K2)**
CO4 - Enhance the knowledge of indexing on milling machine for gear cutting. **(K3)**
CO5 - Select the proper cutting fluids for different machining process. **(K3)**

UNIT I TURNING OPERATIONS (9 Hrs)

Lathe - Types, Designation, Work holding devices – Cutting Speed, Feed and Depth of Cut, MRR - Operations, Machining Time.

UNIT II DRILLING AND ALLIED OPERATIONS (9 Hrs)

Drilling Machines - Types, Operations, Machining Time - Boring, Reaming and Tapping (Definition of operations only)

UNIT III SHAPING MACHINING (9 Hrs)

Shaper, Types, Shaping Operations, Planner, Types, Planning Operation, Slotting Machine Operations.

UNIT IV MILLING AND GRINDING MACHINING (9 Hrs)

Milling Machine, Types, Milling Process, Milling Operations, MRR, Machining Time. Types of Grinding, Shapes and Size of a Grinding Wheel, Various Elements of a Grinding Wheel, Parameters of Grinding Operation. Balancing of Grinding Wheel.

UNIT V CUTTING TOOLS (9 Hrs)

Tool Materials, Nomenclature and Geometry of Cutting Tools, Tool wear Mechanisms, Tool Life – Tool Life Criteria. Cutting Fluids - Categories, Desirable Properties, Selection of Cutting Fluids.

Text Books

1. R.K.Singal, Mridul Singal, Rishi Singal, "Fundamentals of Machining and Machine Tools" I.K.International Publishing Home Pvt. Ltd; New Delhi, 2008.
2. B.S.Nagendra Parashar, R.K.Mittal. "Elements of Manufacturing Processes", Prentice - Hall of India Pvt. Ltd, New Delhi, 2012.
3. Hassan El-Hofy, "Fundamentals of Machining Processes: Conventional and Nonconventional Process", CRC Press, 2018.

Reference Books

1. R. K. Rajput "A Textbook of Manufacturing Technology: Manufacturing Processes ", Laxmi Publications (P) Ltd., New Delhi, 2007.
2. Serope Kalpakjian "Manufacturing Processes for Engineering Materials", Pearson Education, 2009.
3. J. P. Kaushish "Manufacturing Processes", PHI Learning Pvt Ltd, New Delhi, 2010.
4. H. N. Gupta "Manufacturing Processes", New Age International, 2012.
5. David Fenner,"Mini-Lathe Tools and Projects", Fox Chapel Publishing, 2018.

(K.VELMURUGAN)

Web References

1. https://nptel.ac.in/courses/112/107/112107219/
2. https://openoregon.pressbooks.pub/manufacturingprocesses45/
3. https://www.vlab.co.in/broad-area-mechanical-engineering
4. http://www.nptelvideos.in/2012/12/manufacturing-processes-ii.html
5. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3804

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	1	-	-	-	-	-	-	-	1	1	1
2	3	2	1	-	1	-	-	-	-	-	-	-	2	2	1
3	3	1	1	1	1	-	-	-	-	-	-	-	1	2	1
4	3	2	2	1	1	-	-	-	-	-	-	-	2	1	2
5	3	2	1	-	1	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VELMURUGAN)

U19MEP41 COMPUTER AIDED MACHINE DRAWING LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To expose the students to CAD /CAE software in the design and drawing of machine components.
- To create assembly models of simple machine elements.
- To draw various permanent and temporary joints.
- To be able to read and interpret the diagrams drawn by draughtsman and familiarizing in GD&T.
- To familiarize on analysis of engineering drawing.

Course Outcomes

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

CO1 - Design and drawing of machine using suitable software. **(K3)**
CO2 - Draw 2D Assembly models of simple machine elements. **(K3)**
CO3 - Draw various joints using in machine assembly. **(K3)**
CO4 - Apply the concept of GD&T in drawings. **(K3)**
CO5 - Analyze the drawings using engineering skills. **(K4)**

List of Experiments

1. Preparation of Drawings for Parts and Assembly of the following by using Drafting software.
   Gear coupling, spring loaded safety valve, lever safety valve, blow-off cock, cast iron flange joint, hydraulic joint, feed check valve, foot step bearing, ball valve, stuffing box- minimum 5 exercises
2. Preparation of Production Drawings with tolerances limits and fits using Drafting software - Minimum one exercise
3. Introduction to Geometric Dimensioning and Tolerancing, Geometric Tolerances Symbols- Tolerance Zone, Run-out, Feature Control Frame and its components, Straightness, Flatness, Circularity and Cylindricity, Parallelism, Perpendicularity and Angularity, Material Conditions- MMC and LMC, Position Tolerance and Datums, Twelve Degrees of Freedoms and Datum Planes, Surface Symbols – Roughness- Applying Feature Control Frame usage in drawings

References/ Manuals/ Software

1. Ajeet Singh, Machine Drawing, Tata McGraw-Hill Publishing Company, New Delhi, 2nd Edition, 2012.
2. Bhatt.N.D. "Machine Drawing", Charotar Publishing House, 50th Edition, 2016.
3. Narayana, K.L., Bheemanjaneyulu, S, "Engineering Drawing with AutoCAD 2016", New Age International, 1st Edition, 2018.
4. K.Venugopal, V. Prabhu Raja, "Engineering Drawing + AutoCAD", New Age International 5th Edition, 2011.
5. Goutam Pohit, Goutam Ghosh, Machine drawing with AutoCAD, Pearson Education, 1st Edition, 2007.
6. P.S. Gill, Geometric Dimensioning and Tolerancing, S. K. Kataria and Sons, 2009.

Web References

1. https://mech.iitm.ac.in/Production%20Drawing.pdf
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php
3. http://www.nptelvideos.in/2012/12/computer-aided-design.html
4. https://autocadtutorials.com
5. https://dwgmodels.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP42 HEAT TRANSFER LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To define the fundamental concepts in the area of heat transfer and its applications.
- To recognize the practical significance of various parameters involved with different modes of heat transfer.
- To apply conduction and convection mode of heat transfer with heat transfer equipment.
- To understand radiation heat transfer concept to find Stefan Boltzmann constant and emissivity.
- To teach the principle of parallel flow, Counter flow and Plate type heat exchangers

Course Outcomes

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

CO1 - Analyse and Interpret heat transfer parameters by conducting experiments on conduction and convection experimental setups. **(K4)**

CO2 - Analyse and Interpret heat transfer parameters by conducting experiments on radiation experimental setups. **(K4)**

CO3 - Analyse and Interpret heat transfer parameters by conducting experiments on Heat exchanger experimental setups. **(K4)**

CO4 - Analyse and Interpret the surface emissivity of a test plate and Stefan Boltzmann's constant and compare with theoretical value. **(K4)**

CO5 - Analyse and Interpret the thermal conductivity and transient heat conduction experiments. **(K4)**

List of Experiments

1. Heat transfer on cylindrical surface by natural convection
2. Heat transfer on cylindrical surface by forced convection
3. Heat transfer from Pin fin by natural convection
4. Heat transfer from Pin fin by forced convection
5. Heat transfer on a composite wall
6. Determination of Stefan Boltzmann constant
7. Determination of emissivity of a specimen
8. Experiment on Parallel flow heat exchanger
9. Experiment on Counter flow heat exchanger
10. Experiment on plate type heat exchanger

Reference Books

1. C. P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers, 2018.
2. R. C. Sachdeva, Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd, 2017.
3. J. P. Holman, Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited, 2011.
4. S.P. Sukhatme, A text book on Heat Transfer, Fourth Edition, Universities Press, 2005.
5. C. A. Sundén, Brebbia, Heat Transfer XIII Simulation and Experiments in Heat and Mass Transfer, WIT Press, 2013.

Web References

1. http://htv-au.vlabs.ac.in/
2. https://nptel.ac.in/courses/103/103/103103032/
3. https://nptel.ac.in/courses/112/101/112101097/
4. https://www.iitk.ac.in/me/heat-transfer-laboratory
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Heat%20and%20Mass%20Transfer/TOC.htm

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2
4	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP43	MANUFACTURING PROCESSES LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study foundry tools and preparation of solid pattern.
- To study and practice the various operations that can be performed in milling machine.
- To study and practice the various operations that can be performed in shaping and grinding machine.
- To impart students the fundamental knowledge of CNC machines.
- To practice part programming for turning and milling operations.

Course Outcomes

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

CO1 - Understand the mould preparations using solid and split patterns. **(K2)**
CO2 - Understand the principle of gear generation. **(K2)**
CO3 - Perform operations in Grinding machine tool. **(K3)**
CO4 - understand the functions of G and M codes in CNC Machines. **(K2)**
CO5 - Generate CNC program for turning and milling. **(K5)**

List of Experiments

FOUNDRY

1. Demo and practices of foundry tools
2. Mould preparation using solid patterns
3. Mould preparation using split patterns

GEAR CUTTING

4. Demonstration of gear hobbing machine and safety related to each machines
5. Spur gear hobbing
6. Spur gear milling
7. Helical gear milling

TOOL GRINDING

8. Demonstration of cutter grinder and safety related to grinding machines
9. Grinding of single point cutting tool

CNC PROGRAMMING

10. Demonstration of CNC turning and milling machines
11. CNC Part Programming for turning
12. CNC Part Programming for milling
13. APT Programming for drilling
14. APT Programming for milling

Reference Books

1. R.K.Singal, Mridul Singal, Rishi Singal, "Fundamentals of Machining and Machine Tools" I.K.International Publishing Home Pvt. Ltd; New Delhi, 2008.
2. Vajpayee S. Kant, "Principles of Computer Integrated Manufacturing", Prentice Hall of India Learning, 2009.
3. Mikell P.Groover, "Automation, Production systems and Computer Integrated Manufacturing" PHI Learning Pvt. Ltd., 3rd Edition, 2009.
4. Harshal Dhawas, "CNC Programming For Lathe and Milling: Siemens Sinumerik Control", Kindle Edition, 2019.
5. **Kumar**, Kaushik, **Ranjan**, Chikesh, **Davim**, J. Paulo, "CNC Programming for Machining", Springer, 2020.

Web References

1. https://mie.umass.edu/materials-and-processes-lab
2. https://nptel.ac.in/content/storage2/courses/108105063/
3. https://www.cnccookbook.com/cnc-programming-pdf-machine-codes/
4. https://www.walter-machines.com/en/tool-machining/tool-grinding-machines/
5. http://www.iitk.ac.in/mme/test/TA201.pdf

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	-	-	-	-	-	-	-	2	1	2	1
2	3	1	2	-	2	-	-	-	-	-	-	1	1	2	2
3	3	1	2	-	1	-	-	-	-	-	-	2	2	1	2
4	3	2	2	-	3	-	-	-	-	-	-	2	2	2	2
5	3	2	2	1	2	-	-	-	-	-	-	3	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEC4X	CERTIFICATION COURSE - II	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U19MES41

SKILL DEVELOPMENT COURSE 3
GENERAL PROFICIENCY – II
(Common to all branches)

L	T	P	C	Hrs
0	0	2	-	30

Course Objectives

- To examine various standardized test in English language
- To recognize the key features of various technical writing
- To integrate LSRW skills to endorse multifarious skill set in practical situation
- To understand the factors that influence the usage of grammar
- To understand the basic concepts of logical reasoning skills

Course Outcomes

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

CO1 - Infer ideas to attend international standardized test by broadening receptive and productive skills. ***(K2)***
CO2 - Interpret the types of writing in different state of affairs. ***(K2)***
CO3 - Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation. ***(K3)***
CO4 - Identify the rules of grammar in academic discourse settings. ***(K3)***
CO5 - Extend the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc. ***(K2)***

UNIT I CAREER SKILLS (6 Hrs)

Listening: Listening at specific contexts Speaking: Mock interview (Personal and Telephonic) - Reading: Read and Review - Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) Writing: Essay Writing (TOEFL) Vocabulary: Words at specified context (IELTS)

UNIT II CORPORATE SKILLS (6 Hrs)

Listening: Listening and replicating Speaking: Team Presentation (Work Place Etiquettes) Reading: Short texts (signs, emoticons, messages) Writing: E-mail writing- Hard skills -Resume' Writing, Job Application Letter, Formal Letter Vocabulary: Glossary (IELTS)

UNIT III FUNCTIONAL SKILLS (6 Hrs)

Listening: Listening TED Talks – Speaking: Brainstorming and Individual Presentation, Persuasive Communication — Reading: Text Completion (GRE Based) Writing: Expansion of Compound Words Vocabulary: Expansion of vocabulary (IELTS)

UNIT IV TRANSFERABLE SKILLS (6 Hrs)

Listening: Listening Documentaries and making notes – Speaking: Conversation practice at formal and informal context Reading: Read and transform- report, memo, notice and advertisement, Writing: Euphemism, Redundancy, and Intensifiers Vocabulary: Refinement of vocabulary (IELTS)

UNIT V APTITUDE (6 Hrs)

Transformational Grammar: Phrases and Clauses, Concord, Conditional Clauses, Voice, Modals.
Verbal Ability Enhancement: Letter Series, Coding and Decoding, Sentence Completion (GATE), Critical Reasoning and Verbal Deduction (GATE), Syllogism.

Reference Books

1. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008.
2. Tulgan, Bruce. "Bridging the soft skills gap: How to teach the missing basics to today's young talent". John Wiley and Sons, 2015.
3. Sherfield, Robert M. "Cornerstone: Developing Soft Skills". Pearson Education India, 2009.
4. Cullen, Pauline, Amanda French, and Vanessa Jakeman. "The official Cambridge guide to IELTS for academic and general training", Cambridge, 2014.
5. Ramesh, Gopalaswamy. "The ace of soft skills: attitude, communication and etiquette for success". Pearson Education India, 2010.

(K.VELMURUGAN)

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1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
4	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MES42	SKILL DEVELOPMENT COURSE 4 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	-	30

1. FOUR WHEELER TROUBLESHOOTING

Course Content:

The main goal of this programme is to in cultivate students with the broad knowledge on the Workshop situation and as well as to afford the opportunities to know about the basics of the four wheeler servicing workshop and its environment to make qualified and skilled man power for the two wheeler service sector. And also to create an opportunity for the students to have a practical knowledge and to increase their employability. The course has the detailed explanation on the classification of four wheelers, working principles, its components functions such as clutches, shock absorber, chassis, braking systems, battery maintenance etc. To make the students familiarize with the procedure of troubleshooting of four wheelers with both theoretical and practical approach.

2. ELECTRONIC TROUBLESHOOTING FOR MECHANICAL ENGINEERS

Course Content:

This course is aimed for mechanical engineering students to provide a overlapping working areas with electrical and electronics engineering and in interdisciplinary projects. It offers all the theoretical knowledge that a mechanical engineer lacks in fundamentals of electronics. The course is conducted by a mechanical engineer knowledgeable of the material and based on a book describing the vital knowledge of electronics for non-electrical engineers. The course covers the basics and practical applications of diodes, regulator diodes, power supplies, amplifiers and the distinction between analog and digital circuits. After completion of this course, the students can be able to understand and recognize analogue and digital circuits, the functioning and application of diodes and transistors in electronics circuits, realize the performance and be able to design/build/repair rectifiers and power supplies, gains knowledge about inverters and power converters, learns how a transistor can be used for switching or for amplification and classification of amplifiers for signal amplification in different applications.

3. HARDWARE NETWORKING

Course Content:

Computer hardware and Networking is an interesting field of computer science. These courses comprise various content related to computer organization, electrical and electronics circuits. Candidates pursuing these courses also learn about the different parts of computers and how they function. The course enables them to figure out and fix hardware and network issues related to computers and other such devices. This course aims to prepare the students a role as an entry-level IT Support Specialist. In this course, the different facets of Information Technology, like computer hardware, the Internet, computer software, troubleshooting, and customer service were provided. This also course covers how the binary system works, assemble a computer from scratch, install an operating system on a computer, the Internet and its working, common problem-solving methodologies and soft skills in an Information Technology setting.

(K.VELMURUGAN)

U19MEM41	INDIAN CONSTITUTION	L	T	P	C	Hrs
		2	0	0	-	30

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

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SEMESTER – V

(K.VELMURUGAN)

U19MET51	NUMERICAL METHODS AND STATISTICS (Common to MECH & CCE)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- Learn the techniques of solving algebraic and transcendental equations.
- To introduce the numerical techniques of differentiation and integration.
- To know the basic concepts of statistical parameters like mean, median, mode etc.
- To understand the concept of testing of hypothesis using statistical analysis.
- Identify the direction and strength of a linear correlation between two factors.

Course Outcomes

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

CO1 - Solve algebraic and transcendental equations. **(K3)**
CO2 - Apply the knowledge of interpolation by using the numerical methods. **(K3)**
CO3 - Understand the basic concepts of Statistics. **(K2)**
CO4 - Apply the concept of testing of hypothesis for small and large samples. **(K3)**
CO5 - Know the applications of linear regression and correlation. **(K2)**

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS (12 Hrs)

Solution of algebraic and transcendental equations – Newton Raphson method – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT II NUMERICAL DIFFERENTIATION AND INTEGRATION (12 Hrs)

Interpolation: Interpolation by Newton's forward and backward difference formulae for equal intervals – Solution of ordinary differential equations – Single step methods – Taylor series method – Euler methods – Integration by Trapezoidal and Simpson's rules – Lagrange's method for unequal intervals.

UNIT III MEASURES OF DISPERSION (12 Hrs)

Standard deviation – Mean deviation – Quartile deviation – Range – Measures of Skewness and Pearson's coefficient of skewness – Moments about the arbitrary origin and moments based on measures of skewness and kurtosis.

UNIT IV TESTING OF HYPOTHESIS (12 Hrs)

Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means and difference of standard deviations. Small samples: Test for single mean, difference of means and correlation coefficients – test for ratio of variances – Chi–Square test for goodness of fit and independence of attributes.

UNIT V CORRELATION AND REGRESSION (12 Hrs)

Curve fitting - Method of least squares – Correlation – Rank correlation – Regression – Multiple and partial correlation - Plane of regression – Coefficient of multiple correlation – Coefficient of partial correlation.

Text Books

1. B.S.Grewal, "Numerical Methods in Engineering and Science ", Mercury learning & Information, Kindle Edition, 2018.
2. T. Veerarajan and T. Ramachandran, "Statistics and Numerical methods", Mc Graw Hill, 1st Edition, 2019.
3. Richard A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.

Reference Books

1. Rajesh Kumar Guptat, "Numerical Methods, Fundamental and its Applications", Cambridge University, 2019.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019
3. Timothy Sauer, "Numerical Analysis", Pearson Education, 3rd Edition 2017.
4. Arvind Pragati Gautam, "Numerical Methods", Alpha Science International Limited 2019.
5. N.P.Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.

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Web References

1. http://nptel.ac.in/courses/111107063/
2. https://nptel.ac.in/courses/111107119/
3. https://easyengineering.net/ma6452-statistics-and-numerical-methods/
4. https://nptel.ac.in/courses/110/105/110105087/
5. https://nptel.ac.in/courses/111/105/111105077/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	3	1	-
2	3	2	1	1	-	1	-	-	-	-	-	1	3	1	-
3	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-
5	2	1	-	-	-	-	-	-	-	-	-	1	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MET52 **DESIGN OF MACHINE ELEMENTS**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the design methodology for machine elements.
- To develop the Knowledge on basic failure mechanisms of riveted and welded joints.
- To learn the design Procedure for the different machine elements such as Keys, Cotters and Knuckle joints.
- To develop knowledge on design dimensions and to compute the stress acting on machine components like shafts and couplings
- To enable the students to understand the design procedure of springs with appropriate assumptions.

Course Outcomes

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

CO1 - Understand the design process and Compute the stress acting on various machine elements. **(K2)**
CO2 - Understand different welded and riveted joints structure and able to apply its knowledge to analyze its strength when subjected to axial and eccentric loading. **(K2)**
CO3 - Design and analyse of keys, cotters and knuckle Joints. **(K4)**
CO4 - Compute the dimensions, stress requirements of shaft and couplings based on various load conditions. **(K5)**
CO5 - Compute the dimensions of the springs for specific applications. **(K5)**

UNIT I DESIGN FUNDAMENTALS (12 Hrs)

Design Process – Computer aided design – Optimum design – Material Standards – Industrial design form and shape design, embodiment design and design for manufacture. Types of loads –Stresses – Static, varying, thermal, impact and residual. Factors of safety – Theories of failure – Stress concentration factors – S-N curves and its applications.

UNIT II DESIGN OF FASTENERS AND WELDED JOINTS (12 Hrs)

Riveted joints-methods of failure of riveted joints strength equations-efficiency of riveted joints- eccentrically loaded riveted joints. Design of fillet welds- axial loads-circular fillet welds-bending and torsion. Design of bolts with pre-stresses- design of joints under eccentric loading -bolts of uniform strength.

UNIT III DESIGN OF KEYS, COTTERS AND KNUCKLE JOINTS (12 Hrs)

Design of Keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, jib and cotter joints-Knuckle joints.

UNIT IV DESIGN OF SHAFTS AND COUPLINGS (12 Hrs)

Design of solid and hollow shafts for strength and rigidity – Design of shafts for complex loads– Shaft sizes – BIS code- Design of shafts for gear and belt drives, Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Pin-Bush coupling.

UNIT V DESIGN OF SPRINGS (12 Hrs)

Stresses and deflections of helical springs-extension compression springs- spring for static and fatigue loading-natural frequency of helical springs-energy storage capacity-helical torsion springs-co-axial springs.

Text Books

1. K.Ganesh Babu, K.Srithar, "Design of Machine Elements", 1st Edition, McGraw Hill, 2009.
2. V.B.Bhandari. "Design of Machine Elements", 4th edition, McGraw Hill Education India, 2017.
3. T.Jagadeesha, "Design of Machine Elements", Universities Press (India) Private limited, Hyderabad, 2018.

Reference Books

1. J.E Shigley, "Mechanical Engineering Design", 6th ed., McGraw-Hill, New York, 2001.
2. R.C.Juvinall, K.M.Marshek, "Fundamentals of machine component design", 6th edition, John Wiley.2011.
3. Design Data Book for Engineers, PSG College of Technology Coimbatore, Kalaikathir Achchagam 2016.
4. Robert L. Norton, "Machine Design" 5th edition Pearson, 2014.
5. Wai Jiang, "Analysis and Design of Machine Elements", Wiley, 2019

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3. https://nptel.ac.in/content/storage2/courses/112105125/pdf/modules1.pdf
4. https://www.machinedesign.com/fastening-joining/article/21812672/welded-joints
5. http://www.haynesintl.com/alloys/fabrication-brochure/welding-and-joining/weld-joint-design

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
2	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
3	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
4	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2
5	3	2	3	1	2	1	-	1	-	1	-	1	3	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET53	DYNAMICS OF MACHINERY	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To perform force analysis and balancing of reciprocating engines and to determine basic parameters of flywheel and its functions
- To understand the effects of free vibration in single degree of freedom systems
- To understand the dynamic effect of undesirable forced vibrations.
- To understand the principles in mechanisms used for speed control and stability control
- To perform balancing of rotating and reciprocating masses

Course Outcomes

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

CO1 - Carry out static and dynamic force analysis on various parts of reciprocating engine and to determine flywheel parameters by constructing turning moment diagram **(K4)**

CO2 - Compute the frequency of free vibration in single degree of freedom systems **(K4)**

CO3 - Compute the frequency of forced vibration in damped and undamped systems **(K4)**

CO4 - Calculate the speed, lift of the governor, and estimate the gyroscopic effect on automobiles, ships and airplanes. **(K4)**

CO5 - Calculate the magnitude and position of reciprocating and rotating masses and thereby to balance them. **(K4)**.

UNIT I DYNAMIC FORCE ANALYSIS (12 Hrs)

Dynamic force analysis – Inertia force and Inertia torque– D'Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses.

UNIT II VIBRATION – SINGLE DEGREE OF FREEDOM SYSTEMS (12 Hrs)

Introduction to vibration – Terminology – Classification of vibrations – Undammed and Damped free vibration of single degree of freedom systems – Viscous damping – Introduction to coulomb damping. Forced vibration – harmonic excitation – Magnification factor – Vibration isolation and Transmissibility.

UNIT III TRANSVERSE AND TORSIONAL VIBRATION SYSTEMS (12 Hrs)

Transverse vibrations of shafts and beams – Rayleigh's and Dunkerley's method – Whirling of shafts. Torsional vibrations – Single rotor, two rotors and three rotors system – Vibration of geared systems.

UNIT IV MECHANISM FOR CONTROL (12 Hrs)

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 V BALANCING (12 Hrs)

Static and dynamic balancing of rotating masses in different planes - partial balancing of reciprocating masses of inline, V, W and radial engines

Text Books

1. S.S.Rattan, Theory of Machines,3rd edition, Tata McGraw-Hill Education India, 2019
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rd Edition, Publisher: Pearson Education India, 2014
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006

Reference Books

1. John J. Uicker, Joseph E.Shigley, "Theory of Mechanisms and Machines",5th Edition, Oxford Publications, 2016.

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2. P.L.Ballaney, Theory of Machines and Mechanisms, 25th Edition, Khanna Publishers, 2016.
3. R.S.Khurmi, "Theory of Machines", 14th Edition, S Chand Publications, 2008.
4. Brian W. Kernighan & Dennis Ritchie. "The C Programming Language", 2nd Edition, Pearson Education India Publications, 2015.
5. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International Publications, 2014.

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1. https://nptel.ac.in/courses/112104114
2. https:/ ocw.mit.edu
3. http://mm-nitk.vlabs.ac.in/
4. https://nptel.ac.in/courses/112/101/112101096/
5. https://nptel.ac.in/courses/112/106/112106270

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	1	2	-	2	-	-	-	2	2	1
2	3	2	2	-	-	1	-	-	2	-	-	-	2	2	1
3	3	2	2	-	2	1	-	-	2	-	-	-	2	2	1
4	3	2	3	-	-	1	-	-	2	-	-	-	2	2	1
5	3	2	2	-	-	1	-	-	2	-	-	-	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VELMURUGAN)

U19MET54 **METROLOGY AND MEASUREMENT**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide knowledge on various metrological equipment's available in mechanical industry.
- To understand the basic construction and working of linear and angular measurement tools.
- To understand the basics of modern inspection methods and computerized inspection.
- To acquire about the knowledge on form measurement.
- To understand the various measuring techniques for power, flow and temperature used in industries.

Course Outcomes

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

CO1 - Describe the concepts of measurements to apply in various metrological instruments. **(K1)**
CO2 - Outline the principles of linear and angular measurement tools used for industrial applications. **(K2)**
CO3 - Explain the procedure for conducting computer aided inspection. **(K2)**
CO4 - Demonstrate the techniques of form measurement used for industrial components. **(K2)**
CO5 - Apply various measuring techniques of mechanical properties in industrial needs. **(K3)**

UNIT I BASICS OF METROLOGY **(9 Hrs)**

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS **(9 Hrs)**

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchangeability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT III CMM, LASER INTERFEROMETRY AND MACHINE VISION **(9 Hrs)**

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV FORM MEASUREMENT **(9 Hrs)**

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE **(9 Hrs)**

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orificemeter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.

Text Books

1. R.K.Rajput, "Engineering Metrology and Instrumentation", S.K. Kataria and Sons Publishers, 2019.
2. R.K.Jain , "Engineering Metrology", Khanna Publishers, 25th Edition 2019.
3. J.P.Hadiya, H.G.Kataria ," Mechanical Measurements and Metrology", Books India Publications, 2018.

Reference Books

1. I.C Gupta, "A Textbook of Engineering Metrology" Paperback Dhanpat Rai Publications, 2019.
2. A.Bewoor and Vinay Kulkarni, "Metrology & Measurement" McGraw Hill Education, 2017.
3. Krishnamurthy Raghavendra, "Engineering Metrology and Measurements" Oxford University Press, 2013.
4. Rega Rajendira,"Principles of Engineering Metrology", Jaico Publishing House, 2008.
5. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.

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(R.VELMURUGAN)

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3. https:// jcboseust.ac.in
4. https://ndl.iitkgp.ac.in/homestudy/engineering
5. http://mech4u.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	1	-	-	-	-	1	-	1	2	1	2
2	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
3	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
4	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
5	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VELMURUGAN)

U19MEP51

NUMERICAL METHODS LAB

(Common to ICE & MECH)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn the techniques of solving non-linear equation.
- To find the solutions of simultaneous equations.
- To introduce the numerical techniques of differentiation and integration.
- To understand the curve fitting techniques.
- To study about the single mean and difference of means.

Course Outcomes

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

CO1 - Find out the root of the Algebraic and Transcendental equations. **(K3)**
CO2 - Solve the simultaneous equations. **(K3)**
CO3 - Know the iterative Interpolation formula of integration. **(K3)**
CO4 - Implement Simpsons Rule formula. **(K3)**
CO5 - Solve the Laplace equation using Numerical methods. **(K3)**

List of Experiments

1. Roots of non-linear equation using bisection method.
2. Roots of non-linear equation using Newton's method.
3. Solve the system of linear equations using Gauss - Elimination method.
4. Solve the system of linear equations using Gauss - Seidal iteration method.
5. Solve the system of linear equations using Gauss - Jordan method.
6. Find the area by using trapezoidal rule.
7. Fit a straight line by method of least squares.
8. Fit a parabola by method of least squares.
9. Test for Single mean.
10. Test for difference of mean.

Reference Books

1. C. Xavier, "C Language And Numerical Methods", New Age International, 2007.
2. P. Siva Ramakrishna Das, "Numerical Analysis", Kindle Edition, 2016.
3. Timo Heister, Leo G. Rebholz, FeiXue, "Numerical Analysis an Introduction", Publisher De Gruyter, 2019.
4. K. Sankara Rao, "Numerical Methods for Scientists and Engineers", 3rd Edition, PHI Learning Pvt. Ltd, New Delhi, 2018.
5. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers" McGraw – Hill Higher Education, 2010.

Web References

1. http://nptel.ac.in/courses/111107063
2. http://nptel.ac.in/courses/122102009
3. http://nptel.ac.in/courses/111/107/111107105
4. http://www.math.iitb.ac.in/~baskar/book.pdf
5. https://www.math.ust.hk/~machas/numerical-methods.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	-	-	1
2	3	2	1	1	-	1	-	-	-	-	-	1	-	-	1
3	3	2	1	1	-	1	-	-	-	-	-	1	-	-	1
4	3	2	1	1	-	-	-	-	-	-	-	1	-	-	1
5	3	2	1	1	-	-	-	-	-	-	-	1	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP52	METROLOGY AND MEASUREMENTS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To acquaint practical knowledge on various measuring and calibrating devices.
- To familiarize with different measurement equipment's and its usage in industry for quality inspection.
- To explore the working principle of mechanical measuring devices.
- To understand the importance of accurate measurements in the industrial inspection.
- To give exposure and hands on experience about the metrology of tooling.

Course Outcomes

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

CO1 - Calibrate the vernier, micrometer and slip gauges for the inspection. **(K1)**

CO2 - Measure the gear tooth dimensions, angle using sine bar, straightness and flatness, thread parameters, temperature using thermocouple, force, displacement, torque and vibration. **(K1)**

CO3 - Organize experimental investigation of performance of strain gauges, LVDT, Accelerometer, Stroboscope and profile projector. **(K3)**

CO4 - To relate measuring accuracy of different instruments according to the suitability. **(K2)**

CO5 - To extract the results of measurement performed by different equipment's. **(K2)**

List of Experiments

1. Calibration of Micrometer.
2. Measurement of taper using Sine Bar.
3. Tool Maker Microscope (inspection of screws)
4. Straightness and Flatness Measurement using Autocollimator.
5. Surface Roughness Measurement
6. Inspection of Screw Threads (Effective Diameter).
7. Measurement of Pressure using Strain Gauges.
8. Determination of the Time Constant of Thermocouples.
9. Measurement of Force using Transducers.
10. Measurement of Strain using Strain Gauges.
11. Study of Displacement using LVDT
12. Vibration Measurement using Accelerometer.
13. Measurement of speed using stroboscope
14. Inspection of gear tooth profile using profile projectors

Reference Books

1. R.K.Rajput, S.K.Kataria and Sons, Mechanical measurements and instrumentations, S.K.Kataria and Sons, New Delhi, 2013.
2. R.V.Jalgaonkar, Mechanical measurements and Control, Everest publications, New Delhi, 2010.
3. R.K.Jain, Mechanical and Industrial measurements, Khanna publications, New Delhi, 2010.
4. Rega Rajendira ,"Principles of Engineering Metrology", Jaico Publishing House, 2008
5. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2006

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1. https://www.vlab.co.in/participating-institute-iit-bombay
2. http://209.211.220.205/
3. https://sites.google.com/view/vlab-bnmitmech/home
4. https://sites.google.com/site/metrologylabktrsm/list-of-experiments
5. https://www.bitswgl.ac.in/lab-manuals-mech/1.EM-lab-manuals-converted.pdf

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	-	-	-	1	2	3	2	2
2	3	1	2	2	1	-	-	-	-	-	1	2	2	3	2
3	3	1	2	2	3	-	-	-	-	-	1	2	3	2	2
4	3	2	3	2	1	-	-	-	-	-	1	1	3	3	2
5	3	2	2	2	2	-	-	-	-	-	1	2	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP53	DYNAMICS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To equip the students with the principle of working of various governor and gyroscopic effect
- To nurture the students with the different modes of balancing
- To equip the students with understanding of the various modes of vibration
- To inculcate the knowledge of understanding radius of gyration of given systems
- To instill the knowledge of pressure distribution in bearings and to study the motion analysis of CAM

Course Outcomes

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

CO1 - Demonstrate and perform analysis on various governor and understand the gyroscopic principles **(K4)**

CO2 - Recognize different modes of balancing **(K4)**

CO3 - Identify and analysis different modes of vibration **(K4)**

CO4 - Explain the gyration effect on given systems **(K4)**

CO5 - Interpret the pressure distribution in bearings and demonstrate the CAM motion **(K4)**

List of Experiments

1. Demonstration of four bar inversion mechanism
2. Natural frequency of single mass, single helical spring system
3. Natural frequency of combination of springs – springs in parallel, springs in series
4. Natural frequency of undamped torsional single rotor, double rotor system
   Effect of inertia (I) and stiffness(k)
5. Determination of radius of gyration of a given compound pendulum
6. Determination of radius of gyration, moment of inertia – bifilar suspension method – trifilar suspension method
7. Damping coefficient of torsional single rotor system – Effect of depth of immersion in oil and damping ratio
8. Resonance frequency of equivalent spring mass system – undamped and damped condition
   a) To plot amplitude Vs frequency graph for different damping
9. Determination of characteristic curves of Watt, Porter, Proell and spring loaded governors
10. Static and Dynamic balancing
11. Whirling of shafts/ determination of critical speed with and without Rotors
12. Gyroscopic couple verification
13. Journal bearing – pressure distribution of different loads at different Speeds
14. Cam motion analysis

Reference Books

1. S.S.Rattan, Theory of Machines,3rd edition, Tata McGraw-Hill Education India, 2019.
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rd Edition, Publisher: Pearson Education India, 2014.
3. A.Ghosh and A.K.Mallick, "Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2006.
4. Robert L Norton, "Design of Machinery", 5th Edition, McGraw Hill Publication, 2011.
5. J.J.Uicker, G.R.Pennock and J.E.Shigley, "Theory of Machines and Mechanisms, 3rd Edition, Oxford University Press, 2009.

Web References

1. http://mm-nitk.vlabs.ac.in/exp28/index.html
2. http://mm-nitk.vlabs.ac.in/exp20/index.html
3. http://vlabs.iitb.ac.in/vlabs-dev/labs/asmlab/labs/exp10/theory.php
4. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/machine_theory/index.php
5 https://mm-nitk.vlabs.ac.in/exp29/index.html

(K.VELMURUGAN)

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP54	CAD/CAM LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand code of drawing practice as per BIS conventions for mechanical elements using CAD Software and exposure on CNC machines
- Prepare the 2-D and 3-D drawings using parametric solid software's as per industry templates.
- To familiarize on the Structural Analysis of 3D elements using Ansys
- To introduce the concepts of Tool path generation, integration of CAD/CAM with the production machine, and Computer control of machines and processes in manufacturing systems
- To create good understanding on reading, drafting, modeling and analyzing of the given component

Course Outcomes

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

CO1 - Interpret the given drawing as per BIS conventions and exposure in CNC machining. **(K3)**
CO2 - Generate 2-D and 3-D drawings using parametric solid software's as per industry templates. **(K4)**
CO3 - Perform structural analysis on 2D and 3D elements. **(K4)**
CO4 - Extend CAM software to generate NC code. **(K4)**
CO5 - Interpret the given component and perform analysis on 3D elements. **(K4)**

List of Experiments

1. Modeling a component using a 3D Modeling Software and Drafting
2. Model, Assemble and Draft a 3D Product using a 3D Modeling Package
3. Modeling a component and Importing to ANSYS and Meshing
4. Creating APDL in ANSYS for a parametric case study
5. Shear Force and Bending Moment diagram using ANSYS APDL or Workbench
6. Structural Analysis of a 3D Cantilever Beam and Validating the results with 1D and 2D options in ANSYS
7. Programming and machining of given component using CNC turning center.
8. Programming and simulation of given component using CAM software (Lathe).
9. Programming and machining of given component using CNC machining center.
10. Programming and simulation of given component using CAM software (Milling).
11. Programming and machining of given component using Universal Milling Machine.

References/ Manuals/ Software

1. R.K. Singal, Mridul Singal, Rishi Singal. "Fundamentals of Machining and Machine Tools" - I.K. International Publishing Home Pvt. Ltd; New Delhi, 2008.
2. Ken Evans, "Programming of CNC Machines", Industrial Press Inc., U.S.; Fourth edition, 2016.
3. Peter Smid, CNC Programming handbook: a comprehensive guide to practical CNC programming, Industrial press, 2018.
4. Divya Zindani, Working with ANSYS,IK International Publishing House Pvt. Ltd, 2016.

Web References

1. www.CATIA/Creo/Autodesk Inventor/ Solidworks /ANSYS- Software Tutorials
2. https://sites.ualberta.ca/wmoussa/AnsysTutorial
3. https://www.vlab.co.in/broad-area-mechanical-engineering
4. http://vlabs.iitkgp.ernet.in/tcad/
5. https://www.pdfdrive.com/search?q=Duane+Weidinger

Divya
(K.VELMURUGAN)

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEC5X	CERTIFICATION COURSE - III	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

(K.VELMURUGAN)

U19MES51	SKILL DEVELOPMENT COURSE 5 (Foreign Language / IELTS – I)	L	T	P	C	Hrs
		0	0	2	-	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

(K.VELMURUGAN)

U19MES52	SKILL DEVELOPMENT COURSE 6 (Presentation Skills using ICT)	L	T	P	C	Hrs
		0	0	2	-	30

The methodology used is "learning by doing", a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

ICT skills

- Understand ICT workflow in cloud computing.
- Manage multitasking.
- Deal with main issues using technology in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Teaching tools

- Different ways to create audiovisual activities.
- Handle audiovisual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct a detailed study and have to prepare a report, running to 15 or 20 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee for a total of 100 marks. The marks attained for this course is not considered for CGPA calculation.

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U19MEM51	ESSENCE OF INDIAN TRADITIONALKNOWLEDGE	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To get a knowledge in Indian Culture
- To Know Indian Languages and Literature and the fine arts in India
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes

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

CO1 - Understand philosophy of Indian culture.
CO2 - Distinguish the Indian languages and literature.
CO3 - Learn the philosophy of ancient, medieval and modern India.
CO4 - Acquire the information about the fine arts in India.
CO5 - Know the contribution of scientists of different eras.

UNIT I INTRODUCTION TO CULTURE (6 Hrs)

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT II INDIAN LANGUAGES, CULTURE AND LITERATURE (6 Hrs)

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

UNIT III RELIGION AND PHILOSOPHY (6 Hrs)

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) (6 Hrs)

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA (6 Hrs)

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India.

Reference Books

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 198
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

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SEMESTER – VI

(R.VELMURUGAN)

U19MET61	THERMAL ENGINEERING	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To study the components, systems and performance of internal combustion engines.
- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of Brayton cycle and steam power cycles
- To provide knowledge on steam nozzles and steam turbines
- To impart knowledge on working principles and performance of air compressors
- To apply the thermodynamic concepts into refrigeration and air conditioning

Course Outcomes

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

CO1 - Recognize the components and study the performance of internal combustion engines. **(K2)**
CO2 - Illustrate the working of Brayton and steam power cycles in T-S diagram and formulate its efficiency **(K3)**
CO3 - Analyze the problem relates to steam nozzles and steam turbines **(K3)**
CO4 - Compare the working performance of reciprocating and rotary compressors **(K4)**
CO5 - Estimate the performance of refrigeration and air conditioning **(K4)**

UNIT I IC ENGINES CLASSIFICATION (12 Hrs)

Classification of IC engines – petrol and diesel engines; two stroke and four stroke engines – scavenging in two stroke engines - port and valve timing diagram - fuel supply system in SI and CI engines - Ignition system and its types – cooling system and its types – lubrication system and its types - – heat balance test for IC engines.

UNIT II GAS AND STEAM POWER CYCLES (12 Hrs)

Gas power cycle -Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency, Steam power cycles-Rankine cycle, Modifications with reheater and regenerator.

UNIT III STEAM NOZZLES AND TURBINES (12 Hrs)

Flow of steam through nozzles, shapes of nozzles, effect of friction – Nozzle efficiency- General relationship between area, velocity and pressure in nozzle flow. Critical pressure ratio - Impulse and reaction principles, compounding, and velocity diagrams for simple turbines, speed regulations – governors. Reheating the steam-Bleeding.

UNIT IV AIR COMPRESSOR (12 Hrs)

Classification - Reciprocating Air Compressor - working principle, work of compression with and without clearance. Multistage air compressor and inter cooling (Descriptive treatment only), Rotary Compressors – Centrifugal Compressor and axial flow compressor (Descriptive treatment only), Screw Compressors

UNIT V REFRIGERATION AND AIR-CONDITIONING (12 Hrs)

Fundamentals of refrigeration and air conditioning - Vapour compression refrigeration cycle- super heat, sub cooling- Performance calculations- Performance calculation of vapour absorption system: Ammonia- Water, Lithium boride- water systems– Alternate refrigerants- Air conditioning systems: types, working principles- Psychrometry - Cooling Load calculations – Concept of RSHF, GSHF, ESHF.

Text Books

1. Frank Kreith Ed, The CRC Handbook of Thermal Engineering, CRC Press LLC, 2013.
2. C.P.Kothandaraman, S.Domkundwar, A.V.Domkundwar "A course in thermal Engineering", DhanpatRai and sons, 2004.
3. V.Ganesan, "Internal CombustionEngines", TataMcGraw-Hill, 2007.

References Books

1. W.Willard Pulkrabek– Internal Combustion Engines, Prentice Hall of India, 2003.
2. J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 1988.
3. R.Rudramoorthy, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
4. Rajput R.K, Thermal Engineering, 10th edition, Lakshmi Publications, 2018

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5. A.Yunus Cengel, Robert H. Turner, John M. Cimbala, Fundamentals of Thermal-Fluid Sciences, Indian edition,2016

Web References

1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://nptel.ac.in/courses/112/106/112106133/
5. https://nptel.ac.in/courses/112/105/112105129/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	1	-	-	2	2	2	3
2	3	2	2	2	-	-	-	-	1	-	-	2	2	2	3
3	3	2	2	2	-	-	-	-	1	-	-	2	2	2	3
4	3	3	3	3	-	-	-	-	1	-	-	2	2	2	3
5	3	3	3	3	-	-	2	-	1	-	-	2	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET62 DESIGN OF TRANSMISSION SYSTEM

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To study about various transmissions system like belt, ropes and chain drive.
- To correlate difference between spur gears and helical gears and to design.
- To design bevel gears, worm gears and skew gears.
- To select suitable gear box design for specific application.
- To understand different types of clutches and brakes, its failures, applications and determine standard design procedure for single and multi-plate clutches.

Course Outcomes

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

CO1 - Apply the design procedure for belt, rope and chain Drives using Design Data Hand book. **(K3)**
CO2 - Understand the standard geometry, application, failures and design of Spur and Helical Gear. **(K3)**
CO3 - Understand the standard geometry, application, failures and design of Bevel and Worm Gear. **(K3)**
CO4 - Identify the gear box for specific applications **(K3)**
CO5 - Understand different types of clutches and brakes, its failures, applications and determine standard design procedure. **(K3)**

UNIT I BELT, CHAIN AND ROPES (12 Hrs)

Belt Drive: Introduction, types, Material, Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys. Chain and Rope: Design of chain drives – Wire ropes.

UNIT II GEAR DRIVE: SPUR AND HELICAL (12 Hrs)

Spur gears: Introduction, Types of failure, design requirements, gear terminology, design analysis, stress concentration, dynamic load, surface compressive stress, beam strength, gear materials, design procedure, Gear Lubrication.

Helical Gears: Terminology of Helical Gears, Virtual number of teeth, Tooth proportions, Force analysis, Beam strength, Effective Load on gear tooth, design procedure.

UNIT III BEVEL AND WORM GEAR (12 Hrs)

Bevel gears - nomenclature, design of gears – based on bending and wear criteria– based on Lewis and Buckingham equation, worm and worm wheel – nomenclature – design procedure

UNIT IV GEAR BOX (12 Hrs)

Geometric Progression – standard step Ratio- Structural and ray diagrams - Design of sliding mesh gear boxes for machine tools – Design of Speed reducers by using spur and helical gears.

UNIT V MOTION CONTROL: CLUTCHES, BRAKES (12 Hrs)

Internal – Expanding Rim clutches and Brakes – External – Contracting Rim clutches and Brakes – Band type Clutches – Cone clutches and Brakes.

Text Books

1. J.E Shigley and C.R.Mischke, "Mechanical Engineering Design", McGraw-Hill International; 11th Edition 2019.
2. V Bhandari, "Design of Machine Elements", Tata McGraw-Hill Book Co, 4th Edition 2016.
3. T.J.Prabhu, Design of Transmission Elements, Madras book house, Chennai, 2018.

References Books

1. R.S. Khurmi, J.K.Gupta. "Machine Design", Eurasia Publishing House (Pvt.) Ltd. Revised Edition, 2008.
2. Sadhu Singh, "Machine Design", Khanna Publishing House, 1st Edition 2019.
3. P.C. Gope, "Machine Design – Fundamental and Application", PHI learning private ltd, New Delhi, 2012.
4. Design Data book– PSG College of Technology, Coimbatore, 2019.
5. A.C Ugural, "Mechanical Design, An Integrated Approach", McGraw Hill Education, 2003.

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1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112106137/
3. https://nptel.ac.in/courses/108/106/108106160/
4. https://nptel.ac.in/courses/112/105/112105234/
5. https://nptel.ac.in/courses/112/105/112105124/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2
2	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2
3	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2
4	3	2	3	2	3	2	-	1	-	-	-	1	3	3	2
5	3	2	3	2	3	2	-	1	-	-	-	1	3	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET63 **FINITE ELEMENT ANALYSIS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives
- To learn the basic principles of finite element analysis procedure.
- To understand the concepts of discretization
- To learn the theory and characteristics of finite elements that represent engineering structures.
- To understand the nature of iso-parametric and iso-perimetric elements
- To learn and apply finite element solutions to structural, thermal, dynamic problem

Course Outcomes
After completion of the course, the students will be able to

CO1 - Discuss the concepts behind various methods and weighted residual methods in FEM. **(K2)**

CO2 - Describe the discretization concepts. **(K2)**

CO3 - Identify the application and characteristics of FEA elements such as bars, beams, plane and isoperimetric elements, and 3-D element. **(K4)**

CO4 - Compare the iso-parametric and iso-perimetric elements. **(K4)**

CO5 - Identify how the finite element method expands beyond the structural domain, for problems involving in structural dynamics, heat transfer and fluid flow. **(K4)**

UNIT I INTRODUCTION (9 Hrs)
Finite element method, stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, various and weighted residual methods, concept of potential energy, one dimensional problems.

UNIT II DISCRETIZATION (9 Hrs)
Element shapes, discretization procedures, assembly of stiffness matrix, bandwidth, node numbering, mesh generation, interpolation functions, and local and global coordinates, convergence requirements, and treatment of boundary conditions.

UNIT III ANALYSIS OF TRUSSES (9 Hrs)
Finite element modeling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations. Analysis of Beams: Element stiffness matrix for Hermit beam element, derivation of load vector for concentrated and UDL, simple problems on beams. Modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.

UNIT IV HIGHER ORDER AND ISOPARAMETRIC ELEMENTS (9 Hrs)
One dimensional quadratic and cubic elements in natural coordinates, two dimensional four nodded isoperimetric elements and numerical integration.

UNIT V STEADY STATE HEAT TRANSFER ANALYSIS (9 Hrs)
One-dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis.

Text Books

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, 4th Edition, Prentice Hall, 2012.
2. Singiresu S Rao,The Finite Element Methods in Engineering, 6th Edition, Elsevier Butterworth – Heinemann, 2017.
3. Reddy, J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005.

Reference Books

1. P.Seshu, "Text Book of Finite Element Analysis", 3rd Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
2. G.Ramamurthy, "Applied Finite Element Analysis", 2nd Edition, Wiley Publication, 2010.

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3. S.Siddu, Anup Goel, Parmeshwar Patil, N. I. Jamader, "Finite Element Analysis", Technical publications, 2019.
4. C.S.Krishnamurthy, "Finite Element Analysis", Tata McGraw-Hill, 2000.
5. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", 4th edition, John Wiley and Sons, Inc., 2003.

Web References

1. https://nptel.ac.in/courses/112104193/
2. https://www.coursera.org
3. https://www.featutorials.com
4. https://www.sciencedirect.com/topics/engineering/finite-element-analysis
5. https://www.comsol.co.in/multiphysics/finite-element-method

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
2	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
3	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
4	3	2	3	2	2	1	-	-	-	-	-	1	3	2	1
5	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET64 ADVANCED MANUFACTURING TECHNOLOGY

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study about the introduction of unconventional machining processes.
- To study about micro machining process and its material removal mechanism.
- To learn about the micro fabrication.
- To learn about the importance of numerical control machines.
- To impart the knowledge of group technology and flexible manufacturing system.

Course Outcomes

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

CO1 - Acquire knowledge about unconventional machining process and advantages. **(K2)**
CO2 - Get a broad view about micro machining and simulation of atomic scale level **(K2)**
CO3 - Get knowledge about modern micro fabrication processes. **(K3)**
CO4 - Acquire knowledge about numerical control machines. **(K2)**
CO5 - Become familiarize with group technology and flexible manufacturing systems. **(K3)**

UNIT I NON TRADITIONAL MACHINING PROCESSES (9 Hrs)

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining. Selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes. Introduction, equipment and material process of EDM, ECM, ECG, AJM and USM

UNIT II MICRO MACHINING PROCESS (9 Hrs)

Micromachining – definition - principle of mechanical micromachining - Classification of micromachining and Nano finishing processes. Molecular dynamics simulations of machining at atomic scale. Diamond Turn Machining (DTM) - components of DTM – requirements of DTM - material removal mechanism – molecular dynamics - tool geometry

UNIT III MICRO FABRICATION (9 Hrs)

Materials for Microsystems manufacture - Substrates and Wafers, active substrate materials, silicon and silicon components. Photolithography based micro fabrication processes - Photo resist development. Additive and subtractive techniques – CVD – PVD – etching - chemical, plasma - resists removal. Large aspect ratio micro manufacturing - LIGA, Deep Reactive Ion Etching.

UNIT IV NUMERICAL CONTROL MACHINES (9 Hrs)

N.C. machines – Introduction. Types, Economics advantages and applications, CNC, DNC (Direct and Distributed). Turning and Machining centres– Description and Types of ATC, applications.NC part programming – Types – Introduction to programming languages, APT programming, Examples on CNC Turning, Milling & Drilling operations, Preliminary study on simulation of CAD based NC programming.

UNIT V GROUP TECHNOLOGY (9 Hrs)

Group Technology: Part families – parts classification and coding. Examples ROC Algorithm, Applications. Flexible Manufacturing systems – Types, components, planning and implementation Issues. Introduction of Learn and Agile Manufacturing systems – Comparison

Text Books

1. Mikel P. Groover, Automation, Production Systems and Computer Integrated manufacturing,PHI Ltd., New Delhi, 2018
2. Kalpakjian, Schmid. "Manufacturing Engineering and Technology"6th edition, Prentice Hall 2010
3. G.Boothroyd et al, Automatic Assembly, Marcel Dekker Inc., New York, 1993

(K.VELMURUGAN)

Reference Books

1. Chua C.K., Leong K.F., And Lim C.S., "Rapid Prototyping: Principles and Applications", Third
2. Edition, World Scientific Publishers, 2010
3. P. Radhakrishnan, NC Machine Tools, Dhanpat Rai & Sons, New Delhi, 2000
4. P. Radhakrishnan and S. Subramanian – CAD/CAM/CIM, Wiley Eastern Ltd., 2000.
5. P.N. Rao et al, Computer Aided Manufacturing, Tata McGraw Hill Publishers, 1993.

Web References

1. http://nptel.ac.in/courses/112104028/
2. https://nptel.ac.in/courses/112/107/112107078/
3. https://nptel.ac.in/courses/112/104/112104289/
4. https://nptel.ac.in/courses/112/107/112107077/
5. https://nptel.ac.in/courses/112/104/112104204/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
2	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
3	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
4	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2
5	3	2	2	-	-	1	1	1	-	-	-	2	-	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP61	THERMAL ENGINEERING LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To provide knowledge on the performance of steam turbine and boiler
- To understand the function of orsat apparatus and steam calorimeter
- To understand the working principle of cooling tower, refrigeration and Air-conditioning system
- To apply the knowledge to conduct performance test on of IC engines.
- To provide knowledge on Assembly and Dismantle of IC Engines

Course Outcomes

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

CO1 - Explain the air conditioning, refrigeration system, cooling tower and conduct performance test **(K1)**
CO2 - Summarize the petrol engine and diesel engine performance **(K2)**
CO3 - Apply the theoretical and actual knowledge to draw valve timing and port timing diagram **(K3)**
CO4 - Analyse the heat balance test and retardation test on diesel engines **(K4)**
CO5 - Analyse the Engine exhaust gas analysis using Orsat apparatus **(K4)**

List of Experiments

1. Valve and port timing diagrams of 4-stroke and 2-stroke IC engines respectively
2. Performance test on Single/multi cylinder 4-stroke petrol engines
3. Performance test on Single/multi cylinder 4-stroke Diesel engines
4. Heat balance test on IC engines
5. Retardation and motoring test on 4-stroke engine
6. Performance test on Vapour compression Refrigeration system
7. Performance test on Air-conditioning system
8. Performance test on cooling Tower
9. Performance test on Vapour absorption Refrigeration system
10. Engine exhaust gas analysis using Orsat apparatus
11. Performance test on a boiler
12. Performance test on steam turbine
13. Determination of dryness fraction of steam using calorimeter
14. Assembly/Dismantling of Engines to identify the parts and their position in an engine

Reference Books

1. V.Ganesan, "Internal Combustion Engines", Tata McGraw-Hill Education, 4th Edition, 2012.
2. C.P Arora "Refrigeration and Air Conditioning" Tata McGraw-Hill Education, 3rd Edition, 2009.
3. J.B. Heywood "Internal Combustion Engines" fundamentals, McGraw Hill, 1988. J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 1988.
4. R.Rudramoorthy, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
5. R.K Rajput, Thermal Engineering, 10th edition, Lakshmi Publications, 2018

Web References

1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://nptel.ac.in/courses/112/106/112106133/
5. https://nptel.ac.in/courses/112/105/112105129/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
2	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
3	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
4	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3
5	3	2	2	2	3	-	-	-	2	1	2	2	2	1	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP62 COMPUTATIONAL FLUID DYNAMICS LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To introduce the students about the science of computational fluid dynamics and heat transfer.
- To teach the students on the concept of boundary layer flow, the principle of viscosity, pressure and flow measurement.
- To apply the simulation techniques on heat flow problems.
- To apply simulation techniques relates to thermal problems.
- To have a clear understanding on FEM software.

Course Outcomes

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

CO1 - Understand the pre and post processing steps in CFD study **(K2)**
CO2 - Apply the concepts of boundary layer flow, the principle of viscosity, pressure and flow measurement **(K3)**
CO3 - Design Optimization using CFD for fluid flow Simulation **(K4)**
CO4 - Design Optimization using CFD for Thermal Simulation **(K4)**
CO5 - Evaluate the problems using FEM software **(K4)**

List of Experiments

1. Internal Pipe flow problem using theoretical FEM.
2. Analyzing Flow in a System of Pipes using ANSYS.
3. Simulate the drag coefficient of a circular cylinder immersed in a uniform fluid stream using ANSYS/Solid Works Flow Simulation.
4. Flow of water through a ball valve assembly using ANSYS/Solid Works Flow Simulation.
5. Heat Conduction within a Solid using ANSYS.
6. Temperature distribution in a fin cooled electronic component using ANSYS.
7. 3D Heat Conduction within a Solid-Cell Phone using ANSYS.
8. Calculation of the efficiency of the counter flow heat exchanger using ANSYS/Solid Works Flow Simulation.
9. Conjugate heat transfer problem using ANSYS/Solid Works Flow Simulation.
10. 3D Thermal Analysis, Finned Pipe using ANSYS.
11. Thermal stress analysis of piston

Reference Books/ Manuals/ Software

1. Janna, W.S., "Design of Fluid Thermal Systems", Cengage Learning, 3rd Edition, 2011
2. Jaluria, Y., "Design and Optimization of Thermal Systems", McGraw-Hill, 2nd Edition, 2007.
3. McDonald, A. G., and Magande, H. L., "Thermo-Fluids Systems Design", John Wiley, 2012.
4. Suryanarayanan, N. V. and Arici, O. "Design and Simulation of Thermal Systems", McGraw-Hill, 2003.
5. John D, Anderson, "Computational Fluid Dynamics: An Introduction", Springer, 1992.

Web References

1. https://www.coursera.org/course/spobuildaerodynamics
2. http://nptel.ac.in/courses/101106045
3. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005
4. https://nptel.ac.in/courses/112104193/
5. https://www.featutorials.com

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	1	-	1	2	2	1
4	3	3	3	2	2	-	-	-	-	1	-	1	2	2	1
5	3	3	3	2	2	-	-	-	-	1	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP63 MANUFACTURING TECHNOLOGY LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in manufacturing of components in the industry.
- To acquire knowledge in operation of Milling machines and Hobbing machines.
- To understand the basic concepts of Tool grinding.
- To impart knowledge on dynamometers for measuring cutting force during milling.
- To acquire knowledge in operation of CNC machines.

Course Outcomes

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

CO1 - Demonstrate the various milling operations. **(K2)**
CO2 -.Demonstrate the gear generation profile. **(K2)**
CO3 - Understand the function and applications of tool cutter grinder. **(K2)**
CO4 - Distinguish different measuring devices according to the work. **(K2)**
CO5 - Apply G-code programs to CNC lathes and mills. **(K3)**

List of Experiments

1. Demonstrate of milling machine
2. Cube Milling & step milling
3. Contour Milling using vertical Milling machine
4. Spur Gear cutting in Milling machine
5. Helical Gear Cutting in Milling machine
6. Demonstrate of Gear hobbing machine
7. Gear generation in Hobbing machine
8. Tool grinding in tool and Cutter Grinder
9. Measurement of cutting forces in Milling / Turning Process
10. CNC Part Programming

Reference Books

1. Yoram Koren, "Computer Control of Manufacturing Systems", McGraw-Hill, 2005.
2. P.N. Rao, "Manufacturing Technology – Metal Cutting and Machine Tools"-Tata Mc Graw Hill Publishing Company Ltd, 2008.
3. Mohd. Mukhtar Alam, Naresh D.N, Girish Chitoshiya, "Machining and Machine Tools", Genius Publication, 2014.
4. S.Kalpakjain, S.Schimd, "Manufacturing Engineering and Technology", Pearson Education, 7th edition, 2018.
5. Muammer Koç, Tugrul Ozel, "Modern Manufacturing Processes", Wiley, 2019.

Web Resources

1. https://nptel.ac.in/courses/112/107/112107219/
2. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-19.pdf.
3. http://electron.mit.edu/~gsteele/mirrors/www.nmis.org/EducationTraining/machineshop/mill/intro.html.
4. http://web.mit.edu/2.810/www/files/lectures/lec5-machining-2018.pdf.
5. https://www.edx.org/course/fundamentals-of-manufacturing-processes.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 – High

(K.VELMURUGAN)

U19MEC6X	CERTIFICATION COURSE - IV	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U19MES61	SKILL DEVELOPMENT COURSE 7 (Foreign Language / IELTS – II)	L	T	P	C	Hrs
		0	0	2	-	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

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U19MES62

SKILL DEVELOPMENT COURSE 8
TECHNICAL SEMINAR

L	T	P	C	Hrs
2	0	0	-	30

Course Objectives

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

Course Outcomes

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

CO1 - Review, prepare and present technological developments.

CO2 - Face the placement interviews.

Method of Evaluation:

- During the seminar session each student is expected to prepare and present a topic on engineering/technology, for duration of about 20 minutes.
- In a session of three periods per week, 8 to 10 students are expected to present the seminar.
- Each student is expected to present atleast twice during the semester and the student is evaluatedbased on that.
- At the end of the semester, he / she can submit a report on his / her topic of seminar and marks aregiven based on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student andmaintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

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U19MES63	SKILL DEVELOPMENT COURSE 9 (NPTEL / MOOC - I)	L	T	P	C	Hrs
		0	0	0	-	-

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation

(K.VELMURUGAN)

SEMESTER – VII

(K.VELMURUGAN)

U19MET71	PRODUCTION PLANNING AND COST ESTIMATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study tools and technique of work study.
- To understand process planning concepts.
- To understand cost estimation.
- To know about depreciation and ladder cost.
- To study about standard time calculation and Ergonomics.

Course Outcomes

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

CO1 - Develop operational procedures to perform process planning in industrial set up. **(K3)**
CO2 - Identify the costing methods and estimation procedures. **(K3)**
CO3 - Evaluate the cost ladder and various elements of cost to arrive the selling cost. **(K3)**
CO4 - Demonstrate the machining costs in an industry and calculate the machining time. **(K3)**
CO5 - Interpret the standard working procedures using ergonomic principles. **(K2)**

UNIT I INTRODUCTION TO PROCESS PLANNING (9 Hrs)

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES (9 Hrs)

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods – Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION (9 Hrs)

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- cost ladder -Estimation labour cost, material cost- allocation of overhead charges-Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION AND CALCUALTION OF MACHINING TIME (9 Hrs)

Estimation of Different Types of Jobs – Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop, Estimation of Machining Time – Importance of Machine Time Calculation- Calculation of Machining Time with examples.

Unit V STANDARD TIME CALCULATION AND ERGONOMICS (9 Hrs)

Method study – Definition – Objectives-Motion economy- Principles —Applications – Work measurements- purpose – use – procedure – Work Allowances-Standard time calculation – Ergonomics – principles – applications.

Text Books

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.
3. Mikell P. Groover, Automation, Production, Systems and Computer Integrated Manufacturing, Pearson Edn. 2001.
4. Anoop Desai Aashi Mittal, "Production Economics", CRC Press,2017
5. Robert Bridger , "Introduction to Human Factors and Ergonomics" , CRC press , 2015

Reference Books

1. M. Adithan Process Planning and Cost Estimation, , New Age International, 2015
2. R.Pannerselvam, Process Planning and Cost Estimation, , PHI, 2017
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd Edition, PHI, 2012.
4. Banga T R , Sharma S.C, Mechanical Estimation and Costing, Khanna Publishers, 2016
5. K.C. Jain, Production Planning Control and Industrial Management, Khanna Publishers 2016.

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Web References

1. https://nptel.ac.in/courses/112/107/112107238/
2. https://www.vidyarthiplus.com/
3. https://www.youtube.com/watch?v=8M_KDN0_6UM
4. https://www.youtube.com/watch?v=U6DWkAOkBP0
5. https://www.mechanical.in/process-planning-cost-estimation/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	-	-	-	-	-	1	-	3	2	2	1	3
2	2	3	-	2	-	-	-	-	1	-	3	2	2	2	1
3	2	1	-	2	-	-	-	-	1	-	3	2	2	3	-
4	2	2	1	-	-	-	-	-	-	-	2	2	3	1	1
5	1	2	-	-	-	-	-	-	-	-	2	2	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MET72 **INDUSTRIAL AUTOMATION AND ROBOTICS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the architecture of industrial automation system.
- To learn various sensors principles and applications in Robotics.
- To develop the Knowledge of PLC Programming.
- To learn the basic of Robotics and its demand.
- To understand the industrial applications of Robotics.

Course Outcomes

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

CO1 - Understand the concepts industrial automation. **(K2)**
CO2 - Understand the concepts of industrial sensors and their applications. **(K2)**
CO3 - Analyze and select a suitable PLC system for the given application. **(K4)**
CO4 - Understand the development of robotics and future prospects. **(K2)**
CO5 - Apply the various applications of robots in material handling and welding. **(K3)**

UNIT I OVERVIEW OF AUTOMATION (9 Hrs)

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems, Types of automation, significance and importance, evaluation of automation, type of Industries and components of automation.

UNIT II TYPES OF INDUSTRIAL SENSORS (9 Hrs)

Optical, Inductive, Capacitive, Encoders, Ultrasonic, Thermocouples, Demonstrate Proper Wiring Techniques and Practical Applications.

UNIT III PROGRAMMABLE LOGIC CONTROLLER (9 Hrs)

Introduction to PLC, Need of PLC in Designing, Architecture of PLC, Application and Advantage of PLC, Automation Concept and Basic Design, PLC Programming.

UNIT IV EVOLUTION OF ROBOTICS (9 Hrs)

Robotics in science fiction, industrial revolution, history and need of robotics, definition of a robot, robot terminology, types and applications of robot, overview of present status and future trends, robotics market and future prospects.

UNIT V ROBOT APPLICATIONS (9 Hrs)

Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications

Text Books

1. A.K.Gupta, Jean Riescher Westcott, and Satish Kumar Arora, "Industrial Automation and Robotics" Laxmi Publications (P) LTD, 2007.
2. R. K.Rajput ,"Robotics and Industrial Automation", S. Chand Limited, 2008.
3. Mikell P.Groover, Industrial robotics by, Mcgraw Hill Publications, 2012.
4. S. Mukhopadhyay, S. Sen and A. K. Deb, "Industrial Instrumentation, Control and Automation", Jaico Publishing House, 2013
5. Stamatios Manesis, George Nikolakopoulos., "Introduction to Industrial Automation", CRC Press 2018.
6. Nathan Clark, "PLC Programming", Kindle Edition, 2018.

Reference Books

1. Saeed Benjamin Niku, "Introduction to Robotics: Analysis, Control, Applications", Second Edition, Wiley ,2001.
2. James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.
3. Kevin Collins, "PLC Programming for Industrial Automation", Exposure Publishing, 2007.
4. Groover,"Industrial Robotics", Tata McGraw-Hill Education,2008.
5. Rex Miller, "Robots and Robotics: Principles, Systems, and Industrial Applications", Mc Graw Hill,2017.

(R.VELMURUGAN)

Web References

1. https://onlinecourses.nptel.ac.in/noc21_me67/
2. https://nptel.ac.in/courses/112/101/112101098/
3. https://nptel.ac.in/courses/112/102/112102011/
4. https://rosindustrial.org/
5. https://opensource.com/life/16/4/open-source-robotics-projects

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	1	-	1	-	1	1	2	1
2	3	1	2	-	1	1	-	1	-	1	-	1	2	1	2
3	3	1	2	-	1	-	-	1	-	1	-	1	2	2	1
4	3	1	2	-	1	1	-	1	-	1	-	2	2	1	2
5	3	1	2	-	2	-	-	1	-	1	-	3	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP71 BUSINESS BASICS FOR ENTREPRENEUR

L	T	P	C	Hrs
0	0	2	1	18

Course Objectives
- To develop a clear understanding on Business Plans and their significance.
- To be familiar with various forms of business appropriate for an individual entrepreneur
- To understand various ways of judging a successful opportunity for an entrepreneur
- To know the ways to formulate a successful Operation Plan
- To be aware of things to know to prepare effective financial and marketing plans

Course Outcomes
After completion of the course, the students will be able to

CO1 - Impact comprehensive knowledge of an entrepreneurial ecosystem. **(K6)**
CO2 - Understand the need and significance of Business Plan in the success of an Enterprise. **(K2)**
CO3 - Understand the ways to judge the economic and business viability of proposed venture. **(K2)**
CO4 - Utilize the elements of success of entrepreneurial ventures. **(K3)**
CO5 - Evaluate the effectiveness of different entrepreneurial strategies. **(K5)**

UNIT I THE ENTREPRENEURIAL PERSPECTIVE (6 Hrs)
Entrepreneurship and Family Business Management, Entrepreneurship theory and practice, The Nature and Importance of Entrepreneurs, The Entrepreneurial and Intrapreneurial Mind, The Individual Entrepreneur, International Entrepreneurship Opportunities

UNIT II CREATING AND STARTING THE VENTURE (6 Hrs)
Creativity and the Business Idea, Legal Issues for the Entrepreneur, the Business Plan, the Marketing Plan, the Financial Plan, the Organizational Plan

UNIT III FINANCING THE VENTURE (6 Hrs)
Raising Finance, scaling up the venture, NDA'S and term sheet, Sources of the Capital, Informal Risk Capital and Venture Capital

Report Submission:
- Grooming Entrepreneurial Mind-set
- Interaction with Business Leaders/Bankers/Venture Capitalists
- Finding and evaluating an idea
- Develop a business plan
- Financing for a company start-up
- Setting up a company-legal entity
- Entrepreneurial development and employment creation
- Effects of creativity and innovation on the entrepreneurial performance of family business

Text Books

1. Friend, G., & Zehle, S. (2004). Guide to business planning. Profile Books Limited.
2. Lasher, W. (2010). The Perfect Business Plan Made Simple: The best guide to writing a plan that will secure financial backing for your business. Broadway Books.
3. Arjun Kakkar. (2009). Small Business Management: Concepts and Techniques for improving Decisions. Global India Publications.

Reference Books

1. Alexander Osterwalder and Yves Pigneur – Business Model Generation.
2. Arthur R. DeThomas – Writing a Convincing Business Plan.
3. Ben Horowitz – The Hard Thing About Hard Things.
4. Guy Kawasaki – The Art of Start 2.0
5. Hal Shelton – The Secrets to Writing a Successful Business Plan

(K. VELMURUGAN)

Web References

1. https://www.waveapps.com/blog/entrepreneurship/importance-of-a-business-plan
2. https://www.entrepreneur.com/article/200516
3. https://smallbusinessbc.ca/article/how-to-use-viability-to-test-if-you-should-invest-in-your-business/
4. https://www.infoentrepreneurs.org/en/guides/strategic-planning/
5. http://www.marketingmo.com/strategic-planning/marketing-plans-budgets/
6. https://www.mbda.gov/page/loan-documentation

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	2	1	1	3	3	2	3	1	2	1	2	1
2	1	2	2	2	2	2	3	3	3	2	1	2	2	2	1
3	1	2	2	1	2	2	3	3	3	3	2	3	1	2	3
4	1	3	2	2	2	2	3	3	3	3	2	3	1	2	2
5	1	3	2	2	2	2	3	3	3	2	2	3	1	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

		L	T	P	C	Hrs
U19MEP72	**AUTOMATION AND ROBOTICS LAB**	0	0	2	1	30

Course Objectives

- To provide the student with basic skills useful in identifying the concepts of automation.
- To familiarize with part program for gear cutting operations.
- To impart knowledge on drilling and Milling operations.
- To impart knowledge on robot kinematics and programming for a given application.
- To provide an introduction to Industry 4.0 its applications in industry.

Course Outcomes

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

CO1 - Understand the part program for gear cutting using Mill cycle. **(K2)**
CO2 - Generate Part program for multiple drilling operation. **(K3)**
CO3 - Understand the concepts industrial robotics and its application. **(K3)**
CO4 - Solve direct and inverse kinematics and choose appropriate Robot for given application. **(K3)**
CO5 - Choose appropriate materials handling devices and perform robot programming for a given application. **(K3)**

List of Experiments

1. To prepare part program for gear cutting operation.
2. To prepare part program for gear cutting using mill cycle.
3. To prepare part program for drilling operation.
4. To prepare part program for multiple drilling in X-axis
5. To prepare part program for multiple drilling operation in Z-axis.
6. To prepare part program for multiple drilling in X and Z axis using drilling cycle.
7. Demonstration of robot with 2 DOF, 3 DOF, 4 DOF.
8. To detect the sensor scanning system to overcome limitation of fixed sensors on various robotic applications, ultrasonic sensor, laser range finders, infrared detectors and miniature.
9. To find the horizontal and vertical movement up to 180o in either direction.
10. To detect objects with infrared ray detector.
11. To determine object distance (3cm – 300cm).
12. To detect distance (10cm to 80 cm) with infrared object detector.
13. To determine 5 Axis Robotic Arm movement and its degree of rotation.

Reference Books

1. James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.
2. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Third Edition, Pearson Education, 2009.
3. Mikell Groover, "Fundamentals of modern manufacturing", John Wiley & Son, 2010.
4. Rex Miller, "Robots and Robotics: Principles, Systems, and Industrial Applications", Mc Graw Hill, 2017.
5. Stamatios Manesis, George Nikolakopoulos., "Introduction to Industrial Automation", CRC Press 2018.

Web References

1. https://nptel.ac.in/courses/112/101/112101098/
2. https://ed.iitm.ac.in/img/files/Robotics%20and%20Automation%20Laboratory
3. https://www.jnec.org/labmanuals/mech/be/sem1/Final%20Year%20B.Tech-ROBOTICS%20LAB%20%20MANUAL
4. http://www.kctgroups.com/downloads/files/n543b9e884d583
5. https://www.srmist.edu.in/mech-engg/robotics-lab

(R.VELMURUGAN)

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	1	2	-	-	-	1	-	-	2	3	2	2
2	3	1	2	1	2	-	-	-	1	-	-	2	2	3	2
3	3	1	1	1	3	-	-	-	1	-	-	2	3	2	2
4	3	2	3	1	2	-	-	-	1	-	-	1	3	3	2
5	3	2	3	1	3	-	-	-	1	-	-	2	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K. VELMURUGAN)

U19MEP73	PRODUCT DEVELOPMENT LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- Competence with a set of tools and methods for new product development.
- To develop different models and designs of products.
- Awareness of the role of multiple functions in creating a new product.
- To impart knowledge on 3D Printers, its types and application.
- To impart knowledge of generation, working and analysis of STL files.

Course Outcomes

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

CO1 - Demonstrate the working principles of FDM Process and its application. **(K2)**
CO2 - Design complex / creative models ready for 3D printing. **(K3)**
CO3 - Develop STL file for CAD models with appropriate support structures and Orientation. **(K3)**
CO4 - Build complex engineering assemblies in plastic material with minimum build-time. **(K3)**
CO5 - Evaluate the process parameters of 3D Printing machine to improve the quality of the parts Produced. **(K5)**

List of Experiments

1. Generating and working with STL files from the CAD Models.
2. Designing of complex geometries and generating STL files from CAD Data.
3. Demonstration of Fusion Deposition Modeling (FDM) 3D Printers.
4. Modeling and 3D Printing of Engine components
5. Modeling and 3D Printing of navigation components
6. Modeling and 3D Printing mechanical Joint.
7. Modeling and 3D Printing of Impeller.
8. Designing and 3D printing of Intricate shapes for medical applications.
9. Processing the CAD data in Catalyst and CURA or any slicing software.
10. Simulation in Catalyst Software for optimizing build-time and material consumption.
11. 3D printing of machine components using 3D Scanning and re-modeling.
12. Evaluating the quality of the 3D printed part in terms of surface finish and dimensional accuracy.
13. Evaluating the fabricated part for its suitability for a given application.

Reference Books

1. Thomke, Stefan, and Ashok Nimgade. "IDEO Product Development." Boston, MA: Harvard Business School Case, 2000.
2. Irich, Karl, and Steven Eppinger. "Product Design and Development". Third edition. New York, McGraw-Hill, 2003.
3. Crawford, M. and Di Benedetto, A. "New products management", McGraw Hill International, 2011.
4. Joan Horvath, "Mastering 3D Printing", Apress, 2014.
5. Rybicki, Frank J., Grant, Gerald T. 3D Printing in Medicine, Springer, 2017.

Web References

1. https://nptel.ac.in/courses/112/107/112107217/
2. https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_1_Lecture_1_final.pdf
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-de05/
4. https://nptel.ac.in/courses/112/104/112104265/
5. https://www.additive.sandvik/en/products-services-am

(K.VELMURUGAN)

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	3	1	3	1	-	-	2	-	-	2	3	2	3
2	3	1	2	1	2	1	-	-	1	-	-	2	2	1	3
3	3	1	2	1	3	1	-	-	1	-	-	2	2	2	3
4	3	1	2	1	2	1	-	-	1	-	-	1	2	3	2
5	3	1	3	1	3	2	-	-	1	-	-	2	2	1	3

Correlation Level: 1- Low, 2 - Medium, 3 – High

(K.VELMURUGAN)

U19MEP74	COMPREHENSIVE VIVA VOCE	L	T	P	C	Hrs
		0	0	2	1	45

Course Objectives

- The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering concepts, tools, and the process of identifying and solving engineering Problems acquired over 4 years of study in the undergraduate program.

Course Outcomes

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

CO1 - Revise the mechanical engineering principles postulations and other technical information in order to apply in various conditions.**(K2)**

CO2 - Communicate effectively and knowledge of contemporary issues.**(K4)**

CO3 - Collate and justify the design by the acquired comprehensive technical knowledge and skill.**(K5)**

CO4 - Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety, manufacturability and sustainability.**(K5)**

CO5 - Explain the relevance of a technical note for a given application. **(K5)**

CONTENTS

- The viva shall normally cover the all subjects taught in all the semesters of B.Tech Programme.
- The internal assessment for a total of 50 marks will be made by an internal assessment committee.
- The committee will conduct two written examinations of objective or short questions type from all the core subjects.
- The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the committee.

(K.VELMURUGAN)

U19MEW71	PROJECT PHASE - I	L	T	P	C	Hrs
		0	0	4	2	45

Course Objectives

- To enable students to use all concepts of Mechanical engineering in creating a solution for a problem
- To offer students a glimpse into real world problems and challenges that need.
- To create awareness among the students of the characteristics of several domain areas where Mechanical engineering can be effectively used.
- To improve the team building, communication and management skills of the students.
- To introduce students to the vast array of literature available of the various research challenges in the field of Mechanical engineering.

Course Outcomes

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

CO1 - Identify an innovative or creative idea/concept/solution to a problem. **(K1)**
CO2 - Design and Develop the working model. **(K3)**
CO3 - Work independently to lead the project along with team members. **(K3)**
CO4 - Interpret the results and document the report. **(K4)**
CO5 - Communicate effectively through presentation.**(K5)**

CONTENTS

- The Project is a theoretical study/analysis/prototype design/modeling and simulation or a combination of these.
- Should be done as group (preferably four students) project.
- The progress of the project is evaluated based on a minimum three reviews and final viva-voce examination.
- A project report is required to be submitted in the standard prescribed format.

(K.VELMURUGAN)

U19MEW72	INTERNSHIP / INPLANT TRAINING	L	T	P	C	Hrs
		0	0	0	2	45

Course Objectives

- An In plant training is a learning opportunity for students. Students should therefore receive feedback on their performance so that they can grow professionally. Overall professional development of diploma mechanical engineers is the need of the day for enabling them to sustain in competitive global environment

Course Outcomes

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

CO1 - Exposure to the industrial environment and Recognize the requirement of the industry and cope up with the industrial scenario. **(K1)**

CO2 - Identify career paths taking into account their individual strengths and aptitude and Prepare a report about the work experience in industry. **(K2)**

CO3 - Communicate effectively through technical presentation. **(K2)**

CO4 - Enhancing the employability skills and start-up skills to increase his ability to engage in, life-long learning. **(K4)**

CO5 - Develop individual confidence to handle various engineering assignments and expose themselves to acquire life skills to meet societal challenges. **(K5)**

CONTENTS

1. The Guide allotted by the department head have liberty to select nearby organization/industry of local vicinity with prior approval of principal of the institute. Structured training to be arranged by guide and report of the same shall be submitted by the individual student, to full fill their term work.
2. The mechanical engineering diploma students can take in plant training in any one of the following industries.
   a. Public sector enterprises
   b. State government undertaking
   c. Public limited companies
   d. Private limited companies
   e. Individual ownership organisations.

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SEMESTER – VIII

(K.VELMURUGAN)

U19MET81 **POWER PLANT ENGINEERING**

L	T	P	C	Hrs
3	0	0	3	60

Course Objectives

- To understand the basics of thermal plant by coal and diesel as the fuels.
- To explain the students about the nozzles and engines used in the power plants.
- To provide students an understanding about the power production from nuclear and renewable energy sources.
- To teach the students about functioning of material handling system and equipment's utilized in the power plants.
- To explain about the energy, economic and environmental impacts of a power plant.

Course Outcomes

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

CO1 - Demonstrate an understanding of the concepts of power production using different fuels **(K2).**

CO2 - Explain the functioning of steam nozzles and working of engines **(K2)**

CO3 - Illustrate the working of nuclear and renewable energy based power production systems. **(K2)**

CO4 - Compare the functions of different material handling equipment's involved in power production.**(K3)**

CO5 - Apply the knowledge of energy consumption and calculating the tariffs, and analysis on the environmental impact of power plants.**(K3)**

UNIT I THERMAL POWER PLANTS (12 Hrs)

Rankine cycle – improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

Otto, Diesel, Dual & Brayton Cycle – Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT II STEAM NOZZLES AND ENGINES (12 Hrs)

steam nozzles – flow through nozzles – nozzle efficiency – Effect of super heating – supersaturated (or) metastable expansion of steam in a nozzle – steam turbines – classification – turbine blading - velocity diagrams – Compounding of impulse turbine – Reaction turbine - Blade profiles of impulse and reaction turbines

External combustion engines - Gas turbine plant cycle – classification – simple cycle – regenerative cycle – reheat cycle – regenerative – reheat cycle – inter-cooling. Combined cycles - Steam and gas turbine Power plants – cycle analysis.

UNIT III NUCLEAR POWER PLANTS AND RENEWABLE ENERGY (12 Hrs)

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. Safety measures for Nuclear Power plants. Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT IV POWER PLANT HANDLING SYSTEM AND EQUIPMENTS (12 Hrs)

Air handling system: forced draught fans, primary and secondary air system for solid fuels – flue gas path; method of producing draught: natural, induced draughts – induced draught fans – flue gas treatment for pollution: particulate emissions and pollutants - cyclone separator, electro-static precipitator – chimney – calculation of chimney height - Bottom ash handling system. Cooling towers, Feed water treatment: demineralised water, treatment processes: mechanical, chemical processes – Duration – fuel handling system: solid fuels – pulveriserd fuels, liquid and gaseous fuels – supply system.

(K.VELMURUGAN)

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS (12 Hrs)

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Text Books

1. W. Culp, Principles of Energy Conversion, Tata McGraw Hill, 2000.
2. P.K.Nag, Power Plant Engineering, Tata McGraw Hill, 2000.
3. R. K. Rajput, Atextbookon Power Plant Engineering, Laxmi Publictions, 2008.
4. Domkundwar and Arora Domkundwar, Power Plant Engineering, Dhanpatrai and Son's, 4th edition, 2016.
5. P.K Das & A.K Das, An Introduction to Thermal Power Plant Engineering and Operation: For Power Plant Professionals, Notion Press, 2018.

References Books

1. M.M. El-Wakil, Power Plant Technology, Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Black & Veatch, Springer, Power Plant Engineering, 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, Standard Handbook of Power Plant Engineering, Second Edition, McGraw – Hill, 1998.
4. Godfrey Boyle, Renewable energy, Open University, Oxford University Press in association with the Open University, 2004.
5. M.D.Burghardt, Engineering Thermodynamics with Applications, Harper Row,1986

Web References

1. https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-me86/
2. https://npti.gov.in/post-graduate-certificate-course-thermal-power-plant-engineering
3. https://www.coursera.org/lecture/electricity/power-plants-gAZ4H
4. https://powermin.gov.in/en/content/national-power-training-institute.
5. https://www.tpctraining.com/collections/power-plant-operations-training

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
2	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
3	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
4	3	3	3	3	-	-	-	-	-	-	-	1	1	2	2
5	3	3	3	3	1	-	1	1	1	1	-	2	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEP81 **ENTREPRENEURSHIP MANAGEMENT**

L	T	P	C	Hrs
0	0	2	1	18

Course Objectives

- To develop an ability to identify the critical challenges hindering growth of entrepreneurs
- To understand the significance of Finance Skills, Branding, and Sales Skills for an Entrepreneur
- To be aware of various Government Schemes and Subsidies available for Entrepreneurs

Course Outcomes

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

CO1 - Develop and demonstrate the business models. **(K2)**
CO2 - Practice cash management, brand building and enhancing turnover. **(K6)**
CO3 - Understand various schemes and subsidies that are offered by various Government agencies. **(K2)**
CO4 - Effectively tackle growth challenges of their venture. **(K5)**
CO5 - Manage and grow their business in terms of expansion and look for partnerships. **(K3)**

UNIT I ENTRPRENEURIAL SKILLS 1 (6 Hrs)

Introduction to Business Model Generation , Developing Lean Business Model for the Business Idea, Developing Prototype and Evaluating assumptions in Business Model using prototype cheaply, Presentation of Business Model, Business Fair

UNIT II ENTREPRENEURIAL SKILLS 2 (6 Hrs)

Financial Skills – Cash Management – Problems of Poor Cash Management – Learning to be Frugal. Branding – Building a 'niche' follower for your product/service – Developing and Establishing a Brand, Sales skills – KPI of Success of Entrepreneurship – Ensuring Growth in Turnover

UNIT III ENTREPRENEURIAL OPPORTUNITIES (6 Hrs)

Awareness of Government Schemes and Subsidies for various Entrepreneurial Categories – Special Schemes for Women Entrepreneurs – Understanding the Procedure and Documentation Process for availing the Government Schemes – Venture Capital – Crowdfunding – Angel Investors.

Report Submission:

1. How can I get first 100 customers to pay for my products/services?
2. Information technology as a resource
3. Marketing skill and promotion for entrepreneurs
4. Assessment of factors affecting performance of women entrepreneurs
5. Entrepreneurship as a tool for sustainable employment
6. Examination of problem facing small scale business
7. Survival strategies in small business
8. The role of insurance in minimizing business risk

Text Books

1. Storey, D. J., & Greene, F. J. (2010). Small business and entrepreneurship. Financial Times/Prentice Hall.
2. Scarborough, N. M. (2011). Essentials of entrepreneurship and small business management. Prentice Hall.
3. Gupta C.B., & Srinivasan N.P. (2020). Entrepreneurial Development. Sultan Chand and Sons

Reference Books

1. Brian Tracy – The Psychology of Selling.
2. Dale Carnegie – How to Win Friends & Influence People.
3. Robert Kiyosaki and Sharon Lechter – Rich Dad, Poor Dad.
4. Reid Hoffman – The Startup of You: Adapt to the Future, Invest in Yourself, and Transform Your Career.
5. Michael E. Gerber – The E-Myth Revisited.
6. Chris Guillebeau – The Art of Non-Conformity.
7. Eric Ries – The Lean Startup.
8. Kevin D. Johnson – The Entrepreneur Mind.

(K.VELMURUGAN)

Web References

1. https://www.helpguide.org/articles/stress/stress-management.htm
2. https://bscdesigner.com/8-entrepreneurial-kpis.htm
3. https://www.inc.com/ilya-pozin/5-problems-most-entrepreneurs-face.html
4. https://www.inc.com/jessica-stillman/how-to-network-with-super-successful-people.html
5. https://www.entrepreneur.com/article/251603
6. https://seraf-investor.com/compass/article/understanding-crowdfunding

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	1	2	2	1	3	1	1	3	2	2	2	3	3
2	1	1	2	2	1	1	3	2	2	3	3	2	2	2	2
3	1	2	1	1	1	2	3	2	2	3	3	2	1	2	3
4	1	2	2	2	2	3	3	3	3	3	2	3	2	2	2
5	1	2	2	2	2	3	3	3	3	3	2	3	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEW81 PROJECT PHASE - II

L	T	P	C	Hrs
0	0	16	8	45

Course Objectives

- To develop students ability to apply Mechanical Engineering knowledge to transfer ideas to solve real life problems in industries as an individual or as a team.
- To develop effective communication skills and financial management for presentation of project related activities.
- To apply and integrate knowledge and understanding of other engineering disciplines to overcome technical uncertainty and to prepare project proposals.

Course Outcomes

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

CO1 - Demonstrate and practice the concepts of basics sciences and mechanical engineering principles in addressing a real time and real life situation. **(K6)**

CO2 - Enhance the financial management skills to achieve project goal in a stipulated time by working as a Team. **(K5)**

CO3 - Familiarize in technical writing skills and create a project proposal and report on completion. **(K5)**

CO4 - Develop a model comprising of real time application in the industry. **(K6)**

CO5 - Design a system under the domain of mechanical engineering also Evaluate for simulation design, analysis and manufacturing facts of the system. **(K6)**

Guidelines For Carrying Out Project Work

- Create a model/fabricate a model/conduct experiment/simulate mechanical system/implement improved ideas for the project work.
- Analyze data, evaluate the results and conclude the appropriate solution, suggestion for feature work.
- The continuous assessment shall be made as prescribed in the regulations.
- The review committee may be constituted by the Head of the Department.
- The progress of the project is evaluated based on a minimum of three reviews.
- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
- This final report shall be typewritten form as specified in the guidelines.

(K.VELMURUGAN)

U19MES81	SKILL DEVELOPMENT COURSE 10 (NPTEL / MOOC - II)	L	T	P	C	Hrs
		0	0	0	-	-

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation

(K. VELMURUGAN)

PROFESSIONAL ELECTIVES - I

U19MEE41	GAS DYNAMICS AND JET PROPULSION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic difference between incompressible and compressible flow.
- To analyze the effect of Mach number on compressibility.
- To examine the flow properties in variable area and constant area ducts.
- To understand the phenomenon of shock waves and its effect on flow.
- To understand the basic knowledge about jet propulsion and rocket propulsion system.

Course Outcomes

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

CO1 - Explain the basic concepts of compressible fluid flows. **(K1)**
CO2 - Describe the behaviour of fluid flow in constant area ducts. **(K1)**
CO3 - Interpret the equations governing normal shock. **(K2)**
CO4 - Define the performance metrics of turbo jet, ram jet and pulse jet engines. **(K3)**
CO5 - Explain the basics of rocket propulsion systems. **(K1)**

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS (9 Hrs)

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility- Isentropic flow through variable ducts – Nozzle and Diffusers Use of Gas tables.

UNIT II FLOW THROUGH DUCTS (9 Hrs)

Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer- Applications.

UNIT III NORMAL SHOCK (9 Hrs)

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl – Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock- Use of tables and charts.

UNIT IV JET PROPULSION (9 Hrs)

Theory of jet propulsion – types of jet engines – study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of jet engines – thrust, thrust power, propulsive and overall efficiencies.

UNIT V SPACE PROPULSION (9 Hrs)

Theory of rocket propulsion -types of rocket engines – Propellants-feeding systems – Ignition and combustion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance – Staging – Terminal and characteristic velocity – Applications – space flights.

Text Books

1. J.D.Anderson, "Modern Compressible flow: With historical perspective", 3rd Edition, McGraw Hill, 2017.
2. S.M.Yahya, "Fundamentals of Compressible Flow with aircraft and rocket propulsion", New Age International Publisher, New Delhi, 2018.
3. H.Cohen, G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Pearson, 2019.

Reference Books

1. V.Ganesan, "Gas Turbines", Tata McGraw Hill, 2010.
2. P.H. Oosthvizen, William E.Carscallen, "Introduction of Compressible fluid flow", CRC press, 2013.
3. E. Rathakrishnan, "Gas Dynamics", Prentice Hall of India, New Delhi, 2014.

(K.VELMURUGAN)

4. V.Babu "Fundamentals of Gas Dynamics", Wiley, 2015.
5. S.M.Yahya, "Gas tables: For compressible flow calculation", New Age International Publisher,New Delhi, 2018.

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1. https://nptel.ac.in/courses/112106166/
2. https://nptel.ac.in/courses/101101002/
3. https://nptel.ac.in/courses/112103021/
4. http://www.infocobuild.com/education/audio-video-courses/mechanical-engineering/GasDynamics Propulsion- IIT-Madras/lecture-21.html
5. Jet Propulsion -https://www.youtube.com/watch?v=cOk4-nKRhr8- nptl

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	-	-	-	-	-	-	-	1	2	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
3	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
4	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
5	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE42 **COMPUTER AIDED DESIGN**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basics of CAD and its applications.
- To gain exposure over the algorithms and transformation techniques used in CAD.
- To learn about the geometric and surface modelling concepts of CAD
- To understand the rendering of models used in various software.
- To understand the standards and database in CAD

Course Outcomes

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

CO1 - Understand the importance of CAD and its hardware's. **(K2)**
CO2 - Perform transformation techniques and apply algorithm for modifying various CAD drawings. **(K3)**
CO3 - Develop various model using geometric and surface modelling techniques. **(K3)**
CO4 - Illustrate the working of rendering of CAD models. **(K3)**
CO5 - Apply various standards and database models to exchange CAD data models. **(K3)**

UNIT I INTRODUCTION TO CAD AND DISPLAY DEVICES (9 Hrs)

Introduction: Fundamentals of CAD, Design process, Applications of computer for design, Benefits of CAD, Computer peripherals for CAD work station, Graphic terminal, CAD software, CAD database and structure.
Display Devices: Video display devices–Raster scan display, CRT , DVST, Inherent memory display devices, Random Scan Display, Raster scan systems – Video controller, Random scan systems – Graphic monitors and work station, Input devices.

UNIT II TRANSFORMATIONS (9 Hrs)

Bresenham's line and circle algorithms. Transformation in Graphics: co-ordinate system used in Graphics and windowing and view port transformations, Clipping , hidden line elimination, 2D transformations – rotation, scaling, translation, mirror, reflection and shear – homogeneous transformations – concatenation, 3D Transformation – orthographic and Perspective Projections.

UNIT III GEOMETRIC AND SURFACE MODELLING (9 Hrs)

Geometric Modelling: 2D wire frame modelling, 3D Wire frame modelling, Wireframe models, Entities and their definitions. Concept of Parametric and nonparametric representation of curve, Curve fitting techniques, Definitions of cubic splines.
Surface Modelling: Surface modelling and entities, Algebraic and geometric form, Parametric space of Surface, Blending functions, parameterization of surface patch, Subdividing cylindrical surface, Ruled surface, Surface of revolution, Spherical surface, Composite surface.

UNIT IV RENDERING IN CAD (9 Hrs)

Hidden line-surface-solid removal algorithm-shading - colouring-animation Parametric and variational modeling, Feature based modeling, An overview of modeling software like PRO-E, CATIA, IDEAS, SOLID EDGE and other advanced Software's.

UNIT V STANDARDS AND DATABASE IN CAD (9 Hrs)

Standards for computer graphics (GKS) and Data exchange standards – IGES, STEP. Standard for exchange images (open GL) Data structures for Entity storage – Data structures for interactive modelling- Relational databases

Text Books

1. P. Radhakrishnan, S. Subramanyan,V. Raju, "CAD/CAM/CIM", New Age International, 4th Edition, 2020.
2. P.N. Rao, "CAD/CAM: Principles and Applications", Tata McGraw Hill, 3rd Edition, 2010.
3. Ibrahim Zeid and R. Sivasubramaniam, CAD/CAM : Theory and Practice, 2nd Edition, Tata McGraw Hill, 2009

Reference Books

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 5th Edition 2019
2. James A. Rehg, Henry W. Kraebber, "Computer Integrated Manufacturing", Pearson Education. 2007

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3. Donald Hearn and M.Pauline Baker "Computer Graphics" with OpenGL Prentice Hall, International, 2011
4. Chris McMahon, Jimmie Browne CADCAM: Principles, Practice and Manufacturing Management, 2nd Edition, Pearson publications 1992.
5. Sareen Kuldeep, Grewal Chandandeep, CAD/CAM: Theory and Concept, 2nd Edition, S Chand & Company, 2007.

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1. https://nptel.ac.in/courses/112/102/112102101/
2. http://www.nptelvideos.in/2012/12/computer-aided-design.html
3. https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/
4. https://freevideolectures.com/course/2362/computer-aided-design-and-manufacturing
5. https://www.iitk.ac.in/me/me761a

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	2	-	-	-	-	-	-	-	3	2	1
2	3	3	2	-	2	-	-	-	-	-	-	-	3	2	1
3	3	3	2	-	2	-	-	-	-	-	-	-	3	2	1
4	3	3	2	-	2	-	-	-	-	-	-	-	3	2	1
5	3	3	2	-	2	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE43	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the basic concepts of product design and features.
- To understand the quality function deployment tool for identifying customer needs.
- To demonstrate knowledge of Brain dominance theory.
- To understand the approach of material selection for design.
- To get the knowledge about problem solving tools and codes.

Course Outcomes

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

CO1 - Explain conceptual product design techniques. **(K1)**
CO2 - Identify Customer needs and products design specifications. **(K1)**
CO3 - Use different systematic concept generation techniques in product design. **(K3)**
CO4 - Use the embodiment design principles for environment aware design. **(K3)**
CO5 - Solve ethical conflicts and issues in engineering environment. **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Design versus Scientific method, Considerations of a Good Design, Product Development process cycles, Organizations for Product Design, Technological Innovation and Business Strategies, Modern Product development and design theories, Reverse engineering and redesign methodology.

UNIT II PROBLEM DEFINITION **(9 Hrs)**

Identifying Customer needs, Kano Diagram, Establishing Engineering Characteristics, Quality Function Deployment (QFD), Product Design Specification (PDS) Design information and sources, Professional societies and Trade associations, Codes and Standards, Patents and Intellectual Property

UNIT III CONCEPT GENERATION **(9 Hrs)**

Freud's model, Brain dominance theory, Creative thinking techniques and barriers, Systematic methods: Tear down and experimentation, Function structure, Morphological methods, Theory of Inventive Problem solving (TRIZ), Axiomatic Design (AD) Decision Theory, Evaluation methods, Comparison based on absolute criteria, Pugh's concept, Measurement scales, Weighted decision Matrix, Analytic Hierarchy process (AHP).

UNIT IV EMBODIMENT DESIGN **(9 Hrs)**

Product Portfolios and Architecture, Configuration and Parametric design, detailed design, Ergonomics and Design for Environment, Modeling and Simulation, Material selection for Design, Quality assessment and Robust Design.

UNIT V TOOLS AND ETHICAL ISSUES IN ENGINEERING **(9 Hrs)**

Team Roles and Dynamics, Effective Team meeting, Robert rules and Parliamentary procedures, Problem solving tools, planning and scheduling, Time management. Origin of laws, Contracts, Product Liability, Tort Law, Codes of Ethics, and solving ethical conflicts.

Text Books

1. George E Dieter, Engineering Design 3rd Edition McGraw Hill, 2001.
2. Karl T. Ulrich, Product Design and Development, Tata McGraw Hill International, 2003.
3. G. Lawrence Sanders, Developing New Products and Services, Publisher: Saylor Foundation2013

Reference Books

1. Ken Hurst, Engineering Design Principles, Elsevier, 1999.
2. Otto, Product Design, Pearson Education India, 2001.
3. Pahl, W Beitz J Feldhusun, K G Grote, Engineering Design, 3rd Edition, Springer, 2007.
4. Sven G. Bilén, Introduction to Engineering Design, McGraw Hill Learning Solutions, 2008.
5. Steven Eppinger, Karl Ulrich, Product Design and Development McGraw-Hill Higher Education, 2015.

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Web References

1. https://www.digimat.in/nptel/courses/video/112107217/L01.html
2. https://nptel.ac.in/courses/112/104/112104230/
3. http://www.nptelvideos.com/lecture.php?id=15953
4. https://cosmolearning.org/video-lectures/mod-4-lec-14-product-design-development-8953/
5. https://www.udemy.com/course/product-design/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	-	-	-	-	-	1	2	1	2
2	2	2	2	2	2	-	-	-	-	-	-	1	2	2	2
3	2	2	2	2	2	-	-	-	-	-	-	1	2	2	2
4	2	2	2	2	2	-	2	-	-	-	-	1	2	2	2
5	2	2	-	-	-	3	-	3	2	-	-	1	2	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE44 **INDUSTRIAL CASTING TECHNOLOGY**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basic principles of metal casting.
- To know the various types of melting practices.
- To learn about the various casting techniques
- To broaden the understanding of casting design principles.
- To know about casting defects and its remedial measures and automation.

Course Outcomes

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

CO1 - Explain the activities of foundry shop. **(K1)**
CO2 - Describe melting process for various alloys. **(K1)**
CO3 - Identify suitable casting techniques for specific applications. **(K1)**
CO4 - Design of gates and risers in castings. **(K6)**
CO5 - Recognize the casting defects and describe foundry automation. **(K1)**

UNIT I MOLDING PRACTICES (9 Hrs)

Introduction to casting and Foundry industry, Basic principles of casting process- Sequence in foundry operation, Pattern materials, Types – Mold core and its types, core making process.

UNIT II MELTING FURNACES (9 Hrs)

Types of Furnaces used in Foundry – Cupola furnace, Melting practice for cast iron, Aluminium alloy, Copper alloy, and Magnesium alloy – Safety considerations.

UNIT III SPECIAL CASTING TECHNIQUES (9 Hrs)

Investment casting, Shell mould casting, Pressure Die casting – centrifugal casting – Types, CO2 mold casting, Continuous casting, Full mould casting, Evaporative pattern castings.

UNIT IV SOLIDIFICATION OF CASTINGS (9 Hrs)

Concept of solidification, Directional solidification – Gating and Risering design and analysis – Solidification of pure metals – Rate of solidification, Macro and Micro structure – Solidification contraction.

UNIT V CASTING DEFECTS AND AUTOMATION (9 Hrs)

Defects in casting and its remedies – Melting and Quality control of various steels and non-ferrous alloys – Fettling, Cleaning and Inspection of casting – Foundry automation – Mould machine automation of sand plant – moulding and fettling section of foundry.

Text Books

1. Richard W.Heine et al. - Principles of Metal Casting, Tata McGraw Hill Edition, 2013.
2. P.L.Jain, Principles of Foundry Technology, Tata McGraw Hill, 2009.
3. O.P.Khanna, Foundry Technology, DhanpatRai Publications, 2011.

Reference Books

1. B.Wulff, H.F.Taylor, M.C.Fleming, Foundry Engineering, Wiley Eastern, 1999.
2. N.K.Srinivasan, Foundry Technology, Khanna Publications, 2001.
3. T.V. Ramana Rao, Metal Casting: Principles and Practice, New Age International, 2010.
4. Peter Beeley, Foundry Technology, Elsevier, Second Edition, 2001.
5. John Campbell, Complete Casting Handbook: Metal Casting Processes, Metallurgy, Techniques and Design, Elsevier, 1st Edition, 2011.

Web References

1. https://nptel.ac.in/courses/112/107/112107215/
2. https://nptel.ac.in/courses/112/107/112107083/
3. https://nptel.ac.in/courses/112/107/112107219/
4. https://cursa.app/en/course/mechanical-metal-casting-by-nptelhrd/9R19vNE1w2c

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5. http://www.infocobuild.com/education/audio-video-courses/mechanical-engineering/principles-of-casting-technology-iit-roorkee.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
2	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
3	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
4	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-
5	1	-	1	-	-	-	-	-	-	-	-	1	1	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE45	NON - CONVENTIONAL ENERGY SOURCES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the basics of NCES and statistical data on conventional energy resources.
- To study about the concept of solar energy and its types
- To learn the wind energy conversion systems
- To provide knowledge on geothermal energy resources and biomass energy conversion systems
- To impart knowledge about tidal, wave and OTEC energy power generation system

Course Outcomes

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

CO1 - Explain the basics of NCES. **(K1)**
CO2 - Extract on the solar energy and its conversion systems. **(K2)**
CO3 - Describe the concepts of Wind energy conversion systems. **(K1)**
CO4 - Describe the harnessing of Geothermal, Ocean energies. **(K1)**
CO5 - Compare the tidal, wave and OTEC energy power generation system. **(K2)**

UNIT I STATISTICS ON CONVENTIONAL ENERGY SOURCES (9 Hrs)

Statistics on conventional energy sources and supply in developing countries, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES – Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

UNIT II SOLAR ENERGY (9 Hrs)

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

UNIT III WIND ENERGY (9 Hrs)

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion – Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

UNIT IV GEOTHERMAL AND BIOMASS SOURCES (9 Hrs)

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features Atmospheric exhaust and condensing, exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Construction details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs

UNIT V WAVE, TIDAL AND OTEC ENERGY (9 Hrs)

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 MW OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

Text Books

1. Khan , Non-Conventional Energy Resources, McGraw Hill Education India Private Limited; Third edition, 2017
2. S. S. Thipse, Non-Conventional and Renewable Energy Sources, Narossa publisher 2018.
3. N.K.Bansal, Non-Conventional Energy Resources, Vikas Publishing House, 2014

Reference Books

1. R.Ramesh and K.U.Kumar, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004.
2. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 5th edition, 2011.
3. MM.Wakil, Power Plant Technology, McGraw Hill Book Co, New Delhi, 2004.

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4. Magal, "Solar Power Engineering", Tata McGraw Hill, 2005.
5. Non – Conventional Energy Sources, G.D. Rai, Khanna Publishers, 4th edition, 2009.

Web References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://nptel.ac.in/courses/108/108/108108078/
3. https://www.coursera.org/courses?query=renewable%20energy
4. https://www.youtube.com/watch?v=GRwJqD4StEU
5. https://www.youtube.com/watch?v=mSIMA6H80mM

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
2	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
3	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
4	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1
5	-	-	1	-	-	-	2	-	-	-	-	1	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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PROFESSIONAL ELECTIVE - II

U19MEE51	**TURBOMACHINERY**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To study about the classification of turbo machinery in power generation, power absorption and transportation sectors and thermodynamics of fluid flow in turbo machines
- To learn about energy transfer mechanism in turbine, pumps and compressor and analysis of high speed machines
- To acquire knowledge in classification and operational characteristics of steam turbines
- To acquire knowledge in classification and operational characteristics of hydraulic turbines
- To learn about the classification and working of pumps, compressor and its efficiency

Course Outcomes

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

CO1 - Able to describe turbo machines and analysis the fluid flow in machines. **(K1)**
CO2 - Illustrate the energy exchange mechanism in all turbo machines such as Euler's equation for turbo machinery. **(K1)**
CO3 - Classify the operation and principle of steam turbines. **(K2)**
CO4 - Classify the hydraulic turbines and able to design turbine blades. **(K6)**
CO5 - Perform the preliminary design of turbo machines (pumps, rotary compressors and turbines) and analyse the performance of turbo machinery. **(K6)**

UNIT I INTRODUCTION (9 Hrs)

Introduction: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynolds number, Unit and specific quantities, model studies.
Thermodynamics of fluid flow: Application of first and second law of thermodynamics to turbo machines, Efficiencies of turbo machines, Static and Stagnation states, Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency (their comparison) and polytrophic efficiency for both compression and expansion processes. Reheat factor for expansion process

UNIT II ENERGY EXCHANGE IN TURBO MACHINES (9 Hrs)

Energy exchange in Turbo machines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.
General Analysis of Turbo machines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.

UNIT III STEAM TURBINES (9 Hrs)

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor. Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging. Problems.

UNIT IV HYDRAULIC TURBINES (9 Hrs)

Hydraulic Turbines: Classification, various efficiencies. Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters.

UNIT V PUMPS AND COMPRESSORS (9 Hrs)

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump. Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

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Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling, Problems.

Text Books

1. V. Kadambi and Manohar Prasad, An Introduction to Energy Conversion, Volume III, Turbo machinery, New Age International Publishers, 7th Edition 2018.
2. Maneesh Dubey, BVSSS Prasad, Archana Nema, Turbomachinery, Tata McGraw Hill Co. Ltd., 2018.
3. B.K.Venkanna, Fundamentals of Turbo machinery, Phi Learning Private Limited, 2009.

Reference Books

1. S. M. Yahya, Turbines, Compressors and Fans, Tata McGraw Hill Co. Ltd., 2nd edition, 2002
2. D. G. Shepherd, Principals of Turbo machines, The Macmillan Company, 1964.
3. S. L. Dixon, Fluid Mechanics and Thermodynamics of Turbo machines, Elsevier, 2005.
4. M. S. Govindegouda and A. M. Nagaraj, Text Book of Turbo machines, M. M. Publications, 4th Edition, 2008
5. R. K. Turton, Principles of Turbomachinery, Springer Netherlands, 2012.

Web References

1. https://nptel.ac.in/courses/101/101/101101058/
2. https://nptel.ac.in/courses/112/103/112103249/
3. https://www.youtube.com/watch?v=473XQrJjDZE
4. https://www.youtube.com/watch?v=mLwb4Pk2RZo
5. https://www.sciencedirect.com/science/article/abs/pii/S1359431118361039

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	-	-	-	-	-	-	-	1	2	-
2	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
3	3	3	1	2	-	-	-	-	-	-	-	-	-	2	-
4	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	-	-	-	-	-	-	-	-	1	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE52 **POWDER METALLURGY AND SURFACE COATING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To make students understand the different types of powder manufacturing methods and applications.
- To teach the characterization techniques and testing of metal powders
- To make them understand the powder compaction methods and selection of methods
- To learn about the different types of sintering techniques and uses
- To understand powder metallurgy application in aerospace, automobile and machining materials

Course Outcomes

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

CO1 - Acquire the knowledge of Powder Metallurgy History, Applications and its manufacturing methods. **(K1)**
CO2 - Gain knowledge about powder characterizing techniques. **(K2)**
CO3 - Classify the metal powder compaction methods, adhesives and Surface coatings. **(K3)**
CO4 - Exemplify the suitable sintering techniques for powder metallurgy. **(K3)**
CO5 - Appraise the suitable material for different applications. **(K4)**

UNIT I POWDER MANUFACTURE AND CONDITIONING (9 Hrs)

Mechanical methods Machine milling, ball milling, atomization, shotting- Chemical methods, condensation, thermal decomposition, carbonyl Reduction by gas-hydride, dehydride process, electro deposition, precipitation from aqueous solution and fused salts, hydrometallurgical method. Physical methods: Electrolysis and atomisation processes, types of equipment, factors affecting these processes, examples of powders produced by these methods, applications, powder conditioning, heat treatment, blending and mixing, types of equipment, types of mixing and blending, Self- propagating high-temperature synthesis (SHS), sol-gel synthesis- Nano powder production methods.

UNIT II CHARACTERISTICS AND TESTING OF METAL POWDERS (9 Hrs)

Sampling, chemical composition purity, surface contamination etc. Particle size and its measurement, Principle and procedure of sieve analysis, microscopic analysis: sedimentation, elutriation, permeability. Adsorption methods and resistivity methods: particle shape, classifications, microstructure, specific surface area, apparent and tap density, green density, green strength, sintered compact density, porosity, shrinkage.

UNIT III POWDER COMPACTION (9 Hrs)

Pressure less compaction: slip casting and slurry casting. Pressure compaction- lubrication, single ended and double ended compaction, isostatic pressing, powder rolling, forging and extrusion, explosive compaction.

UNIT IV SINTERING (9 Hrs)

Stage of sintering, property changes, mechanisms of sintering, liquid phase sintering and infiltration, activated sintering, hot pressing and Hot isostatic Pressing (HIP), vacuum sintering, sintering furnaces-batch and continuous-sintering atmosphere, Finishing operations – sizing, coining, repressing and heat treatment, special sintering processes- microwave sintering, Spark plasma sintering, Field assisted sintering, Reactive sintering, sintering of nanostructured materials.

UNIT V APPLICATIONS (9 Hrs)

Major applications in Aerospace, Nuclear and Automobile industries- Bearing Materials-types, Self-lubrication and other types, Methods of production, Properties, Applications, Sintered Friction Materials-Clutches, Brake linings, Tool Materials- Cemented carbides, Oxide ceramics, Cermets- Dispersion strengthened materials

Text Books

1. Anish Upadhya and G.S.Upadhaya, "Powder Metallurgy: Science, Technology and Materials, Universities Press, 2018
2. V. Raghavan, "Physical Metallurgy: principles and practice" PHI Learning, 3rd Editions ,2015
3. Cuie Wen "Surface Coating and Modification of Metallic Biomaterial" Woodhead Publishing, 2015.

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Reference Books

1. Ramakrishnan. P., Powder Metallurgy-Opportunities for Engineering Industries, Oxford and IBH Publishing Co., Pvt. Ltd, New Delhi, 1987.
2. Isaac Chang YuyuanZhao,"Advances in Powder Metallurgy", 1st Edition, Woodhead Publishing, 2013.
3. A.K.Sinha, "Powder Metallurgy", DhanpatRai and Sons, New Delhi, 1982
4. R.M. German, "Powder Metallurgy and Particulate Materials Processing", Metal Powder Industries Federation, Princeton, NJ, 2005.
5. P.C.Angelo and R.Subramanian., "Powder Metallurgy: Science, Technology and Application" Prentice Hall, 2008

Web References

1. https://nptel.ac.in/courses/113/106/113106098/#
2. https://nptel.ac.in/courses/112/105/112105053/
3. https://youtu.be/uRVaLUQUmA8
4. https://youtu.be/7u54Hx9n3LY
5. https://ironpowders.com/iron-powder-for-surface-coating/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	3	3	1	2	1	-	-	-	-	-	-	-	-	-	-
3	3	2	-	1	-	-	-	-	-	-	-	-	-	2	-
4	3	3	1	2	1	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	2	-	-	-	-	-	-	-	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE53	GREEN MANUFACTURING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To describe about sustainable manufacturing, green product and process
- To study the various principles of green manufacturing
- To study about the semiconductor manufacturing and closed loop production systems
- To study about the nano manufacturing and its technologies
- To describe about the packaging and supply chain

Course Outcomes

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

CO1 - Describe the basic design concepts, methods, tools, the key technologies and the operation of sustainable green manufacturing. **(K1)**

CO2 - Appropriate the principles, techniques and methods to customize the learned generic concepts to meet the needs of a particular Industry/enterprise. **(K3)**

CO3 - Recognize the strategies for the purpose of satisfying a set of given sustainable green manufacturing requirements. **(K1)**

CO4 - Use the nanotechnologies in real time applications. **(K3)**

CO5 - Design the rules and processes to meet the market need and the green manufacturing requirements by selecting and evaluating suitable technical, managerial / project management and supply chain management scheme. **(K4)**

UNIT I **(9 Hrs)**

Introduction to Green Manufacturing: Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing, Sustainable green manufacturing The Social, Business, and Policy Environment for Green Manufacturing: Introduction, The Social Environment-Present Atmosphere and Challenges for Green Manufacturing, The Business Environment: Present Atmosphere and Challenges, The Policy Environment - Present Atmosphere and Challenges for Green Manufacturing

UNIT II **(9 Hrs)**

Metrics for Green Manufacturing" Introduction, Overview of Currently Used Metrics, Overview of LCA Methodologies, Metrics Development Methodologies, Outlook and Research Needs.

Green Supply Chain: Motivation and Introduction, Definition, Issues in Green Supply Chains (GSC), Techniques/Methods of Green Supply Chain, Future of Green Supply Chain.

Principles of Green Manufacturing: Introduction, Background, and Technology Wedges, Principles, Mapping Five Principles to Other Methods and Solutions.

UNIT III **(9 Hrs)**

Closed-Loop Production Systems: Life Cycle of Production Systems, Economic and Ecological Benefits of Closed Loop Systems, Machine Tools and Energy Consumption, LCA of Machine Tools, Process Parameter Optimization, Dry Machining and Minimum Quantity Lubrication, Remanufacturing, Reuse, Approaches for Sustainable Factory Design.

Semiconductor Manufacturing: Overview of Semiconductor Fabrication, Micro fabrication Processes, Facility Systems, and Green Manufacturing in the Semiconductor Industry: Concepts and Challenges, Use-Phase Issues with Semiconductors, Example of Analysis of Semiconductor Manufacturing.

UNIT IV **(9 Hrs)**

Environmental Implications of Nano-manufacturing: Introduction, Nano-manufacturing Technologies, Conventional Environmental Impact of Nano-manufacturing, Unconventional Environmental Impacts of Nano-manufacturing, Life Cycle Assessment (LCA) of Nanotechnologies. Green Manufacturing Through Clean Energy Supply Introduction, Clean Energy Technologies, Application Potential of Clean Energy Supplying Green Manufacturing

UNIT V **(9 Hrs)**

Packaging and the Supply Chain: A Look at Transportation Introduction, Background, Recommended Method to Determine Opportunities for Improved Pallet Utilization, Discussion.

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Enabling Technologies for Assuring Green Manufacturing: Motivation, Process Monitoring System, Applying Sensor Flows in Decision Making: Automated Monitoring, Case Study.
Concluding Remarks and Observations about the Future: Introduction, Evolution of Manufacturing, Leveraging Manufacturing, Energy of Labour.

Text Books

1. Ade Asefeso , Green Manufacturing: (Paradigm Shift to Sustainable Capitalism), AA Global Sourcing ltd.,2013
2. Ame,Green Manufacturing: Case Studies in Lean and Sustainability, Productivity Press, 2017
3. Mrityunjay Singh, TatsukiOhji, Rajiv Asthana, Green and Sustainable Manufacturing of Advanced Material, Elsevier, 2015

Reference Books

1. Nand K. Jha , Green Design and Manufacturing for Sustainability, CRC Press,2016
2. World commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
3. Cairncrss and Francis – Costing the earth – Harvard Business School Press – 2009.
4. T.E Gradel and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
5. A David. Dornfeld Green Manufacturing: Fundamentals and Applications, Springer, 2013

Web References

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2. https://nptel.ac.in/courses/110/104/110104119/
3. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mg24/
4. https://www.youtube.com/watch?v=16vobnhafVw
5. https://www.youtube.com/watch?v=NSzvtlpHdWY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
5	3	-	-	-	-	-	2	-	-	-	-	-	-	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE54 **FLUID POWER AUTOMATION**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To recognize the performance of hydraulic components.
- To recognize the performance of pneumatic components.
- To understand the circuit design methodology and various types of fluid power circuits.
- To identify the various components related to electro-pneumatic and hydraulic circuits.
- To demonstrate the application, basic troubleshooting and maintenance for fluid power system.

Course Outcomes

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

CO1 - Demonstrate the components and performance of hydraulic fluid power system. **(K2)**
CO2 - Demonstrate the components and performance of pneumatic fluid power system. **(K2)**
CO3 - Illustrate the circuit design for fluid power system using various types of circuits. **(K5)**
CO4 - Apply the various components to design electro-pneumatic and hydraulic circuits. **(K3)**
CO5 - Perform basic maintenance and troubleshooting in fluid power systems. **(K2)**

UNIT I HYDRAULIC COMPONENTS (9 Hrs)

Introduction to fluid power system-Pascal's Law-Hydraulic fluids-Hydraulic pumps - Gear, Vane and Piston pumps-Pump Performance-Characteristics and Selection-actuators-valves-pressure control-flow control and direction control valves-Hydraulic accessories-Hydraulic Accumulator.

UNIT II PNEUMATIC COMPONENTS (9 Hrs)

Introduction to Pneumatics-Compressors-types-Air treatment-FRL unit-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors–types-characteristics and applications.

UNIT III FLUID POWER CIRCUITS (9 Hrs)

Circuit Design Methodology-Sequencing circuits-Overlapping signals - Cascade method - KV Map method-Industrial Hydraulic circuits - Double pump circuits-Speed control Circuits-Regenerative circuits-Safety circuits-Synchronizing circuits - Accumulator circuits.

UNIT IV ELECTRO - PNEUMATICS AND HYDRAULICS (9 Hrs)

Relay, Switches-Solenoid - Solenoid operated valves -Timer-Counter - Servo and proportional control - Microcontroller and PLC based control-Design of electro-pneumatic and hydraulic circuits.

UNIT V APPLICATION, MAINTENANCE AND TROUBLE SHOOTING (9 Hrs)

Development of hydraulic / pneumatic circuits applied to machine tools-Presses-Material handling systems-Automotive systems-Packaging industries-Manufacturing automation-Maintenance and troubleshooting of Fluid Power circuits-Safety aspects involved.

Text Books

1. S John. Cundiff, Michael F. Kocher, "Fluid Power Circuits and Controls – Fundamental and application", CRC Press LLC, 2nd Edition 2019.
2. R Srinivasan, "Hydraulic & Pneumatic Controls" Vijay Nicole Imprints Pvt Ltd, 3rd Edition 2019.
3. Anthony Esposito, "Fluid Power with applications" Pearson New International Edition, 2013.

Reference Books

1. S.R Majumdar, "Pneumatic systems-principles and maintenance", Tata McGraw Hill, 2017.
2. Ilango Sivaraman, "Introduction to Hydraulics and Pneumatics", PHI Learning Pvt. Ltd, 2017.
3. M. Winston, "Essential Hydraulics: Fluid Power: Volume 2", Create Space Independent Publishing Platform, 2014.
4. Andrew Parr, "Hydraulics and pneumatics", Butterworth-Heinemann, 2011.
5. FESTO, "Fundamentals of Pneumatics", Vol I, II, III.

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Web References

1. https://nptel.ac.in/courses/112/105/112105047
2. https://nptel.ac.in/courses/108/105/108105062
3. https://www.youtube.com/watch?v=jKb-KLVzCtw
4. https://www.youtube.com/watch?v=S_4anj7GpRo
5. https://www.youtube.com/watch?v=clVwKynHpB0

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	1	-	-	-	-	-	-	-	-	-	-	-	1	1	2
2	3	2	2	2	-	-	-	-	-	-	-	-	1	2	1
3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
4	1	1	2	-	-	-	-	-	-	-	-	-	2	2	1
5	1	3	3	-	-	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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(R.VELMURUGAN)

U19MEE55 **IOT AND SMART MANUFACTURING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To present a problem oriented in depth knowledge of IOT and Smart Manufacturing.
- To address the underlying concepts and methods behind IOT and Smart Manufacturing.
- To learn about the smart manufacturing distinguish its signification in comparison to conventional manufacturing.
- To Study about tools for Smart Manufacturing and its application.
- To study about Smart and Empowered working.

Course Outcomes

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

CO1 - Identify different areas of IOT and Smart Manufacturing. **(K2)**
CO2 - Acquire a broad view about automatic storage management and its governance. **(K2)**
CO3 - Get a knowledge about smart manufacturing. **(K2)**
CO4 - Attain knowledge about smart design and find applications of all the areas in daily life. **(K3)**
CO5 - Become familiarize with elimination of error with smart tools in operations. **(K3)**

UNIT I INTERNET OF THINGS (9 Hrs)

The Internet of Things: An overview; Design Principles for Connected Devices; Internet Principles. Thinking about Prototyping – Costs versus ease of prototyping, prototyping and Production, open source versus Closed Source. Proto typing Embedded devices – Electronics, Embedded Computing Basics, Arduino/ Raspberry Pi/ Beagle Bone Black/ etc., Electric Imp and other notable platforms Prototyping of Physical Design. Prototyping online Components – Getting Started with an API, Writing a New API, Real Time Reactions, Other Protocols. Techniques for Writing Embedded Code – Memory Management, Performance and Battery Life, Libraries and debugging.

UNIT II AUTOMATIC STORAGE MANAGEMENT AND SECURITY (9 Hrs)

Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, Automatic Storage Management in the Cloud. Smart Connected System Design Case Study Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

UNIT III INTRODUCTION TO SMART MANUFACTURING (9 Hrs)

Introduction to "smart manufacturing"- conventional/legacy manufacturing -Smart Manufacturing Processes- Three Dimensions: Demand Driven and Integrated Supply Chains - Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations) - Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG)

UNIT IV SMART DESIGN/FABRICATION (9 Hrs)

Smart Design/Fabrication - Digital Tools, Product Representation and Exchange Technologies and Standards, Agile (Additive) Manufacturing Systems and Standards. Mass Customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy), Smart Perception – Sensor networks and Devices. Smart Applications: Online Predictive Modelling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes; Smart Energy Management of manufacturing processes and facilities

UNIT V SMART AND EMPOWERED WORKERS (9 Hrs)

Eliminating Errors and Omissions, Deskilling Operations, Improving Speed/Agility, Improving Information Capture/Traceability, Improving Intelligent Decision Making under uncertainty Assisted/Augmented Production, Assisted/Augmented Assembly, Assisted/Augmented Quality, Assisted/Augmented Maintenance, Assisted/Augmented Warehouse Operations and Assisted Training

Text Books

1. Zaigham Mahmood - The Internet of Things in the Industrial Sector – Springer – 1st edition – 2019
2. Loveleen Gaur Internet of Things: Approach and Applicability in Manufacturing- Chapman and Hall/CRC -1st Edition - 2019
3. A.McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2014.

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Reference Books

1. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013.
2. B.K. Tripathy - Internet of Things (IoT): Technologies, Applications, Challenges and Solutions - CRC Press 1st Edition 2018.
3. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 1st edition, 2017.
4. A. Bahga and V. Madisetti, Internet of Things, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2014.
5. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2013.

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2. https://www.digimat.in/nptel/courses/video/106105195/L10.html
3. https://www.youtube.com/watch?v=EV1Ygw6_rCs
4. https://www.sciencedirect.com/journal/internet-of-things
5. https://www.digimat.in/nptel/courses/video/106105195/L01.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	-	-	-	-	-	-	-	-	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

PROFESSIONAL ELECTIVE - III

U19MEE61 **AUTOMOBILE ENGINEERING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To explain various types of automobiles, their power packs and types of vehicle bodies.
- To analyze the various types of transmission systems for vehicle.
- To analyze the working parameters of various braking and suspension system in a vehicle.
- To study various alternate fuels and its properties.
- To understand various electric, hybrid vehicles and Bharat standards.

Course Outcomes

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

CO1 - Demonstrate the functions chassis, body and frame. **(K3)**
CO2 - Interrupt the knowledge on the types of transmission systems. **(K4)**
CO3 - Establish the different suspension and braking systems. **(K4)**
CO4 - Obtain detailed knowledge about alternate fuels. **(K3)**
CO5 - Acquire knowledge about Bharat standards. **(K3)**

UNIT I INTRODUCTION TO AUTOMOBILE AND TYPES (9 Hrs)

An overview of different types of automobiles - Trends in automobile design - Classification of internal combustion engines - Engine components, Materials and functions - Electronic engine management system for SI and CI engines - Car body construction - General consideration relating to chassis layout - Frame types & materials - Rolling, wind and gradient resultant-factors affecting resistance – Mono point and Multi point injection system - Supercharging - Turbo Chargers – EGR - Catalytic converter - Pollution Norms.

UNIT II CLUTCH AND TRANSMISSION SYSTEMS (9 Hrs)

Requirement of transmission system – clutches – plate clutches – semi automatic & automatic clutches - Gear box: manual shift four speed and positive speed gear boxes - synchromesh devices -fluid transmission – fluid flywheel and torque converter-automatic transmission - drive line - differential, conventional and non-slip types – drive axle-Propeller shaft-Universal joint - Tyres: materials and types - Battery: types.

UNIT III SUSPENSION AND BRAKING SYSTEMS (9 Hrs)

Suspension system – requirements - rigid axle and independent suspension - types of suspension - leaf spring - coil spring - torsion rod and air suspension – shock absorbers. Front axle: types – front wheel geometry - conditions for true rolling. Ackerman and Davis steering –steering linkages - steering gearbox-power and power assisted steering - Wheel alignment - Braking system - hydraulic braking systems - drum type and disc type brakes - power and power assisted brakes - factors affecting brake performance - tests on brakes –ABS- skid and skid prevention.

UNIT IV ALTERNATE FUELS (9 Hrs)

Fuels: classification, properties - Liquid and gaseous fuels - Alternate fuels - Alcohol, LPG, Natural gas, CNG, Gasohol, Bio-diesel and Hydrogen - Combustion & emission characteristics of alternative fuels in SI and CI engines.

UNIT V RECENT TRENDS IN AUTOMOBILE TECHNOLOGY (9 Hrs)

Electric vehicles: classification, Hybrid vehicles - Automotive Sensors & ECU - HCCI and RCCI engines - Autonomous vehicle - Bharath Standards (BS) and its norms - Automotive transmission - Exhaust emissions analysis and its control - Manufacturing trends in automobile industry.

Text Books

1. R.K.Rajput, "Automobile Engineering", LP publications", 2nd Edition, 2018.
2. Kirpal Singh, "Automobile Engineering Volume I and II", Standard Publishers and Distributors, 14th Edition, 2019.
3. N.K. Giri, "Automotive Technology", Khanna Publishers, 2nd Edition, 2014.

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Reference Books

1. P.S.Gill., "A Textbook of Automobile Engineering – Vol. I, II and III", S.K.Kataria and Sons, 2nd Edition, 2012.
2. D.S.Kumar, "Automobile Engineering", S.K.Kataria and Sons, 2nd Edition, 2015.
3. Robert Bosch GmbH, "Automotive Handbook", Robert Bosch, 2004.
4. K.K.Ramalingam, "Automobile Engineering", Scitech publications, 2011.
5. Halderman, "Automotive Engines: Theory and Servicing", Pearson, 2019.

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2. https://nptel.ac.in/courses/107/106/107106088/
3. https://www.youtube.com/watch?v=u_CiLG1EkdU
4. https://www.youtube.com/watch?v=lkuln7TWAI0
5. https://www.youtube.com/watch?v=owjMb76AIvE

COs/POs/PSOs Mapping

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VEL MURUGAN)

U19MEE62	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To expose student to widely used techniques in the numerical solution of fluid equations.
- To develop an understanding for the major theories, approaches and methodologies used in CFD.
- To understand the transformation of coordinates and principles of grid generation.
- To gain experience in the application of CFD analysis to real engineering designs.
- To expose students to various case studies applied to heat and fluid flow.

Course Outcomes

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

CO1 - Solve numerically the governing equations for fluid flow. **(K3)**
CO2 - Analyze the numerical integration the linear algebra methods in various methods. **(K4)**
CO3 - Apply grid generation principles for various problems in CAD interface. **(K3)**
CO4 - Solve numerically a heat transfer and fluid flow problem. **(K3)**
CO5 - Acquire FEM problems in fluid flow and heat transfer by various case studies. **(K3)**

UNIT I EQUATIONS OF FLUID DYNAMICS (9 Hrs)

Basic concepts Eulerarian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, vorticity. Laws governing fluid motion, continuity, Navier – stokes & energy equations. Boundary layer equation, Euler equations, potential flow equations, Bernoulli's equation and vorticity transport equation. Initial and boundary conditions. Classification of equation of motions – hyperbolic, parabolic, elliptic.

UNIT II MATHEMATICAL PRELIMINARIES (9 Hrs)

Numerical integration. Review of linear algebra, solution of simultaneous linear algebraic equations – matrix inversion, solvers – direct methods, elimination methods, ill conditioned systems; Gauss- Sidel method, successive over relaxation method.

UNIT III GRID GENERATION (9 Hrs)

Transformation of coordinates. General principles of grid generation – structured girids in two and three dimensions, algebraic grid generation, differential equations based grid generation; Elliptic grid generation, algorithm, Grid clustering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation. Techniques for complex and large problems: Multi block methods.

UNIT IV FINITE DIFFERENCE DISCRETIZATION (9 Hrs)

Elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations. Fundamentals of fluid flow modelling-conservative property, upwind scheme, transporting property, higher order unwinding. Finite difference applications in heat transfer – conduction, convection.

UNIT V FINITE VOLUME METHOD (9 Hrs)

Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretised equations using TDMA. Finite volume methods for unsteady problems – explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and variational formulations. Interpolation in one-dimensional and two-dimensional cases. Application of FEM to ID and 2D problems in fluid flow and heat transfer

Text Books

1. Atul sharma, "Introduction to Computational Fluid Dynamics: Development, Application and Analysis:, Wiley publication, 2016.
2. Muralidhar. K and Sundararajan. T, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, 2014.
3. Versteeg. H.K. and Malalasekera. W, "An introduction to computational fluid dynamics", 2nd Edition, Pearson, 2007.

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Reference Books

1. Jiyuan Tu Guan Heng Yeoh Chaoqun Liu, "Computational Fluid Dynamics", 3rd Edition, Butterworth-Heinemann, 2018.
2. M.Ramakrishna, "Elements of Computational Fluid Dynamics", A Golden Jubilee Publication, 2011.
3. T.J.Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
4. John F.Wendt, "Computational Fluid Dynamics - An Introduction", Springer-Verlag, 1992.
5. R.H.Pletcher, J.C.Tannehil and Anderson. D.A, "Computational Fluid Mechanics and Heat Transfer", Taylor and Francis, 3rd Edition, 2013.

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2. https://nptel.ac.in/courses/112/105/112105045/
3. https://nptel.ac.in/courses/112/104/112104030/
4. https://nptel.ac.in/courses/112/103/112103289/
5. https://www.youtube.com/watch?v=E9_kyXjtRHc

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE63	FUZZY LOGIC AND NEURAL NETWORKS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To expose the concepts of fuzzy set theory and its operations.
- To provide adequate knowledge about modeling and control of fuzzy logic.
- To understand the different hybrid control schemes and its case study.
- To provide adequate knowledge about modeling and control of neural networks.
- To understand the ANN structures and online learning algorithms.

Course Outcomes

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

CO1 - Generalize the concept of fuzziness involved in various systems and fuzzy set theory. **(K2)**
CO2 - Apply the fuzzy logic control and adaptive fuzzy logic to design the fuzzy control. **(K3)**
CO3 - Utilize the hybrid control schemes in Neuro Fuzzy Systems. **(K3)**
CO4 - Acquire the concepts of Neural Networks for modeling and controls. **(K3)**
CO5 - Execute the knowledge of ANN structures and online training algorithms. **(K3)**

UNIT I FUZZY SET THEORY **(9 Hrs)**

Fuzzy set theory- fuzzy sets- operation on fuzzy sets- Scalar cardinality, fuzzy cardinality, union and intersection complement (Yeger and sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation- fuzzy membership functions

UNIT II FUZZY LOGIC FOR MODELING AND CONTROL **(9 Hrs)**

Modelling of nonlinear systems using fuzzy models – TSK model – fuzzy logic controller- fuzzification – knowledge base- decision making logic – de fuzzification – adaptive fuzzy systems – Familiarization with fuzzy logic toolbox

UNIT III HYBRID CONTROL SCHEMES **(9 Hrs)**

Fuzzification and rule base using ANN – Neuro fuzzy systems ANFIS – Fuzzy neuron – Introduction to GA – Optimization of membership function and rule base using Genetic algorithm – Introduction to support vector machine – particle swarm optimization – case study – familiarization with ANFIS toolbox

UNIT IV NEURAL NETWORKS FOR MODELLING AND CONTROL **(9 Hrs)**

Modelling of non-linear systems using ANN- generation of training data – optimal architecture – model validation – control of non- linear systems using ANN – direct and indirect neuro control schemes – adaptive neuro controller – familiarization with neural network toolbox

UNIT V ANN STRUCTURES AND ONLINE TRAINING ALGORITHMS **(9 Hrs)**

Recurrent neural network (RNN) - Adaptive resonance theory (ART) based network- Radial basis function network- Online learning algorithms: BP through time - RTRL algorithms – Least Mean square algorithm - Reinforcement learning.

Text Books

1. Laurene V.Fausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Pearson Education, 2013.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Wiley, 3rd Edition, 2010.
3. David E.Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 2013.

Reference Books

1. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 3rd Edition 2010.
2. George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", PHI, 1st Edition, 1995.
3. Charu C. Aggarwal, "Neural Networks and Deep Learning, Springer, 2018.
4. B.Kosko, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice Hall, New Delhi, 2004.
5. Kayacan, M.Erdal, "Fuzzy neural networks for real time control applications", Elsevier, 1st Edition, 2015.

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2. https://www.tutorialspoint.com/fuzzy_logic/fuzziness_in_neural_networks.htm
3. http://www.scholarpedia.org/article/Fuzzy_neural_network
4. https://www.youtube.com/watch?v=phMLnHZgmQ
5. https://www.youtube.com/watch?v=xwUKQcT1bKc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1
2	3	2	2	-	-	-	-	-	-	-	-	1	2	3	3
3	3	3	3	-	-	-	-	-	-	-	-	1	3	2	2
4	3	2	2	-	-	-	-	-	-	-	-	1	1	3	2
5	2	3	3	-	-	-	-	-	-	-	-	1	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE64	ADDITIVE MANUFACTURING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic needs, principle and applications of rapid prototyping.
- To understand the design tools of additive manufacturing.
- To identify the materials, process and application of Photo polymerization and Powder Bed Fusion.
- To learn the principles of Extrusion Based and Sheet Lamination process.
- To understand the application of Beam Deposition process.

Course Outcomes

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

CO1 - Understand the role of additive manufacturing in the design process and the implications for design. **(K2)**
CO2 - Apply the design tools in additive manufacturing for medical applications. **(K3)**
CO3 - Analyze the processes of Photo polymerization and Powder Bed Fusion. **(K4)**
CO4 - Illustrate extrusion based process systems. **(K4)**
CO5 - Develop the additive manufacturing process and materials applications. **(K5)**

UNITI INTRODUCTION (9 Hrs)

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 Hrs)

Design tools: 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- Customised design and fabrication for medical applications.

UNIT III PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES (9 Hrs)

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 Hrs)

Extrusion Based System: FDM-Introduction – Basic Principle – Materials – Applications and Limitations – Bioextrusion. Sheet Lamination Process: LOM- Gluing or Adhesive bonding – Thermal bonding.

UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES (9 Hrs)

Droplet formation technologies – Continuous mode – Drop on Demand mode – Three Dimensional Printing – Advantages – Bioplotter - Beam Deposition Process: LENS- Process description – Material delivery – Process parameters – Materials – Benefits – Applications.

Text Books

1. Ian Gibson, David W.Rosen, Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer, 2010.
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.
3. Andreas Gebhardt "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing" Hanser Gardner Publication 2011.

Reference Books

1. A.K.Kamrani and E.A.Nasr, "Rapid Prototyping: Theory and practice", Springer, 2006.
2. L.W Liou and F.W Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
3. Tom Page "Design for Additive Manufacturing" LAP Lambert Academic Publishing, 2012.
4. Amit Bandyopadhyay, Susmita bose , "Additive Manufacturing", CRC Press, 2015

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5. Di Nicolantonio, Massimo, Rossi, Emilio, Alexander, Thomas "Advances in Additive Manufacturing, Modeling Systems and 3D Prototyping", Proceedings of the AHFE 2019.

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3. https://additivenews.com/videos/
4. https://www.journals.elsevier.com/additive-manufacturing
5. https://www.springer.com/journal/40964

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	2	2	1	2	1	1	-	2	1	2	1
2	3	1	2	-	2	1	-	2	1	-	-	2	2	2	2
3	3	1	1	1	2	2	1	1	1	-	-	2	2	2	3
4	3	1	1	-	1	1	1	1	1	-	-	2	2	2	3
5	3	1	2	-	2	1	1	1	1	1	2	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE65 **ENERGY AND CLIMATE CHANGE**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart knowledge on the global warming, the impact of climate change on society
- To recommend adaptation and mitigation measures
- To understand about the climate change effects on environment
- To provide knowledge on mitigating climate change
- To differentiate alternate and renewable fuels

Course Outcomes

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

CO1 - An insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radioactive forcing, climate change, global warming and measures **(K3)**

CO2 - Adapt and mitigate the impacts of climate change. **(K2)**

CO3 - Understand the growing scientific consensus established through the IPCC as well as the complexities and uncertainties **(K3)**

CO4 - Plan climate change mitigation and adaptation projects **(K2)**

CO5 - Use of alternate fuels and renewable energy **(K2)**

UNIT I INTRODUCTION **(9 Hrs)**

Atmosphere – weather and Climate – climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect – Carbon cycle

UNIT II ELEMENTS RELATED TO CLIMATE **(9 Hrs)**

Greenhouse gases – Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space – Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect

UNIT III IMPACTS OF CLIMATE CHANGE **(9 Hrs)**

Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

UNIT IV MITIGATING CLIMATE CHANGE **(9 Hrs)**

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment reflective roofing and reflective paving enhancement of evapotranspiration – tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.

UNIT V UP-SCALING RENEWABLE ENERGY: POLICY INCENTIVES **(9 Hrs)**

Energy source - Biofuels – Energy policies for a cool future – Energy Audit - Energy and climate governance, Global Energy - Energy - Geopolitics - Energy Security - Energy Production - Energy Consumption - Energy Markets - Energy Policy.

Text Books

1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2014.
2. Velma. I. Grover "Global Warming and Climate" Change. Vol. I and II. Science Publishers, 2005.
3. Twidell and wier" Renewable energy resources", CRC press (Taylor and Francis), 2015.

Reference Books

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007.
2. Thomas E, Lovejoy and Lee Hannah "Climate Change and Biodiversity", TERI Publishers, 2018.
3. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2011.

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4. Tiwari and Ghosal" Renewable energy resources" Narosa publications, 2005.
5. Ramesh and Kumar" Renewable Energy Technologies "Narosa publications, 2015.

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2. https://swayam.gov.in/nd2_arp19_ap55/preview
3. https://nptel.ac.in/courses/103/107/103107157/
4. https://olc.worldbank.org/content/climate-change-online-learning
5. https://nptel.ac.in/courses/119/106/119106015/

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	2	1	1	-	-	-	2	1	2	2
2	3	1	1	2	-	1	2	1	-	-	-	2	2	1	2
3	3	2	2	1	-	2	1	1	-	-	-	1	1	1	2
4	3	2	1	2	-	2	2	1	-	-	-	1	1	2	1
5	3	2	2	1	-	1	2	1	-	-	-	2	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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PROFESSIONAL ELECTIVE - IV

U19MEE71	INDUSTRIAL TRIBOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the friction characteristics of different materials
- To understand the different types of wear mechanisms
- To know the different types of lubrication and testing methods
- To understand the concepts of film lubrication
- To understand the surface modification process and material selection for different types of bearings

Course Outcomes

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

CO1 - Explain the friction characteristics of different surfaces **(K2)**
CO2 - Describe the different wear situations **(K1)**
CO3 - Discuss on the different types of lubrication. **(K2)**
CO4 - Describe the film lubrication with Reynolds equation and Somerfield diagram **(K1)**
CO5 - Explain how the surface can be modified with suitable materials to reduce friction **(K2)**

UNIT I SURFACES AND FRICTION (9 Hrs)

Topography of Engineering surfaces- Contact between surfaces – Sources of sliding Friction– Adhesion-Ploughing- Energy dissipation mechanisms Friction Characteristics of metals – Friction of non-metals. Friction of lamellar solids – friction of Ceramic materials and polymers – Rolling Friction – Source of Rolling Friction – Stick slip motion – Measurement of Friction.

UNIT II WEAR (9 Hrs)

Types of wear – Simple theory of Sliding Wear, Mechanism of sliding wear of metals – Abrasive wear – Materials for Adhesive and Abrasive wear situations – Corrosive wear – Surface Fatigue wear situations – Brittle Fracture – wear – Wear of Ceramics and Polymers – Wear Measurements.

UNIT III LUBRICANTS AND LUBRICATION TYPES (9 Hrs)

Types and properties of Lubricants – Testing methods – Hydrodynamic Lubrication – Elasto- hydrodynamic lubrication- Boundary Lubrication – Solid Lubrication- Hydrostatic Lubrication.

UNIT IV FILM LUBRICATION THEORY (9 Hrs)

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual Co-efficient of friction - The Somerfield diagram.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS (9 Hrs)

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

Text Books

1. Ian Hutchings, Philip Shipway, Tribology: Friction and Wear of Engineering Materials, Elsevier, 2017
2. Theo Mang, Kirsten Bobzin, Thorsten Bartels, Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering, Wiley -VCH Verlag publication, 2011
3. A W Batchelor, G W Stachowiak Gwidon Stachowiak, Andrew W Batchelor, Engineering Tribology 2005 Edition.

Reference Books

1. Shizhu Wen, Ping Huang , Principles of Tribology, Wiley, 2017.
2. T.A. Stolarski, " Tribology in Machine Design ", Industrial Press Inc., 2000.
3. E.P.Bowden and Tabor.D., " Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.

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4. A.Cameron, " Basic Lubrication theory ", Longman, U.K.., 1981.
5. M.J.Neale (Editor), "Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1975.

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2. https://core.ac.uk/search?q=INDUSTRIAL%20TRIBOLOGY
3. https://onlinecourses.nptel.ac.in/noc20_mm12/
4. https://www.classcentral.com/course/swayam-friction-and-wear-of-materials-principle-and-case-studies-17614
5. https://www.digimat.in/nptel/courses/video/112102014/L19

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	1	-	-	-	1	-	1	-	2	1
2	3	2	1	-	-	2	-	-	-	1	-	2	-	2	1
3	3	2	2	-	-	2	-	-	-	1	-	2	-	2	1
4	3	2	2	-	-	2	-	-	-	1	-	2	-	2	1
5	3	2	2	-	-	2	-	-	-	1	-	3	-	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE72 **ADVANCED WELDING TECHNOLOGY**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basics of welding process, the symbols used and the various joints involved.
- To illustrate students about the welding mettalurgy
- To provide students an understanding about the different types of advanced welding processes.
- To teach students about process of plasma arc, resistance welding, its types, application and the concept of welding of plastics.
- To explain about the testing of weld joints different methods.

Course Outcomes

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

CO1 - Demonstrate an understanding of the concepts of welding and its characteristics **(K2).**
CO2 - Understand the theory of welding metallurgy **(K2)**
CO3 - Explain the various advanced welding techniques and its applications. **(K2)**
CO4 - Understand the processes of plasma arc, resistance welding and welding of plastics.**(K2)**
CO5 - Apply the knowledge of testing of weld joints and analyses the causes failure **(K3)**

UNIT I INTRODUCTION TO WELDING, SYMBOLS AND ITS TYPES **(9 Hrs)**

Introduction to consolidation processes, Classification of welding processes, some common concerns, types of fusion welds and types of joints, Design considerations, Heat effects, Weld ability and join ability. Welding terms and definitions, welding positions, elements of and construction of welding symbols.

UNIT II WELDING METALLURGY **(9 Hrs)**

Fundamentals of physical metallurgy: Need, phase diagrams: Fe-C, Al-Cu, Cu-Zn system, phase transformations in Fe-C system, TTT diagram, CCT diagram, carbon equivalent, Schaffer diagram, relevance of above in welding. Principle of solidification of weld metal, modes of solidification, effect of welding parameters on weld structure, grain refinement principle of weld metal. HAZ, Transformations in HAZ of steel, factors affecting changes in microstructure and mechanical properties of HAZ, reactions in weld pool- gas metal reaction, slag metal reaction.

UNIT III ARC WELDING AND ADVANCED WELDING PROCESSESS **(9 Hrs)**

Arc Welding : Introduction – Electrodes , Transfer of Metal from electrode- Power Supplies , Operation - Carbon Arc Welding, Metal Arc Welding, Gas Shield Arc Welding and Submerged Arc Welding Process – Arc Cutting Process – Applications. Electrogas and Electroslag Welding – Solid State Bonding. Electron Beam Welding – Laser Welding – Thermit Welding – Metal Flame Spraying. Introduction to Under water Welding - Applications.

UNIT IV PLASMA ARC WELDING, RESISTANCE WELDING, WELDING OF PLASTICS **(9 Hrs)**

Special features of plasma arc- transferred and non-transferred arc, key hole and puddle-in mode of operation, micro low and high current plasma arc welding and their applications, plasma cutting, surfacing and applications. Resistance Welding : Types , Process, Applications. Welding of Plastics: Ultrasonic – Friction – Hot plate – Hot gas – High Frequency Welding of Plastics, Welding of plastic Pipes and other Applications.

UNIT V WELDMENT INSPECTION AND TESTING **(9 Hrs)**

Codes governing welding inspection: Structural welding code; spot examination of welded joints, duties of the inspector, ASTM standards, API standards.Chemical, Metallurgical, and Mechanical testing of weldments, Comparison of destructive and non-destructive tests, chemical tests, forms of corrosion, testing for corrosion resistance, metallographic tests. Liquid penetrant test. Magnetic particle inspection,Ultrasonic inspection: Criteria for successful implementation, test equipment and techniques, advantages, limitations.

Text Books

1. Little, Principles of Welding Technology, Tata McGraw Hill, 1985.
2. Parmar. R. S. Welding Engineering And Technology, Khanna Publishers, 2nd Edition, 2013.
3. Dr. Yadav. K. S, Advance Welding Technology, Rajson's Publication pvt Ltd, 2006.
4. Khanna. O. P, A Textbook of Welding Technology, Dhanpatrai and Sons, 2015.

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5. Srinivasan. N. K, Welding Technology, Khanna Publishers, 4th Edition, 2001.

Reference Books

1. P.T.Hould Croft, Welding Process Technology, Cambridge University Press, 1983.
2. L.Carl Love, Welding Procedures and Applications, Prentice Hall Inc., 1993.
3. M.N.Watson, Joining Plastics in Production, Welding Institute, Cambridge, 1990.
4. Richard Little, Welding and Welding Technology, Mc Grawhill Education, Indian Edition, 2017.
5. ASM Handbook vol.6, welding Brazing & Soldering, 2003

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2. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-me20/
3. https://www.classcentral.com/course/swayam-fundamental-of-welding-science-and-technology-13016.
4. https://www.wileymetal.com/6-advanced-welding-processes-and-their-applications-explained/
5. https://www.tws.edu/blog/welding/advanced-welding-techniques/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
2	3	3	1	1	-	-	-	-	-	-	-	1	1	2	2
3	3	1	1	1	-	-	-	-	-	-	-	1	1	2	2
4	3	3	3	3	-	-	-	-	-	-	-	1	1	2	2
5	3	3	3	3	1	-	1	1	1	1	-	1	1	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE73 **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide an insight into different search techniques used in problem solving
- To introduce the principles of knowledge representation and Inference techniques
- To familiarize with the concept of reasoning and Fuzzy logic
- To introduce the different Planning and Learning methods in machine learning
- To illustrate the relevance of AI and machine learning with case studies and applications

Course Outcomes

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

CO1 - Understand the logic of different search techniques used for problem solving **(K2)**
CO2 - Explain the different methods of knowledge representation **(K2)**
CO3 - Understand the principle behind Probabilistic reasoning and Fuzzy logic **(K2)**
CO4 - Understand the different types of planning and learning methods **(K2)**
CO5 - Appreciate the relevance and applications of artificial intelligence **(K3)**

UNIT I INTRODUCTION TO SEARCH TECHNIQUES (9 Hrs)

History of AI - Problem-solving through search: state-space - Blind search techniques: BFS, DFS, UCS, - Heuristic search techniques: Best-first search, Greedy search, A* search, AO* search- Adversarial search: Mini-max search - alpha-beta cut off - Problem reduction: AND-OR Graphs - Constraint satisfaction problem - Means Ends Analysis.

UNIT II KNOWLEDGE REPRESENTATION AND INFERENCE TECHNIQUE (9 Hrs)

Types of Knowledge - Knowledge Engineering- Approaches for knowledge representation: Propositional Logic, Predicate logic, Representing knowledge using rules, Semantic Networks, Frames, Slots, Conceptual dependency, Scripts - Inference Techniques: Unification, Resolution, Forward and backward reasoning – Conflict Resolution.

UNIT III UNCERTAIN KNOWLEDGE REPRESENTATION AND REASONING (9 Hrs)

Non-Monotonic reasoning - Probabilistic Reasoning – Bayes rule – Bayesian Belief Networks –Causal Reasoning from Bayesian networks - Certainty factors – Fuzzy Logic: Fuzzification, Fuzzy Rule Base, Defuzzification - Reasoning using Fuzzy Logic – Dempster-Shafer Belief Update Theory

UNIT IV PLANNING AND LEARNING (9 Hrs)

Planning: State space planning - partial order planning - Planning graphs - Conditional planning-Continuous planning, Planning under uncertainty - Learning Types: Rote Learning, Learning by taking advice, Explanation based learning, Discovery, Analogy - Supervised and Unsupervised learning - Decision trees based learning – Reinforcement Learning.

UNIT V APPLICATIONS OF ARTIFICIAL INTELLIGENCE (9 Hrs)

Expert Systems: Characteristics - Building blocks- Case Study, Intelligent agents: Agent Environment- Case Study - Robotics: Hardware, Perception, Planning - Natural Language Processing: Text classification, Information Retrieval and Information Extraction.

Text Books

1. Dr.Dheeraj Mehrotra, Basics Of Artificial Intelligence & Machine Learning, Notion press, 2019
2. Parag Kulkarni and Prachi Joshi, Artificial Intelligence: Building Intelligent Systems, PHI Learning Private Limited, 2015.
3. Jeff Heaton, Artificial Intelligence for human, Create Space Independent Publishing Platform; 1 edition, 2013

Reference Books

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Pearson Education Asia, 2015.
2. Vinod Chandra S.S. and Anand Hareendran, Artificial Intelligence and Machine Learning, First Edition, PHI Learning Private Limited, 2014.

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3. Deepak Khemani, A First Course in Artificial Intelligence, First Edition, McGraw Hill Education (India) Private Limited, 2013
4. Neil Wilkins, Artificial Intelligence: An Essential Beginner's Guide to AI, Machine Learning, Robotics, The Internet of Things, Neural Networks, Deep Learning, Reinforcement Learning, and Our Future,2019
5. Chris baker, Artificial Intelligence: Learning automation skills with python, 2019.

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2. https://nptel.ac.in/courses/106/102/106102220/
3. https://nptel.ac.in/courses/106/105/106105079/
4. https://nptel.ac.in/courses/106/106/106106202/
5. https://www.greatlearning.in/great-lakes-artificial-intelligence-and-machine-learning?&utm

COs/POs/PSOs Mapping

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE74 **NANO TECHNOLOGY**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basic concepts of Nanotechnology.
- To know the dimensions and properties at nanoscale.
- To understand different approaches used in the synthesis of nanostructured materials.
- To know and compare the different techniques used in the characterization of nanomaterials.
- To appreciate the scope and applications of nanotechnology.

Course Outcomes

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

CO1 - Describe the properties, features and types of bonding in nanostructures. **(K1)**
CO2 - Discuss on the thermal, chemical, mechanical, magnetic and electronic properties of nonmaterial. **(K2)**
CO3 - Explain the physical and chemical methods used for synthesising Nano materials. **(K2)**
CO4 - Explain the principle behind different material characterisation techniques used in nanotechnology. **(K2)**
CO5 - Give an account on various applications of Nanomaterial. **(K2)**

UNIT I INTRODUCTION TO NANO TECHNOLOGY (9 Hrs)

Introduction of nanomaterials and nanotechnologies, Features of nanostructures, Background of nanostructures, Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance, crystal structure, and Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties.

UNIT II NANOSCALE DIMENSIONS AND PROPERTIES (9 Hrs)

Effect of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.

UNIT III SYNTHESIS OF NANOMATERIALS (9 Hrs)

Fabrication methods: Top down and bottom up approaches-Top down processes: Milling, Lithographic, machining process, pulsed laser methods- Bottom up processes: Vapour phase deposition methods, PVD, CVD, electro deposition, plasma assisted deposition process, MBE, chemical methods, colloidal and solgel methods.

UNIT IV NANOSTRUCTURED MATERIALS CHARACTERIZATION TECHNIQUES (9 Hrs)

X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation

UNIT V APPLICATIONS OF NANOMATERIALS (9 Hrs)

Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications.

Text Books

1. Sanjay Mathur and Mrityunjay Singh, Nanostructured Materials and Nanotechnology – 2nd, Edition. Willey, 2008.
2. Charles P. Poole, Jr., and Frank J. Owens, Introduction to Nanotechnology, Wiley India 2012.
3. Amretashis Sengupta, Introduction to Nano: Basic to Nanoscience and nanotechnology, Springer, 2015.

Reference Books

1. A.I. Gusev and A. A. Rempel, Nanocrystalline Materials, Viva Books, New Delhi, 2008.
2. Gregory Timp, Nanotechnology, Springer-Verlag, 2009.
3. Guozhong Cao and Ying Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific Series 2011.
4. Alessandra L.Da Roz, Nanostructures, Elsevier, 2016
5. Himadri B. Bohidar, Design of nanostructures, John Wiley-VCH, 2017

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2. www.azonano.com
3. https://nptel.ac.in/courses/118/107/118107015/
4. https://nptel.ac.in/courses/118/102/118102003/
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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	1	-	-	1	-	1	1	-	2	1
2	3	1	1	-	-	2	-	-	1	-	2	1	-	2	1
3	3	2	2	-	-	2	-	-	1	-	2	1	-	2	1
4	3	2	2	-	-	2	-	-	1	-	2	1	-	2	1
5	3	2	2	-	-	2	-	-	1	-	2	1	-	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE75	MODELLING AND SIMULATION OF MANUFACTURING SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize the concepts of simulation and modelling
- To provide an overview of different simulation models and programming languages
- To introduce the basics of simulation of manufacturing systems and related software
- To enable the students understand the analysis of simulation data
- To illustrate the importance of simulation with example applications in engineering

Course Outcomes

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

CO1 - Understand the principles of discrete and continuous simulation **(K2)**
CO2 - Compare FORTRAN, GPSS, SIMAN, SLAM and MODSIM in terms of their suitability for simulation **(K3)**
CO3 - Illustrate the process of simulating the manufacturing systems with case studies **(K3)**
CO4 - Understand the process of simulation data analysis **(K2)**
CO5 - Appreciate the importance and relevance of simulation in engineering **(K3)**

UNIT I INTRODUCTION TO SYSTEM SIMULATION (9 Hrs)

Introduction to system simulation – Applications – Discrete and Continuous simulation –Simulation models – Simulation procedure – Simulation Examples – General Principles -Simulation software.

UNIT II MATHEMATICAL AND STATISTICAL MODELS (9 Hrs)

Mathematical and statistical models in Simulation – review of terminology and concepts. Manual simulation using event scheduling and operations - List processing – basic properties. Introduction to programming languages – simulation in FORTRAN, GPSS, SIMAN, SLAM and MODSIM – Comparison.

UNIT III SIMULATION OF MANUFACTURING SYSTEMS (9 Hrs)

Simulation of manufacturing systems – models, goals and performance measures issues – some preliminary case studies of simulation of manufacturing - study of Software's available in the market – SIM FACTORY II.5, ProModel, AutoMod, Arena, AIM, Witress, Taylor – II

UNIT IV ANALYSIS OF SIMULATION DATA (9 Hrs)

Analysis of simulation data - Input data models, Collection of data, identification of statistical distribution, estimating parameters and testing for goodness of it. Verification and validation of simulation models - Face validity, Validation of assumptions, Input -Output validation.

UNIT V APPLICATIONS (9 Hrs)

Simulation of Manufacturing and Material Handling systems – Simulation of Computer Systems – Simulation of Computer Networks

Text Books

1. A.Tolk, Engineering principles of combat modeling and distributed simulation, Wiley, 2012.
2. L.G Birta and G.Arbez, Modeling and simulation, Springer 2013.
3. D.J. Murray smith, Testing and validation of computer simulation models; principles, Methods and application, Springer 2015.

Reference Books

1. Averill M. Law and W David Kelton, Simulation Modeling and Analysis, 3rd Edition, McGraw Hill, 2000.
2. W David Kelton, Randoll P Sadowski and Debroah A Sasowski, Simulation with ARENA, McGraw Hill, 2002.
3. Guy L.Curry, Richard M.Feldman, Manufacturing System Modeling and Analysis, Springer, Second Edition 2008.
4. ByoungKyuChoi,Donghun Kang, Modeling and Simulation of Discrete-Event systems, John Wiley and Sons,Inc, 2013.
5. A.Muzy and E.Kofman, Theory of modeling and simulation, 3rd Edition, Academic Press, 2018.

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1. https:/ ubalt.edu
2. https://core.ac.uk/search?q=MODELING%2BAND%2BSIMULATION%2BOF%2 BMANUFACTURING %2B SYSTEMS
3. https://nptel.ac.in/courses/112/107/112107220/
4. http://www.digimat.in/nptel/courses/video/112107214/L12.html
5. http://www.nptelvideos.in/2012/12/manufacturing-systems-management.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	1	-	-	1	1	1	2	1	1	1
2	3	2	1	-	1	2	-	-	1	1	2	2	1	1	1
3	3	2	2	-	1	2	-	-	1	1	2	2	1	2	1
4	3	2	2	-	1	2	-	-	1	1	2	2	1	2	1
5	3	2	2	-	1	2	-	-	1	1	2	3	1	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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PROFESSIONAL ELECTIVE - V

U19MEE80	LEAN MANUFACTURING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the various tools for lean manufacturing
- To be appropriate the tools to implement LM system in various organization.
- To acquire knowledge to deliver value added products and services to the customer by LM.
- To understand the terminology relating to lean operations in both service and manufacturing.
- To instruct students about strategic issues and process mapping.

Course Outcomes

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

CO1 - Highlighting the lean concepts in an organization. **(K1)**
CO2 - Commenting fundamentals of lean manufacturing and thus acquire the capability to apply them. **(K2)**
CO3 - Examining the concept of lean manufacturing in the industries. **(K3)**
CO4 - Distinguishing lean manufacturing in other concepts **(K4)**
CO5 - Validating the knowledge of systematic planning methodology **(K5)**

UNIT I INTRODUCTION TO LEAN MANUFACTURING (9 Hrs)

Introduction to Lean and Factory Simulation: History of Lean and comparison to other methods - The 7 Wastes, their causes and the effects - An overview of Lean Principles / concepts / tools - Stockless Production.

UNIT II LEAN MANUFACTURING METHODOLOGIES & TOOLS (9 Hrs)

Lean manufacturing basic tools, Techniques, assessment tools, implementations. Standard work – communication to employees' visual control. Total Productive maintenance – Single minute exchange of dies.

UNIT III PROCESS MAPPING (9 Hrs)

Value stream mapping – current state diagram – present & future state. Application to the factory simulation scenario - reduce stream mapping process mapping overview step by step approach – where to use and how to use. Detail Instruction limit, facilitation.

UNIT IV IMPLEMENTATION OF LEAN AND JUST IN TIME MANUFACTURING (9 Hrs)

Road map – Senior management - Involvement of best practices – Toyota production system – Lean with ISO 9001 – 2000. Introduction and elements of just in time – uniform production rate pull versus push method. Kanban system – continuous improvement – kaizen cells for assembly lines – case studies.

UNIT V WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY (9 Hrs)

Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture

Text Books

1. TaiichiOhno, The Toyota Production System (Beyond Large Scale production), Portland, Oregon Productivity Press. 2019.
2. Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2012.
3. Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2008.

Reference Books

1. Kiyoshi Suzaki, The New Manufacturing Challenge, Free Press, New York 2012.
2. Shigeo Shingo, Study of Toyota Production System, Portland, Oregon Productivity Press. 2013
3. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Publishing Pvt Ltd, 2012.
4. Kenichi Sekine, "One-Piece Flow", Productivity Press, Portland, Oregon, 2013.

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5. Alan Robinson "Continuous Improvement in Operations", Productivity Press, Portland, Oregon, 2015.

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2. https://core.ac.uk/search?q=LEAN%20MANUFACTURING
3. https://nptel.ac.in/courses/110/107/110107130/
4. https://www.youtube.com/watch?v=G_0bl6FHo_c
5. https://www.youtube.com/watch?v=50yrQ5Ub1lc&list=PLLy_2iUCG87B2T7MqpfCr8Vl4A5nwLVm2

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	-	-	-	-	-	-	-	-	1	3	1	1
2	3	2	3	-	-	-	-	-	-	-	-	1	3	1	2
3	3	2	3	-	-	-	-	-	-	-	-	1	3	1	2
4	2	2	2	-	-	-	-	-	-	-	-	1	2	1	2
5	2	2	2	-	-	-	-	-	-	-	-	1	2	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE81	CRYOGENIC ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge of about the cryogenic material properties and its application.
- To impart knowledge on the liquefaction cycles and liquefaction systems.
- To provide knowledge about the types of cryogenic refrigerators and purification of gas.
- To present design aspects of cryogenic storage and transfer lines.
- To learn about the design aspects of cryogenic instrumentation.

Course Outcomes

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

CO1 - Memorizing the effect of material properties at cryogenic temperatures and its application. **(K1)**
CO2 - Comparing the various cryogenic liquefaction system with their performance. **(K2)**
CO3 - Executing design the cryogenic refrigeration systems in accordance with application. **(K3)**
CO4 - Dividing storage systems, transfer system and insulation technique used in cryogenic applications. **(K4)**
CO5 - Experimenting on cryogenic applications. **(K5)**

UNIT I INTRODUCTION TO CRYOGENIC SYSTEMS (9 Hrs)

Cryogenic engineering, properties of cryogenic fluids like Oxygen, Nitrogen, Argon, Neon, Florin, Helium, Hydrogen, Properties of material at cryogenic temperature- mechanical, thermal, and electrical-Super conductivity.

UNIT II CRYOGENIC REFRIGERATION (9 Hrs)

Principle and Methods of production of low temperature and their analysis; Joule Thomson Expansion, Cascade processes, Ortho and para hydrogen conversion, cold gas refrigerators, Linde -Hampson cycles, Claude and cascaded systems, magnetic cooling, Stirling Cycle Cryocoolers, Philips refrigerators, Gifford single volume refrigerator, Pulse tube refrigerators

UNIT III GAS SEPARATION AND PURIFICATION (9 Hrs)

Ideal gas, mixture characteristics composition diagrams, gas separation, principle of rectification, plate calculation, flash calculation rectification column analysis, separation of air, hydrogen and helium, gas purification methods

UNIT IV CRYOGENIC INSTRUMENTATION AND SAFETY (9 Hrs)

Properties and characteristics of instrumentation, strain displacement, pressure, flow, liquid level, density and temperature measurement in cryogenic range. Safety in cryogenic fluid handling, storage and use. Safety against cryogen hazards like burns, frostbite, asphyxiation and hypothermia.

UNIT V CRYOGENIC APPLICATIONS (9 Hrs)

Super conductive devices such as bearings, motors, cryotrons, magnets, D.C. transformers, tunnel diodes, space technology, space simulation, cryogenics in biology and medicine, food preservation and industrial applications, nuclear propulsions, chemical propulsions

Text Books

1. Klaus D. Timmerhous and Thomas M.Flynn, "Cryogenic Process Engineering"' Plenum Press, New York, 2013.
2. Randall Barron, "Cryogenic Systems, McGraw Hill book publishing Co. Ltd., New York, 2002.
3. Dr. Chao Wang, Dr. Zuyu Zhao Cryogenic Engineering and Technologies Principles and Applications of Cryogen-Free Systems CRC Press, 2019

Reference Books

1. Mamata Mukhopadhyay, "Fundamental of Cryogenic Engineering", PHI learning Private Limited, New Delhi, 2014.
2. Thomas M.Flynn, "Cryogenic engineering", marcel dekker, New York, 2005.
3. A. R. Jha, "Cryogenic technology and applications", Butterworth-Heinemann, 2005.

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4. Haselden, G. G., "Cryogenic Fundamental", Academic press, London, 1999.
5. R. B. Scott, Cryogenic Engineering, Van Nostrand Co., 1959.

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2. https://www.youtube.com/watch?v=f42L-HEWg0Q
3. https://www.youtube.com/watch?v=wZae17GUFe8
4. https://www.youtube.com/watch?v=cSDkMs4yTAA
5. https://www.youtube.com/watch?v=4gGMBNEzeuc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	-	-	-	-	-	1	3	2	3	1
2	3	3	2	1	-	-	-	-	-	-	2	2	2	2	2
3	3	3	2	1	-	-	-	-	-	-	1	1	2	2	3
4	3	3	3	1	-	-	-	-	-	-	2	2	1	-	-
5	3	3	3	1	-	-	-	-	-	-	1	1	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE82 **AUTOTRONICS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To formulate the student understand the working of Ignition system storage battery and principles.
- To make the students understand the working of alternator and charging systems.
- To learn working of fusing systems and wiring involved in auto electrical systems
- To compose the students understand the electrical accessories.
- To enhance the students' knowledge regarding semiconductor and waves.

Course Outcomes

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

CO1 - Outlining knowledge about ignition systems **(K1)**
CO2 - Associating the working of alternator and charging systems **(K2)**
CO3 - Examining wiring for auto electrical systems **(K3)**
CO4 -Testing the dash board units and electrical accessories **(K4)**
CO5 - Moderating knowledge about semi-conductor and waves. **(K5)**

UNIT I INTRODUCTION (9 Hrs)

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II IGNITION AND INJECTION SYSTEMS (9 Hrs)

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III SENSOR AND ACTUATORS (9 Hrs)

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS (9 Hrs)

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU s used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT V APPLICATIONS IN AUTOMOBILE (9 Hrs)

An Application of mobile robot vision to a vehicles information systems –objectives directions-collisions warning and avoidance system – low tire pressure warning systems. Vehicles inelegancy- vision based autonomous road vehicles- architecture for dynamics visions systems.

Text Books

1. N. R. Khatawale Automotive Electrical auxiliary systems,2012
2. ManoDigital Logic and Computer Design ,2014
3. William B.Ribbens Understanding Automotive Electronics,2017

Reference Books

1. Young and Griffith, ButterworthAutomotive Electrical systems,2011
2. C.P.Nakra, DhanpatRai. Basic automotive electrical systems,2009
3. William H. Grouse, TMH Automotive mechanics,2015
4. P.I. Kohli, TMHAutomotive Electrical Equipment,2018
5. A. W. Judge Modern Electrical Equipments,2017

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3. https://nptel.ac.in/courses/108/101/108101038/
4. https://www.youtube.com/watch?v=LZ82iANWBL0
5. https://www.youtube.com/watch?v=hs7bABMtOMI&list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	-	-	-	1	-	-	-	2	2	2	3	1
2	3	3	1	-	-	-	2	-	-	-	3	3	2	2	2
3	3	3	2	-	-	-	1	-	-	-	2	3	2	2	3
4	3	3	1	-	-	-	2	-	-	-	3	2	1	2	3
5	3	3	1	-	-	-	2	-	-	-	2	3	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE83 OPTIMIZATION TECHNIQUES IN ENGINEERING DESIGN

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To afford the knowledge of Optimization.
- To endow with knowledge on the methods for optimum design.
- To familiarize with various unconstrained optimization.
- To give the knowledge of constrained optimization.
- To present the knowledge of Modern methods of Optimization.

Course Outcomes

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

CO1 - Finding of optimization. **(K2)**
CO2 - Categorizing the various optimum design. **(K2)**
CO3 - Choosing ideas on unconstrained optimization. **(K3)**
CO4 - Mashing about constrained optimization. **(K4)**
CO5 - Grading about Modern methods of optimization like Neural-Network **(K4)**

UNIT I INTRODUCTION TO OPTIMIZATION (9 Hrs)

Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts. Definition of Global and Local optima – Optimality criteria - Review of basic calculus concepts – Global optimality

UNIT II LINEAR PROGRAMMING METHODS FOR OPTIMUM DESIGN (9 Hrs)

Evaluation of Linear programming methods for optimum design – Post optimality analysis - Application of LPP models in design and manufacturing.

UNIT III UNCONSTRAINED OPTIMIZATION (9 Hrs)

Optimization algorithms for solving unconstrained optimization problems – Gradient based method. Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

UNIT IV CONSTRAINED OPTIMIZATION (9 Hrs)

Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method - Engineering applications of constrained and unconstrained algorithms.

UNIT V MODERN METHODS OF OPTIMIZATION (9 Hrs)

Modern methods of Optimization, Neural-Network based Optimization, Applications. Use of Matlab to solve optimization problems.

Text Books

1. Rao S. S. - 'Engineering Optimization, Theory and Practice' - New Age International Publishers, 4th Edition, 2012.
2. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, Eastern Economy edition, PHI Learning Privtae Limited, 2012.
3. Hardley G. -'Linear Programming' - Narosa Book Distributors Private Ltd., 2002.

Reference Books

1. R.VenkataRao, Vimal J. Savsani, Mechanical Design Optimization Using Advanced Optimization Techniques, Springer,2012.
2. Arora J. - 'Introduction to Optimization Design' - Elsevier Academic Press, New Delhi - 2004
3. Saravanan R. - 'Manufacturing Optimization through Intelligent Techniques', Taylor & Francis (CRC Press), 2006.
4. John Gero , Design Optimization, AP Academic press,2012.
5. Ashok D. Belegundu, Tirupathi R. Chandrupatla, Optimization Concepts and Applications in Engineering, Cambridge umiversity press, 2011

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3. https://www.youtube.com/watch?v=LL20TZGXp3Q
4. https://www.youtube.com/watch?v=3Bh_viwz6_0
5. https://www.youtube.com/watch?v=aJKuM4U-eYg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	-	-	2	3	2	3	1
2	3	3	2	2	-	-	-	-	-	-	1	3	2	2	3
3	3	3	2	2	-	-	-	-	-	-	2	3	2	1	3
4	3	3	3	2	-	-	-	-	-	-	1	3	1	2	3
5	3	3	3	2	-	-	-	-	-	-	2	3	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE84	TOTAL QUALITY MANAGEMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce students with the TQM concepts, techniques and various process.
- To analysis TQM tools, international standards.
- To expose students to organizational TQM.
- To Implementation techniques of TQM
- To continuous quality improvement for various industry.

Course Outcomes

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

CO1 - Relating seven QC tools for data collection and analysis. **(K1)**
CO2 - Determine the quality system and take corrective actions when necessary. **(K2)**
CO3 - Appraising management for the TQM approach development. **(K3)**
CO4 - Experimenting the TQM approach in an organization for continuous quality improvement. **(K4)**
CO5 - Measuring an organization stands on quality management with respect to various quality standards. **(K5)**

UNIT I INTRODUCTION TO TQM (9 Hrs)

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES (9 Hrs)

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating

UNIT III TQM TOOLS & TECHNIQUES I (9 Hrs)

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types

UNIT IV TQM TOOLS & TECHNIQUES II (9 Hrs)

Quality based product and process Design – Design for reliability – Design for maintainability – Quality Function Deployment (QFD) – QFD and Quality Assurance – QFD Principles, Concepts and applications – case studies.

UNIT V QUALITY SYSTEMS (9 Hrs)

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

Text Books

1. Dale H.Besterfiled, et al. - Total Quality Management, Pearson Education Asia, 4th Edition, 2015.
2. P.N.Mukherjee – Total Quality Management, Prentice Hall of India Ltd., New Delhi, 2006.
3. James R Evans and William M Lindsay – Quality Control and Management, Centage Learning India Pvt. Ltd., New Delhi, 8th edition 2010

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1. Poornima M. Charantimath - Total Quality Management - Pearson Education , 3rd edition-2017
2. R Kesavan C Elanchezhian B VijayaRamnath Total Quality Management - I K International Publishing House, 2008
3. Total Quality Management by R.S Naagarazan ,New Age international,3rd Edition, 2015
4. Besterfield Dale H.- Total Quality Management (TQM) , 5th edition, 2018

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5. P.N. Harikumar and Susha D., Total Quality Management, Abhijeet Publications, 2018

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4. https://www.youtube.com/watch?v=yWIAOFs04go
5. https://www.youtube.com/watch?v=VxNIYCMr1Nc&list=PLueDbnzoKDZ-ZIJigjav-j8ZWz5CEoz-0

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	-	-	-	-	2	3	2	2	3
2	3	3	2	-	-	-	-	-	-	-	1	3	2	2	2
3	3	3	2	-	-	-	-	-	-	-	2	3	2	3	3
4	3	3	3	-	-	-	-	-	-	-	1	3	1	3	3
5	3	3	3	-	-	-	-	-	-	-	2	3	2	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

PREFESSIONAL ELECTIVE - VI

U19MEE85	COMPOSITES MATERIAL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the need and types of composites available.
- To know about polymer matrix composites, their properties, manufacturing methods and applications.
- To know about metal matrix composites, their properties, manufacturing methods and applications.
- To know about ceramic matrix composites, their properties, manufacturing methods and applications.
- To know the recent advancements in composites.

Course Outcomes

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

CO1 - Gain knowledge on the need of various types of composites. **(K2)**
CO2 - Infer different techniques to process polymer-matrix composites and its limitations. **(K3)**
CO3 - Infer different techniques to process metal-matrix composites and its limitations. **(K3)**
CO4 - Infer different techniques to process ceramic-matrix composites and its limitations. **(K3)**
CO5 - Select appropriate composites for specific applications. **(K3)**

UNIT I INTRODUCTION TO COMPOSITES (9 Hrs)

Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites. Applications of various types of composites.

UNIT II POLYMER MATRIX COMPOSITES (9 Hrs)

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand layup processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP).

UNIT III METAL MATRIX COMPOSITES (9 Hrs)

Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting.

UNIT IV CERAMIC MATRIX COMPOSITES (9 Hrs)

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot Isostatic Pressing (HIPing).

UNIT V ADVANCES IN COMPOSITES (9 Hrs)

Carbon / carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

Text Books

1. Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 2006.
2. Chawla K.K., Composite materials, Springer – Verlag, 2013.
3. Autar.K.Kaw, "Mechanics of Composite Materials", CRC Press, 2006.

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Reference Books

1. Clyne T.W. and Withers P.J., Introduction to Metal Matrix Composites, Cambridge University Press, 2003.
2. Strong A.B., Fundamentals of Composite Manufacturing, SME, 2008.
3. Sharma S.C., "Composite materials", Narosa Publications, 2004.
4. Broutman, L.J. and Krock, R.M., " Modern Composite Materials", Addison-Wesley, 1967.
5. ASM Hand Book, "Composites", Vol.21, ASM International, 2001.

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1. https://nptel.ac.in/content/storage2/courses/101106038/mod01lec01
2. https://www.classcentral.com/course/edx-composite-materials-overview-for-10
3. https://nptel.ac.in/courses/112/104/112104168/
4. https://nptel.ac.in/courses/112/104/112104161/
5. https://onlinecourses.nptel.ac.in/noc20_me95/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	1	1	-	-	1	-	1	2	1	1
2	3	-	1	-	-	1	1	-	-	1	-	2	2	1	1
3	3	-	2	-	-	1	1	-	-	1	-	2	2	2	1
4	3	-	2	-	-	1	1	-	-	1	-	2	2	2	1
5	3	-	2	-	-	1	1	-	-	1	-	2	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE86	ALTERNATIVE FUELS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics of need of an Alternative fuels.
- To explain the characteristics of vegetable oil and alcohol as fuels.
- To provide students an understanding about the biodiesel and biogas as the fuel.
- To teach students about CNG, LPG and hydrogen fuels.
- To explain about the electric, hybrid and fuel cell vehicles.

Course Outcomes

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

CO1 - Understand the need of alternate fuels and its importance **(K2)**

CO2 - interpret the usage of vegetable oils and alcohols as the fuel to the engines **(K2)**

CO3 - Adopt the usage of biodiesel and biogas as the alternative fuels **(K2)**

CO4 - Identify and understand the utilization of gaseous fuels to the engines.**(K2)**

CO5 - Interpret the concept of eclectic, hybrid and fuel cell utilized to energies the engines **(K3)**

UNIT I INTRODUCTION TO ALTERNATIVE FUEL (9 Hrs)

Introduction to alternative fuels, Need for alternative fuels, Availability of different alternative fuels for SI and CI engines, Selection criterion of fuel, Selection criteria of raw material. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT II VEGETABLE OILS AND ALCHOHOL AS FUELS (9 Hrs)

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Trans esterification and emulsification of Vegetable oils – Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

Introduction, Raw Material Selection criteria for Methanol and Ethanol, Potential of Methanol and Ethanol (Petrol Blends and Diesel Blends, Bio diesel production ingredient, Di methyl ether, Fuel cell) Production method of ethanol, Production methods of methanol, Methanol Economics, Methanol and Ethanol Safety Aspects, Properties of Methanol and Ethanol, Methanol and Ethanol Engine tests, Methanol and Ethanol Benefits, Engine Modification required for alcohol uses in SI and CI engine

UNIT III BIODIESEL AND BIOGAS (9 Hrs)

Introduction, Raw materials used for production of Bio Diesel, Biodiesel production methods, Bio Diesel Production Equipment, Types of Transesterification process, Bio Diesel Properties, Bio Diesel Quality Standards, Performance characteristics of biodiesel, Engine Tests for Bio Diesels, Engine Modification required for biodiesel uses in engine, Challenges for Bio Diesel.

Introduction, Biogas production method, Biogas Plants, Factors affecting biogas formation, Engine Modification required for biogas uses in SI and CI engine, Biogas purification methods, Emission Characteristics of biogas, Storage and safety aspect of Biogas

UNIT IV CNG & LPG and HYDROGEN (9 Hrs)

Potential of LPG, LPG production, Properties of LPG, LPG Modeling studies, LPG Engine tests, LPG Material compatibility, LPG Economics, LPG Safety aspects, LPG Merits and Demerits, CNG Storage, CNG Distribution, CNG Safety, CNG Advantages, CNG challenges, Hydrogen Production, Hydrogen Storage, Hydrogen Properties, Hydrogen Economics, Hydrogen Safety, Hydrogen in Fuel cell, Hydrogen in SI and CI engines, Hydrogen Benefits, Hydrogen Barriers and challenges

UNIT V ELECTRIC, HYBRID AND FUEL CELL VEHICLES (9 Hrs)

Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

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Text Books

1. A S Ramadhas, Alternative Fuels for Transportation, CRC, 2011.
2. K. A. Subramanian and M. K. Gajendra Babu, Alternative Transportation Fuels: Utilisation in Combustion Engines, CRC Press, 2013.
3. S. S. Thipse, Alternative Fuels : Concepts, Technologies And Developments, GBD Publishers, 2010.
4. Richard Folkson, Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance: Towards Zero Carbon Transportation, Woodhead Publishing in energy, 2014.
5. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer- Verlag London Limited 2008,ISBN-13: 9781846289941

Reference books

1. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
2. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
3. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
4. Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.
5. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.)

Web References

1. https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture40.pdf
2. https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture35.pdf
3. https://nptel.ac.in/courses/112/103/112103262/
4. https://afdc.energy.gov/publications/search/category/?tags[]=methanol
5. https://www.sae.org/publications/books/content/r-180/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	1	-	1-	2	2	2	2
2	3	3	2	2	-	-	-	-	-	-	-	2	2	2	2
3	3	2	2	2	-	1	-	-	-	-	-	2	2	2	2
4	3	3	3	3	1	-	-	-	-	1	-	2	2	2	2
5	3	3	3	3	1	-	1	1	1	1	-	2	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MEE87	ELECTRIC AND HYBRID VEHICLES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics of electric and hybrid vehicles.
- To explain the concept of electric propulsion unit in EV.
- To provide students an understanding about the energy storage and sizing of the drive system.
- To teach students about energy consumption in EV.
- To explain about the energy management strategies.

Course Outcomes

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

CO1 - Understand the need and working of electric and hybrid vehicles **(K2).**
CO2 - Explain the working of propulsion unit powered by electricity in automobile **(K2)**
CO3 - Understand the concept of energy storage and the sizing of the drive system. **(K2)**
CO4 - Analyze the energy consumption by the drive unit.**(K3)**
CO5 - Analyze and discuss the concept of energy management strategies.**(K3)**

UNIT I INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES (9 Hrs)

Introduction to Hybrid Electric Vehicles, Conventional Vehicles. Hybrid Electric Drive-trains and Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT II ELECTRIC PROPULSION UNIT (9 Hrs)

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT III ENERGY STORAGE AND SIZING THE DRIVE SYSTEM (9 Hrs)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles. Battery, Fuel Cell, Super Capacitor and Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

UNIT IV ENERGY CONSUMPTION (9 Hrs)

Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor

UNIT V ENERGY MANAGEMENT STRATEGIES (9 Hrs)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text Books

1. A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishers, 2019.
2. Mary Murphy Electric and Hybrid Vehicles: Principles, Design and Technology, Larsen and Keller Publication, 2019.
3. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press , 2003

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5. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004

Reference books

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd. , 2011
3. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003
4. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012
5. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013

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2. https://onlinecourses.nptel.ac.in/noc20_ee18/preview
3. https://greenmobility-library.org/public/index.php/single-esource/V2xNb3U3eDVSZE55VGt5dlZJZFg4UT09
4. https://afdc.energy.gov/vehicles/electric_basics_hev.html
5. http://autocaat.org/Technologies/Hybrid_and_Battery_Electric_Vehicles/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	1	-	1-	2	2	2	2
2	3	3	2	2	-	-	-	-	-	-	-	2	2	2	2
3	3	2	2	2	-	1	-	-	-	-	-	2	2	2	2
4	3	3	3	3	1	-	-	-	-	1	-	2	2	2	2
5	3	3	3	3	1	-	1	1	1	1	-	2	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19MEE88 MAINTENANCE AND SAFETY ENGINEERING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basic definitions of maintenance terms
- To explain the different kinds of Maintenance required and their procedures.
- To provide students an understanding about the maintenance strategies.
- To teach about different kinds of Safety procedures followed in industries and occupational diseases
- To explain about the Criteria to choose different maintenance techniques or maintenance management.

Course Outcomes

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

CO1 - Demonstrate an understanding of the different Maintenance Engineering terms. **(K2)**
CO2 - Follow the procedures and functions of different maintenance methods. **(K2)**
CO3 - Understand the various strategies followed to carry out maintenance operations. **(K2)**
CO4 - Explain the various safety procedures and its related consequences. **(K2)**
CO5 - Adopt the knowledge of choose the different maintenance techniques. **(K3)**

UNIT I INTRODUCTION TO MAINTENANCE ENGINEERING (9 Hrs)

Introduction, Need for Maintenance, Facts and Figures, Modern Maintenance, Problem and Maintenance Strategy for the 21st Century, Engineering Maintenance Objectives and Maintenance in Equipment Life Cycle, Terms and Definitions. Maintenance Manual, Facility Evaluation, Functions of Effective Maintenance Management.

UNIT II MAINTENANCE AND INVENTORY (9 Hrs)

Types Of Maintenance: Preventive Maintenance and its elements, Maintenance Program, Program Evaluation and Improvement, Measures, Models, Corrective Maintenance and its types, Downtime Components, CM Measures and Models. Inventory Control In Maintenance: Objectives, Basic Inventory Decisions, ABC Method, Two-Bin Inventory Control and Safety Stock.

UNIT III MAINTENANCE STRATEGIES (9 Hrs)

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero-break down, preventive inspection of equipment used in emergency.

UNIT IV QUALITY AND SAFETY IN MAINTENANCE (9 Hrs)

Needs for Quality Maintenance Processes, Use of Quality Control Charts in Maintenance Work Sampling, Post Maintenance Testing, Reasons for Safety Problems in Maintenance, Guidelines to Improve Safety in Maintenance Work, Budget, Labor Cost Estimation, Material Cost Estimation, Equipment Life Cycle Maintenance Cost Estimation, Maintenance Cost Estimation Models.

UNIT V MAINTENANCE MANAGEMENT (9 Hrs)

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

Text Books

1. Venkataraman, K. , Maintenance Engineering and Management, PHI publication, 2010.
2. R.C. Mishra & K. Pathak, Maintenance Engineering and Management, PHI publication, 2012.
3. A.K. Gupta, Reliability, Maintenance and Safety Engineering, Laxmi Publications, 2015.
4. E Balagurusamy, Reliability Engineering McGraw Hill Education, 2017.
5. H. P. Garg, Industrial Mainteance, S Chand Publications, 2014.

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Reference Books

1. Iberto Martinetti, Micaela Demichela, and Sarbjeet Singh, Applications and Challenges of Maintenance and Safety Engineering in Industry 4.0, IGI Global, 2020.
2. Verma, Ajit Kumar, Ajit, Srividya, Karanki, Durga Rao Reliability and Safety Engineering, Springer, 2016.
3. Shawn A. Ballee and Gary R. Shearer, Industrial Maintenance and Mechatronics, Goodheart-Willcox; First Edition, 2018.
4. Michael E. Brumbach, Jeffrey A. Clade, Industrial Maintenance, 2nd Edition, Cengage Learning, 2013.
5. MP Poonia and SC Sharma, Industrial safety and Maintenance Management, Khanna Publications, 2019

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1. https://nptel.ac.in/courses/112/107/112107143/
2. https://nptel.ac.in/courses/112/107/112107241/
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4. https://freevideolectures.com/course/4411/nptel-industrial-safety-engineering
5. https://www.classcentral.com/course/swayam-industrial-safety-engineering-14124

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	1	2	2	2
2	3	2	2	2	-	-	-	-	-	-	-	1	2	2	2
3	3	2	2	2	-	-	-	-	-	-	-	1	2	2	2
4	3	2	2	2	-	-	-	-	-	-	-	1	2	2	2
5	3	3	3	3	1	-	1	1	1	1	-	2	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	T	P	C	Hrs
U19MEE89	NON-DESTRUCTIVE EVALUATION AND TESTING	3	0	0	3	45

Course Objectives

- To understand the basics of NDT and its evaluation.
- To illustrate students about the die penetration and magnetic particle inspection.
- To provide students an understanding about the various radiographic method of weld test.
- To teach students about process of welding test by ultrasonic testing methods.
- To explain about the various special NDT techniques.

Course Outcomes

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

CO1 - Demonstrate an understanding of the concepts of NDT E basics **(K2).**
CO2 - Understand the process of die penetration and magnetic particle inspection. **(K2)**
CO3 - Interpret the concepts of testing methods by radiographic methods. **(K2)**
CO4 - Analyse and adopt the various testing methods by ultrasonic testing methods.**(K3)**
CO5 - Apply the knowledge of testing of weld joints by special NDT techniques and to analyze some case studies **(K3)**

UNIT I INTRODUCTION TO NDT (9 Hrs)

Scope and advantages of NDT, Comparison of NDT with Destructive Testing, Some common NDT methods used since ages, Terminology, Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test, chalk test (oil whitening test). Uses of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection.

UNIT II DIE PENETRATION TEST AND MAGNETIC PARTICLE INSPECTION (9 Hrs)

Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrants and developers, Zyglo test, Illustrative examples and interpretation of defects. Magnetic particle Inspection – scope and working principle, Ferro Magnetic and Nonferromagnetic materials, equipment & testing. Advantages, limitations Interpretation of results, DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications.

UNIT III RADIOGRAPHIC METHOD (9 Hrs)

Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering), Pair production, Beam geometry and Scattering factor. X-ray radiography: principle, equipment & methodology, applications, types of radiations and limitations. γ-ray radiography – principle, equipment., source of radioactive materials & technique, advantages of γ-ray radiography over X-ray radiography Precautions against radiation hazards. Case Study - casting and forging.

UNIT IV ULTRASONIC TESTING METHODS (9 Hrs)

Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.

UNIT V SPECIAL NDT TECHNIQUES (9 Hrs)

Eddy Current Inspection: Principle, Methods, Equipment for ECT, Techniques, Sensitivity, advanced ECT methods. Application, scope and limitations, types of Probes and Case Studies. Introduction to Holography, Thermography and Acoustic emission Testing

Text Books

1. J Prasad and C. G. Krishnadas Nair, Non- Destructive Test and Evaluation of Materials, Tata McGraw-Hill, 2008.
2. Lari & Kumar, Basics of Non-Destructive Testing, KATSON Books, 2012.

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3. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-destructive Testing, 2nd Edition, Woodhead Publishing, 2002.
4. Ravi Prakash, Non-destructive Testing Techniques, New Age Science, 2009.
5. T.Raja Santhosh Kumar Dr. A.Anderson, Dr. S.Ramachandran, Non - Destructive Testing, Air walk Publications, 2017.

Reference Books

1. Robert C. McMaster, Non-destructive Testing Handbook, Amer Society for Nondestructive, 1959.
2. Barry Hull and Vernon John , Non Destructive Testing, Springer Verlag, 1988.
3. Mohammed Omar, Non-Destructive Testing Methods and New Applications, InTech, 2021.
4. Paul E. Mix, Introduction to Non-destructive Testing: A Training Guide, Second Edition, Wiley, 2004.
5. Nathan Ida, Norbert Meyendorf, Handbook of Advanced Nondestructive Evaluation, Springer International Publishing, 2019.

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2. https://www.nde-ed.org
3. https://web.itu.edu.tr/~arana/ndt.pdf
4. https://www.coursera.org/lecture/corrosion/corrosion-inspection-GYVGI
5. https://www.edx.org/course/fundamentals-of-non-destructive-testing

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	1	-	1-	2	2	2	2
2	3	3	2	2	-	-	-	-	-	-	-	2	2	2	2
3	3	1	1	1	-	1	-	-	-	-	-	2	2	2	2
4	3	3	3	3	1	-	-	-	-	1	-	2	2	2	2
5	3	3	3	3	1	-	1	1	1	1	-	2	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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OPEN ELECTIVE - I

U19EEO41	SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS (Common to ECE, ICE, MECH, CIVIL, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart fundamental knowledge of solar cell formation and its properties.
- To understand the various technologies used to improve solar cells.
- To discuss the various components in On-grid connected systems.
- To gain knowledge on components in Off-grid connected systems using Solar PV.
- To design the PV systems for various real load applications with cost benefits.

Course Outcomes

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

CO1 - Explain the fundamentals of solar cells. **(K2)**
CO2 - Recognize the various solar PV technologies and their up gradations along with their benefits. **(K2)**
CO3 - Design and analyze on–grid PV applications. **(K4)**
CO4 - Design and analyze off–grid PV applications. **(K4)**
CO5 - Realize cost benefit analysis of PV installations. **(K4)**

UNIT I ESSENTIAL BASICS OF SOLAR CELL (9 Hrs)

Solar cell – physics – Photovoltaics in Global Energy Scenario – Fundamentals of Semiconductors, Energy band, Charge carriers – Motion, PN Junction diode, Solar cells – Design characteristics, Solar radiation.

UNIT II COMMERCIAL AND DEVELOPING TECHNOLOGIES (9 Hrs)

Commercial technologies – Mono crystalline and Multi crystalline, Silicon – Wafer based Solar cell, Thin film solar cells – A–Si, Cd–Te and CIGS, Concentrated PV cells, Developing technologies – Organic cells, Dye sensitized cells.

UNIT III SOLAR PV FOR ON-GRID APPLICATIONS (9 Hrs)

Solar cells to solar array – On–Grid PV system – With and Without storage – Balance of system – DC–DC converters – Inverters – Net Metering – Design and analysis – Performance evaluation and monitoring – Field visit – Grid tied PV power plant.

UNIT IV SOLAR PV FOR OFF–GRID APPLICATIONS (9 Hrs)

Off–Grid stand alone PV system – System sizing – Module and Battery – Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One–axis, Two–axis – Maximum power point tracking – Design and analysis – Performance evaluation and monitoring – Field visit – Off–grid PV system

UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS (9 Hrs)

Cost and manufacturability – Manufacturing economics – Scaling – Pricing – Trends in retail pricing – Energy economics – Grid tied power plant – Solar street lighting system

Text Books

1. C.S. Solanki, "Solar Photovoltaics – Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., 2nd Edition, 2011.
2. Martin A. Green, "Solar Cells Operating Principles, Technology, and System Applications", Prentice - Hall, 1st Edition, 2008.

Reference Books

1. J. Nelson, "The Physics of Solar Cells", Imperial College Press, 1st Edition, 2003.
2. Thomas Markvart, "Solar Electricity", John Wiley and Sons, 2nd Edition, 2000.
3. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish , "Applied Photovoltaics", Earthscan, 3rd Edition, 2011.
4. Michael Boxwell, "The Solar Electricity Handbook", Green stream Publishing, 10th Edition, 2016.

(K.VELMURUGAN)

5. RikDe Gunther, "Solar Power-Your Home for Dummies", Wiley Publishing Inc, 2nd Edition, 2010.

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1. https://swayam.gov.in/nd1_noc20_ph21/preview
2. https://swayam.gov.in/nd2_nou20_ag13/preview
3. https://www.studentenergy.org/topics/solar-pv
4. https://www.eia.gov/energyexplained/solar/photovoltaics-and-electricity.php
5. https://www.energysage.com/solar/
6. https://www.bca.gov.sg/publications/others/handbook_for_solar_pv_systems.pdf
7. http://www.oas.org/dsd/publications/unit/oea79e/ch05.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	3	-	-	-	-	3	3	3	1
2	3	3	3	3	2	-	3	-	-	-	-	3	3	3	1
3	3	3	3	3	2	-	3	-	-	-	-	3	3	3	1
4	3	3	3	3	2	-	3	-	-	-	-	3	3	3	1
5	3	3	3	3	2	-	3	-	-	-	-	3	3	3	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19EEO42	ELECTRICAL SAFETY (Common to ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize the Indian Electricity Rules and Act related with electrical safety.
- To provide a knowledge about electrical shocks and safety precautions.
- To create awareness of the electrical safety associated with installation of electrical equipment.
- To analyze different Hazardous areas for electrical safety.
- To expose knowledge about necessity of safety policy and safety management.

Course Outcomes

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

CO1 - Describe the Indian Electricity (IE) acts and various rules for electrical safety. **(K2)**
CO2 - Expose safety measures to prevent electrical shock in handling of domestic electrical appliances. **(K3)**
CO3 - Evaluate the safety aspects during installation of plant and equipment. **(K3)**
CO4 - Describe the various hazardous area and application of electrical safety in various places. **(K3)**
CO5 - Acquire knowledge about importance of electrical safety training to improve quality management in electrical systems. **(K3)**

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS (9 Hrs)

Objective and scope of electrical safety - National electrical Safety code - Statutory requirements – Indian Electricity acts related to electrical Safety - Safety electrical one line diagram - International standards on electrical safety safe limits of current and voltage - Grounding of electrical equipment of low voltage and high voltage systems - Safety policy - Electrical safety certificate requirement

UNITII ELECTRICAL SHOCKS AND THEIR PREVENTION (9 Hrs)

Primary and secondary electrical shocks - Possibilities of getting electrical shock and its severity - Effect of electrical shock of human being - Shocks due to flash/ Spark over's - Firing shock - Multi storied building - Prevention of shocks - Safety precautions - Safe guards for operators - Do's and Don'ts for safety in the use of domestic electrical appliances - Case studies on electrical causes of fire and explosion

UNIT III SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE (9 Hrs)

Need for inspection and maintenance - Preliminary preparations - Field quality and safety - Personal protective equipment - Safe guards for operators - Safety equipment - Risks during installation of electrical plant and equipment - Effect of lightning current on installation and buildings - Safety aspects during installation -Safety during installation of electrical rotating machines - Importance of earthing in installation– Agricultural pump installation

UNIT IV HAZARDOUS ZONES (9 Hrs)

Primary and secondary hazards - Hazardous area classification and of electrical equipments (IS, NFPA, API and OSHA standards) - Explosive gas area classifications: Class I(Division 1) - Zone 0, Zone 1, zone 2 classified locations, Design Philosophy for Equipment and installations-Classification of equipment enclosure for various hazardous gases and vapors - flash hazard calculation and approach distances- calculating the required level of arc protection

UNIT V SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS (9 Hrs)

Principles of Safety Management - Occupational safety and health administration standards - Safety organization - Safety auditing - Employee electrical safety teams - Electrical safety training to improve Quality management - Total quality control and management – Importance of high load factor - Causes of low power factor - Disadvantages of low power factor - Power factor improvement - Importance of P.F. improvement - Case studies of electrical workplace safety practices.

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Text Books

1. John Cadick, Mary CapelliSchellpfeffer, Dennis Neitzel, Al Winfield, "Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 2012.
2. Madden, M. John, "Electrical Safety and the Law: A Guide to Compliance", Wiley publications, 4th Edition, 2002.
3. Madden, M. John, "Electrical Safety and the Law: A Guide to Compliance", Wiley publications, 4th Edition, 2002.
4. Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards", CRC Press; 1st Edition, 2013.

Reference books

1. Rob Zachariason, "Electrical Safety", Delmar Cengage Learning, 1st Edition, 2011.
2. Peter E. Sutherland, "Principles of Electrical Safety", Wiley-IEEE Press; 1st Edition, 2014.

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1. https://www.apeasternpower.com/downloads/elecact2003.pdf
2. https://safetyculture.com/topics/electrical-hazards/
3. https://www.jove.com/science-education/10114/electrical-safety-precautions-and-basic-equipment
4. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
5. https://www.electrical4u.com/safety-precautions-for-electrical-system/
6. https://www.constellation.com/energy-101/electrical-safety-tips.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	2	-	-	-	-	-	-	2	2	1
2	3	3	3	2	-	2	-	-	-	-	-	-	2	2	1
3	3	3	3	2	-	2	-	-	-	-	-	-	2	2	1
4	3	3	3	2	-	2	-	-	-	-	-	-	2	2	1
5	3	3	3	2	-	2	-	-	-	-	-	-	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ECO41	**ENGINEERING COMPUTATION WITH MATLAB**	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand basic representation of Matrices and vectors in MATLAB
- To learn various programming structures in MATLAB
- To study built in and user defined functions in MATLAB.
- To become conversant with 2D as well as 3D graphics in MATLAB
- To make a Graphical User Interface (GUI) in MATLAB in order to achieve interactivity

Course Outcomes

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

CO1 - State the basics of MATLAB. **(K1)**
CO2 - Explain how to work with matrices, and their operations. **(K2)**
CO3 - Use the MATLAB functions relevant to communication engineering. **(K3)**
CO4 - Demonstrates various file operations in MATLAB. **(K3)**
CO5 - Applying the plotting capabilities of MATLAB effectively to various systems. **(K3)**

UNIT I INTRODUCTION TO MATLAB (9 Hrs)

Menus & Tool bars, Variables - Matrices and Vectors - initializing vectors - Data types- Functions – User defined functions - passing arguments - writing data to a file-reading data from a file - using functions with vectors and matrices- cell arrays & structures - Strings - 2D strings-String comparing - Concatenation - Input and Output statements - Script files .

UNIT II LOOPS AND CONTROL STATEMENTS (9 Hrs)

Introduction; Relational & Logical operations - Example programs - Operator precedence - Control & Decision statements- IF - IF ELSE - NESTED IF ELSE - SWITCH - TRY & CATCH - FOR -WHILE - NESTED FOR - FOR with IF statements, MATLAB program organization, Debugging methods - Error trapping using eval & lastern commands.

UNIT III PLOTS IN MATLAB & GUI (9 Hrs)

Basic 2D plots, Labels, Line style, Markers, plot, subplot, LOG, LOG-LOG, SEMILOG-POLARCOMET, Grid axis, labeling, fplot, ezplot, ezpolar, polyval, exporting figures, HOLD, STEM, BAR, HIST, Interactive plotting, Basic Fitting Interface – Polyfit - 3D plots – Mesh - Contour - Example programs. GUI - Creation Fundamentals – Capturing mouse actions

UNIT IV MISCELLANEOUS TOPICS (9 Hrs)

File & Directory management - Native Data Files - Data import & Export - Low Level File I/O – Directory management - FTP File Operations - Time Computations -Date & Time – Format Conversions - Date & Time, Functions - Plot labels - Optimization - zero Finding - Minimization in one Dimension - Minimization in Higher Dimensions- Practical Issues. Differentiation & Integration using MATLAB, 1D & 2D Data Interpolation

UNIT V SIMULINK & APPLICATIONS (9 Hrs)

How to create & run Simulink, Simulink Designing - Using SIMULINK Generating an AM signal & 2nd order systems - Designing of FWR & HWR using Simulink - Creating a subsystem in Simulink. Applications Programs -Frequency response of filters. Open Loop gain of OPAMP, I/P characteristics of BJT, Plotting the graph between Breakdown voltage & Doping Concentration.

Text Books

1. RudraPratap, Getting Started with MATLAB 6.0 ,1st Edition, Oxford University Press-2004.
2. Duane Hanselman ,Bruce LittleField, "Mastering MATLAB 7", Pearson Education Inc, 2005
3. William J.Palm, "Introduction to MATLAB 6.0 for Engineers", McGraw Hill & Co, 2001.

Reference books

1. M.Herniter, "Programming in MATLAB", Thomson Learning, 2001

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2. John OkyereAltia, "Electronics and circuit analysis using MATLAB", CRC press, 1999
3. K.K.Sharma, "MATLAB Demustifyied", Vikas Publishing House Pvt Ltd. 2004

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2. https://www.tutorialspoint.com/matlab/index.htm
3. https://www.cmu.edu/computing/software/all/matlab/
4. https://ctms.engin.umich.edu/CTMS/index.php?aux=Home

COs/POs/PSOs Mapping

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

Deepa
(K.VELMURUGAN)

U19ECO42	CONSUMER ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To enable the troubleshoot of different types of microphones and loudspeakers.
- To make the students to analyze the working of digital console, digital FM tuner and troubleshoot audio systems.
- To train and test the working of various colour TV.
- To empower them to troubleshoot colour TV receivers.
- To equip them to maintain various electronic home and office appliances.

Course Outcomes

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

CO1 - Describe the fundamental audio characteristics and measurements, operating principles of microphone and loudspeaker. **(K1)**

CO2 - Explain the working of digital console, digital FM tuner and troubleshoot the audio systems. **(K2)**

CO3 - Distinguish the salient features of colour TV and Monochrome and troubleshoot TV camera. **(K2)**

CO4 - Demonstrate various interfaces in digital TV, the working of DTH receiver, CD/DVD players. **(K3)**

CO5 - Explain the working of FAX, Microwave oven, Washing machine, Air conditioner, Refrigerators, camera. **(K2)**

UNIT I AUDIO FUNDAMENTALS AND DEVICES (9 Hrs)

Basic characteristics of sound signal, Microphone- working principle, sensitivity, nature of response. Types of Microphone, Loud speaker- working principle, Woofers and Tweeters, characteristics. Types of Loudspeaker. Sound recording

UNIT II AUDIO SYSTEMS (9 Hrs)

Introduction to audio system, Digital Console- Block diagram, working principle, applications, FM tuner- concepts of digital tuning, ICs used in FM tuner TD702IT, PA address system- Planning, speaker impedance matching, characteristics, Power amplifier specification

UNIT III TELEVISION SYSTEMS (9 Hrs)

Monochrome TV standards, Components of TV system, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution. Composite video signal, Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance. Different types of TV camera.

UNIT IV TELEVISION RECEIVERS AND VIDEO STANDARDS (9 Hrs)

Colour TV receiver- block diagram, Digital TVs- LCD, LED , PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video Interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI, Digital Video Interface, CD and DVD player: working principles, interfaces

UNIT V HOME AND OFFICE APPLIANCES (9 Hrs)

Microwave Oven: Types, technical specifications. Washing Machine: hardware and software. Air conditioner and Refrigerators: Components features, applications, and technical specification. Digital camera and cam coder: - pick up devices, picture processing, picture storage

Text Books

1. S.P.Bali, 'Consumer Electronics', copyright,Pearson Education India, 2008.
2. R.Bali and S.[.Bali, 'Audio video systems : principle practices & troubleshooting', Khanna Book Publishing Co. (P) Ltd
3. Gulati R.R., 'Modern Television practices', 5th edition, New Age International Publication (P) Ltd, 2015.

Reference Books

1. R.G.Gupta, 'Audio video systems', 2nd edition, Tata Mcgraw Hill, New Delhi, India, 2017.
2. Whitaker Jerry & Benson Blair, 'Mastering Digital Television', McGraw-Hill Professional, 2006.

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3. Whitaker Jerry & Benson Blair, 'Standard handbook of Audio engineering', 2nd edition, McGraw-Hill Professional, 2002.

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2. http://www.cosc.brocku.ca/Offerings/3P92/seminars/HDTV.ppt
3. http://www.circuitstoday.com/blu-ray-technology-working
4. http://www.freevideolectures.com

COs/POs/PSOs Mapping

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CSO41 **WEB DEVELOPMENT**
(Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study the fundamentals of web application development
- To understand the design components and tools using CSS
- To learn the concepts JavaScript and programming fundamentals.
- To study about advance scripting and Ajax applications.
- To understand the working procedure of XML

Course Outcomes

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

CO1 - Develop basic web applications. **(K5)**
CO2 - Design the web applications using CSS. **(K5)**
CO3 - Validate the web pages using javascripts functions. **(K5)**
CO4 - Demonstrate the web 2.0 application to advance scripts. **(K3)**
CO5 - Update the knowledge of XML Data. **(K4)**

UNIT I INTRODUCTION TO WWW & HTML **(9 Hrs)**

Protocols – Secure Connections – Application and development tools – Web browser – Server definition – Dynamic IP. Web Design: Web site design principles – Planning the site and navigation. HTML: Development process – Html tags and simple HTML forms – Web site structure.

UNIT II STYLE SHEETS **(9 Hrs)**

Introduction to CSS: Need for CSS – Basic syntax and structure using CSS – Background images – Colors and properties – Manipulating texts using fonts, borders and boxes – Margins, padding lists, positioning using CSS – CSS2.

UNIT III JAVASCRIPTS **(9 Hrs)**

Client side scripting: Basic JavaScript – Variables – Functions – Conditions – Loops. Applications: Page Validation – Reporting.

UNIT IV ADVANCE SCRIPT **(9 Hrs)**

JavaScript and objects – DOM and Web browser environments – Forms and Validations – DHTML. AJAX: Introduction – Web applications – Alternatives of AJAX.

UNIT V XML **(9 Hrs)**

Introduction to XML – Uses of XML – Simple XML – XML key components – DTD and Schemas – Well-formed XML document – Applications of XML – XSL and XSLT.

Text Books

1. Keith Wald, Jason Lengstorf," Pro PHP and jQuery", Paperback, 2016.
2. Semmy Purewal, "Learning Web App Development", O'Reilly Media, 2014.
3. P.J. Deitel AND H.M. Deitel," Internet and World Wide Web - How to Program", Pearson Education, 2009.

Reference Books

1. Yakov Fain, Victor Rasputnis, Anatole Tartakovsky and Viktor Gamov, "Enterprise Web Development ", O'Reilly Media, 2014.
2. Steven Suehring, Janet Valade, "PHP, MySQL, JavaScript & HTML5 All-in-One", John Wiley & Sons, Inc, 2013.
3. UttamK.Roy, "Web Technologies", Oxford University Press, 2010.
4. Rajkamal, "Web Technology", Tata McGraw-Hill, 2009.
5. Shklar, Leon, Rosen, Rich, "Web Application Architecture: Principles, Protocols and Practices", Wiley Publication, 2009.

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3. https://www.guru99.com/cakephp-tutorial.html
4. https://www.ithands.com/blog/cms-or-php-framework-which-technology-is-better-for-my-business
5. http://Oriel.ly/learning-web-app

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	3	3	3	3	3	3	3	3	-	-	3	-	-	-	-
2	2	2	2	2	-	2	-	2	-	2	-	2	-	-	-
3	3	3	3	3	3	3	3	3	-	-	3	-	-	-	-
4	2	2	2	2	-	2	-	2	-	2	-	2	-	-	-
5	2	2	2	2	-	2	-	2	-	2	-	2	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CSO42	ANALYSIS OF ALGORITHMS (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To analyze the performance of algorithms in terms of time and space complexity.
- To understand the performance of the algorithms such as divide and conquer, greedy method
- To solve problems using Dynamic Programming and derive the time complexity.
- To solve problems using Backtracking technique and derive the time complexity.
- To solve problems using Branch and Bound technique and derive the time complexity.

Course Outcomes

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

CO1 - Choose the appropriate data structure and algorithm design method for a specified application.**(K2)**

CO2 - Ability to understand the design technique such as divide and conquer, greedy method applied to realistic problems and analyse them. **(K3)**

CO3 - Ability to understand the dynamic programming design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO4 - Ability to understand the backtracking design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO5 - Ability to understand Branch and Bound design technique and how it is applied to realistic problems and analyze them. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis – Time complexity, Space complexity, Asymptotic Notation – Big oh notation, Omega notation, Theta notation and Little oh notation.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD (9 Hrs)

Divide and Conquer method: Applications – Binary search, Merge sort, Quick sort. Greedy method: General method, applications – Knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT III DYNAMIC PROGRAMMING (9 Hrs)

Dynamic Programming: Applications - Multistage graphs, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT IV BACKTRACKING (9 Hrs)

Backtracking: General method, Applications – N-queen problem, Sum of subsets problem, Graph Coloring – Hamiltonian Cycles.

UNIT V BRANCH AND BOUND (9 Hrs)

Branch and Bound: General method, Applications – Traveling sales person problem, 0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution.

Text Books

1. E. Horowitz and S.Sahni, "Fundamentals of Algorithms", Galgotia Publications, 2nd Edition, 2010.
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, "Introduction to Algorithms", PHI/Pearson Education, 3rd Edition, 2009.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, Third Edition, 2012.

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1. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley India, 2006.
2. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson Education Asia, 3rd Edition, 2010.

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3. Donald E Knuth, "The Art of Computer Programming, Volume I & II", Addison Wessely, Third Edition, 2011.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2006.
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.

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3. https://www.javatpoint.com/daa-tutorial
4. https://www.guru99.com/design-analysis-algorithms-tutorial.html
5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CSO43 **PROGRAMMING IN JAVA**
(Common to ECE, MECH, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives
- To gain and explore the knowledge of Java programming.
- To know the principles of inheritances and packages.
- To learn about the usage of interfaces in Java.
- To gain and explore the event handling in Java.
- To get familiarized to the interfaces generic programming, multithreading concepts

Course Outcomes
After completion of the course, the students will be able to

CO1 - Write a maintainable java Program for a given algorithm and implement the same. **(K2)**
CO2 - Demonstrate the use of inheritance and package in relevant applications. **(K3)**
CO3 - Construct Java programs using interfaces. **(K3)**
CO4 - Build Java applications using Event Handling. **(K3)**
CO5 - Create Java applications using multithreading and generic programming. **(K3)**

UNIT I INTRODUCTION TO JAVA PROGRAMMING (9 Hrs)
The History and Evolution of Java - Byte code - Java buzzwords - Data types – Variables – Arrays – Operators - Control statements - Type conversion and casting – Objects and classes in Java – Defining classes – Methods - Access specifiers – Static members – Constructors – Finalize method.

UNIT II INHERITANCE AND PACKAGES (9 Hrs)
Arrays – Strings - Packages – Java-Doc comments — Inheritance – Class hierarchy – Polymorphism – Dynamic binding – Final keyword – Abstract classes

UNIT III INTERFACES (9 Hrs)
The Object class – Reflection – Interfaces – Object cloning – Inner classes – Proxies - I/O Streams - Graphics programming – Frame – Components – Working with 2D shapes.

UNIT IV EVENT HANDLING (9 Hrs)
Basics of event handling – Event handlers – Adapter classes – Actions – Mouse events – AWT event hierarchy – Introduction to Swing – Model-View-Controller design pattern – Buttons – Layout Management – Swing Components – Exception handling – Exception hierarchy – Throwing And catching exceptions.

UNIT V GENERIC PROGRAMMING AND MULTITHREADING (9 Hrs)
Motivation for generic programming – Generic classes – Generic methods – Generic code and virtual machine – Inheritance and generics – Reflection and generics - Multi-threaded programming – Interrupting threads – Thread States – Thread properties – Thread synchronization – Executors – Synchronizers. Enumeration – Autoboxing – Generics.

Text Books
1. Herbert Schildt, "Java: The Complete Reference", TMH Publishing Company Ltd, 11th Edition, 2018.
2. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018.
3. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", Sun Microsystems Press, Eighth Edition, 2008.
4. Herbert Schildt, "The Complete Reference JAVA 2", TMH, Seventh Edition, 2006.

Reference Books
1. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.
2. H.M.Dietel and P.J.Dietel, "Java How to Program", Pearson Education/PHI, 11th Edition, 2017.
3. Cay.S.Horstmann and Gary Cornell, "Core Java 2", Vol 2, Advanced Features, Pearson Education,8th Edition, 2008.

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4. Java for Programmers, P.J. Dietel and H.M Dietel, Pearson Education (OR) JAVA:
5. Programming in Java, S.Malhotra and S.Choudary, Oxford Univ. Press

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1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM's tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	-	-	2
2	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
3	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
4	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
5	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ITO42	R PROGRAMMING (Common to ECE, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics in R programming in terms of constructs, control statements, string functions
- To learn to apply R programming for Text processing
- To understand the use of data frames and tables
- To able to appreciate and apply the R programming from a statistical perspective
- To understand the interface model

Course Outcomes

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

CO1 - Create artful graphs to visualize complex data sets and functions.**(K3)**
CO2 - Write more efficient code using parallel R and vectorization.**(K3)**
CO3 - Create data frames and working with tables.**(K3)**
CO4 - Interface R with C/C++ and Python for increased speed or functionality.**(K2)**
CO5 - Find new packages for text analysis, image manipulation & perform statistical analysis.**(K4)**

UNIT I INTRODUCTION **(9 Hrs)**

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

UNIT II MATRICES AND ARRAYS **(9 Hrs)**

Matrices, Arrays And Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT III DATA FRAMES **(9 Hrs)**

Data Frames Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions

UNIT IV FUNCTIONS AND ARGUMENTS **(9 Hrs)**

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots

UNIT V INTERFACING **(9 Hrs)**

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear models – Time Series and Auto-correlation – Clustering.

Text Books

1. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.
2. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013.

Reference books

1. Mark Gardener, " Beginning R – The Statistical Programming Language", Wiley, 2013
2. Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013

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1. https://www.coursera.org/learn/r-programming
2. https://www.r-project.org/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ICO41	SENSORS AND TRANSDUCERS (Common to ECE, CSE, IT, MECH, CIVIL)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Get to know the methods of measurement, classification of transducers and to analyze error.
- Get exposed to different types of resistive transducers and their application areas
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers
- To introduce about advancements in sensor technology.

Course Outcomes

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

CO1 - Understand the concepts of classification of Transducers. **(K2)**
CO2 - Familiar with the working of resistance Transducer. **(K3)**
CO3 - Familiar with the principle and working of various Inductive and Capacitive transducer **(K1)**
CO4 - Able to design signal conditioning circuit for various transducers **(K3)**
CO5 - Able to identify or choose a transducer for a specific measurement application **(K4)**

UNIT I CLASSIFICATION OF TRANSDUCERS (9 Hrs)

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

UNIT II RESISTANCE TRANSDUCERS (9 Hrs)

Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement, Digital displacement sensors.

UNIT III INDUCTIVE AND CAPACITIVE TRANSDUCERS (9 Hrs)

Transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT IV OTHER TRANSDUCERS (9 Hrs)

Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers. Eddy current transducers. Hall effect transducers – Optical sensors, IC sensor for temperature – signal conditioning circuits, Introduction to Fiber optic sensors – Temperature, pressure, flow and level measurement using fiber optic sensors

UNIT V SMART TRANSDUCER (9 Hrs)

Introduction to semiconductor sensor, materials, scaling issues and basics of micro fabrication. Smart sensors, Intelligent sensor, Mems Sensor, Nano-sensors, SQUID Sensors,- Environmental Monitoring sensors

Text Books

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 6th Edition, McGraw-Hill Education Pvt. Ltd.,2011.
2. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge,2003
3. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design Clarendon, Oxford2nd edition Jacob Fraden - 2010
4. DoeblinE..O. "Measurement System Applications and Design", TMH, 5th Edition, 2004

Reference books

1. BelaG. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol.1 ISA/CRC Press,2003.
2. BelaG. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th edition, Vol.2 ASME PTC ,2018

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3. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.
4. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education,2000.

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1. www.electrical4u.com
2. https://nptel.ac.in/courses/108108147/
3. https://www.youtube.com/watch?v=1uPTyjxZzyo

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	2	-	-	1	2	-	-	-	2	-	-	1	1
2	2	-	3	-	-	1	2	-	-	-	2	-	-	1	1
3	2	-	2	-	-	1	2	-	-	-	2	-	-	1	1
4	2	-	3	-	-	1	2	-	-	-	-	-	-	1	1
5	2	-	3	-	2	2	3	-	-	-	2	-	-	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19ICO42 **CONTROL SYSTEM ENGINEERING**
(Common to CSE, IT, MECH)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems
- To introduce stability analysis of control systems.
- To introduce compensation technique.

Course Outcomes

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

CO1 - Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form. **(K2)**
CO2 - Perform time domain analysis of various models of linear system **(K3)**
CO3 - Do frequency domain analysis of various models of linear system **(K4)**
CO4 - Determine and analyse the stability of the system **(K4)**
CO5 - Design the compensation technique that can be used to stabilize control systems. **(K3)**

UNIT I SYSTEM CONCEPTS (9 Hrs)

Types of system – open loop systems, closed loop systems, Basic elements in control system – Mathematical models of physical system: Differential equation- transfer functions of simple electrical networks – D.C and A.C servo motor – Mechanical system- Translational and Rotational system – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS (9 Hrs)

Standard test signals -Time response of first and second order system, Time domain- specifications- Generalized error series – Steady state error and error constants

UNIT III FREQUENCY RESPONSE ANALYSIS (9 Hrs)

Frequency response of the system – Correlation between time and frequency response – Gain and Phase margin – Bode plot, Polar Plot.

UNIT IV STABILITY ANALYSIS (9 Hrs)

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Nyquist stability criterion.

UNIT V COMPENSATION NETWORKS (9 Hrs)

Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot

Text Books

1. Nagrath I J and Gopal M, Control System Engineering, New Age International Pvt Ltd, Sixth Edition, 2017
2. Ogata K, —Modern Control Engineeringll, Prentice-Hall of India Pvt Ltd., New Delhi, Fifth Edition, 2015.

Reference Books

1. Norman S Nise, Control System Engineering , John Wiley and sons, inc., Seventh Edition, 2015
2. Benjamin C Kuo, —Automatic Control Systemsll, Prentice Hall India Pvt. Ltd, Ninth Edition, 2015
3. Smarajith Ghosh, —Control Systems Theory and Applicationsll, Pearson Education, Singapore, Sixth Edition, 2015
4. Richard C. Dorf, Robert H Bishop, —Modern Control Systemsll, Pearson Education, Twelfth Edition, 2017

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1. https://lecturenotes.in/notes/6579-note-for-control-system-engineering-cse-by-gyana-ranjan-biswal
2. https://www.smartzworld.com/notes/control-systems-pdf-notes-cs/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	2	2	1	-	-	1	1	1	2	2	-	-
2	2	3	2	2	1	2	1	1	1	1	1	2	2	-	-
3	2	2	1	2	2	1	1	-	-	1	-	1	2	-	-
4	2	2	1	2	2	1	1	-	-	1	-	1	2	-	-
5	3	3	2	2	2	1	1	-	1	-	1	2	2	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CEO41	ENERGY AND ENVIRONMENT (Common to EEE, ECE, MECH, BME, IT, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Explain the importance of energy, classifications of energy sources and energy demand scenario
- Analyze the impacts of energy on environment & sustainability energy options
- Outline the harness of hydropower and geothermal energy sources
- Discuss the aspects of solar and wind energy
- To study the importance of biomass energy and its applications

Course Outcomes

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

CO1 - Apply the knowledge of science & engineering to the contemporary issues of Energy for better humankind & environment **(K3)**

CO2 - Identify, review & analyze the complex problems of Energy crises in environment **(K4)**

CO3 - Designing solutions for the energy crises in the form of renewable energy systems to meet the needs by understanding the limitations **(K4)**

CO4 - Understanding the impact of energy on environment and providing solutions for sustainable development. **(K5)**

CO5 - Apply biomass energy under relevant technologies **(K3)**

UNIT I ENERGY **(9 Hrs)**

Introduction, Importance of energy, role of energy consumption in economic and social transformation, Energy needs and crisis. Energy production and utilization. Types and classification of energy sources, Conventional & unconventional energy, Renewable sources & Nonrenewable sources of energy advantages, limitations, comparisons

UNIT II ENVIRONMENT **(9 Hrs)**

Impact of energy on economy &environment. Regional impacts of temperature change - Global warming, Greenhouse effect, Acid rain, Ozone layer depletion. Indian environment degradation, Environmental laws - Water Act-1974 (Prevention & control of pollution), The environment protection act 1986, Air act.

UNIT III HYDROPOWER & GEOTHERMAL ENERGY **(9 Hrs)**

Hydropower Energy – Introduction, Site selection, layout of hydro power plant, components & working, classifications, power station, structure and control. Geothermal Energy - Introduction, Site selection, layout of power plant, components & working, Advantages and disadvantages.

UNIT IV SOLAR & WIND ENERGY **(9 Hrs)**

Sun as source of energy - Introduction, Site selection, layout of power plant components & working, classifications, Types of collectors, collection systems efficiency, Solar cells. Wind Energy - Introduction, advantages/limitations, Site selection, layout of power plant, components &working, classification.

UNIT V BIOMASS ENERGY **(9 Hrs)**

Introduction, advantages/limitations, Photosynthesis, biomass fuel, biomass gasification, biogas from waste biomass, factors affecting biogas generation, types of biogas plant, Biomass programme in India.

Text Books

1. Trivedi R.R. and Jalka K.R, "Energy Management", Commonwealth Publication, 2017.
2. Diamant R.M.E., "Total Energy", Pergamon, OxfordPublishers, 2017.
3. N.G. AJJANNA " Energy auditing & demand side management" first edition, Gouthami Publications, Shimoga
4. Chakrabarti, M.L.Soni, P.V. Gupta,U.S. Bhatnagar " Power system Engineering" 2001, DhanpatRai&Co, New Delhi.
5. D.P.Kothari, K.C Singal, Rajesh Ranjan, "Renewable Energy sources and Emerging Technologies" second edition , PHI , India

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Reference Books

1. Boyle G, Everett B and Ramett J, "Energy systems and sustainability", Oxford University Press, 2018
2. "Pollution Control Acts, Rules and Notifications", CPCB, Pollution Control series, PC/2/2014, Vol.I,2014
3. Peavy.H, Rowe.D, and Tchobanoglous, G., Environmental Engineering, Tata McGraw-Hill, 2013
4. S.Rao, Dr. BB Parulekar "Energy Technologies" Khanna Publications , New Delhi
5. David M Buchla, Thomas E Kissel, Thomas L Floyd "Renewable Energy systems" Pearson, India
6. Godfrey Boyle "Renewable Energy power for sustainable future" oxford Publications , New Delhi

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2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. www.iucn.org
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5. www.thesummitbali.com/
6. http://engineering geology.gov.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	3	3	3	2	3	2	3	2	2	2
2	3	3	2	3	2	3	3	3	2	3	2	3	2	2	1
3	3	3	3	3	2	3	3	3	2	3	2	3	2	2	2
4	3	3	2	3	2	3	3	3	2	3	2	3	2	2	2
5	3	3	2	3	2	3	2	3	2	3	2	3	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19CEO42	BUILDING SCIENCE AND ENGINEERING (Common to EEE, MECH, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand the basic materials in civil engineering and Have an insight to different types of doors, windows.
- Analyze the types of foundation.
- Gain the knowledge of bylaws for the planning of a public/private building
- Understand the different methods and materials of interiors for building
- Understand the concept of landscaping

Course Outcomes

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

CO1 - Apply the knowledge of engineering fundamentals to understand, the characteristics of basic civil engineering materials **(K2)**
CO2 - Apply the knowledge of engineering fundamentals and analyze the types of foundation **(K2)**
CO3 - Develop plan, section and apply bylaws and investigate causes and remedies for cracks, have an insight to cost effective construction **(K3)**
CO4 - Understand, design and work in a team and develop the interiors **(K5)**
CO5 - Understand, design and work in a team and develop landscaping for buildings as per design guidelines.**(K5)**

UNIT I MATERIALS FOR CONSTRUCTION (9 Hrs)

Cement concrete: introduction, ingredients of cement, grade of concrete, properties, Steel :definition , types of steel, uses of steel, market forms of steel used in construction Doors and windows : location of doors and windows, types of doors, types of windows, Stairs : requirements of good stairs, types , stairs of different materials

UNIT II FOUNDATION AND STRUCTURAL MEMBERS (9 Hrs)

Selection of site, substructure, objectives of foundation, site inspection, soils, loads on foundations, essential requirements of good foundation, types of foundation, failure of foundation and remedial measures. Structural members: columns, lintels, roofing (flat roof and sloped roof), flooring (types of floors and floor covering), damp proofing, plastering.

UNIT III BUILDING PLANNING AND MAINTAINENCE (9 Hrs)

Plan, section and elevation .Introduction, classification of buildings, components of buildings, building bylaws, orientation of buildings, ventilation, acoustic requirements, Superstructure: introduction, brick masonry, stone masonry and rcc. Building maintenance Deterioration of concrete, deterioration of masonry works, prevention of cracks and leaks, cost effective construction, anti-termite treatment in building.

UNIT IV INTERIOR DESIGN (9 Hrs)

Functional requirement of interior designer, basic elements of interior design, design problems :Interior design for spacious rooms, comfortable rooms, theme rooms, living area, cooking area, drinking area dining area, home offices, sleeping area, bathrooms, public/private buildings

UNIT V LANDSCAPING (9 Hrs)

Elements of Landscape architecture, specialization in landscape, landscape products, landscape materials, and water efficient landscaping, design guidelines for interior landscape

Text Books

1. Basic civil engineering : M.S.palanichamy fourth edition Tata mcgraw hill limited ,2005
2. Basic civil engineering : sateeshgopi ,pearson, 2010
3. Building Science: Concepts and Applications: Jens Pohl, Wiley-Blackwell, 2011

Reference Books

1. Basic civil engineering : Dr.B.C.Punmia, Ashok kumarjain, ArunkumarjainLaxmi publications year of publication ,2004
2. Basic civil engineering : S.S.Bhavikatti New Age International Limited, 2010
3. Interior Design and Decoration: Seetharaman P.2019

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2. https://www.youtube.com/watch?v=LYvDoy7MtkE
3. https://www.youtube.com/watch?v=zjZVIFt3WQY
4. https://www.youtube.com/watch?v=pYAXsbsFBC8
5. https://www.youtube.com/watch?v=PIY63QacRTc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	3	3	3	2	3	3	3	-	-	-
2	3	3	2	3	1	3	3	3	2	3	3	3	-	-	-
3	3	3	2	3	1	3	3	3	2	3	3	3	-	-	-
4	3	3	2	3	2	3	3	3	2	3	3	3	-	-	
5	3	3	2	3	2	3	2	3	2	3	3	3	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

		L	T	P	C	Hrs
U19BMO41	**MEDICAL ELECTRONICS** (Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS)	3	0	0	3	45

Course Objectives

- To gain knowledge about the various physiological parameters measurements
- To understand the various biochemical and nonelectrical sensors
- To study about the assist devices
- To gain knowledge on surgical equipments and telemetry in healthcare
- To understand the concepts of recent advancements in healthcare

Course Outcomes

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

CO1 - Explain the electro- physiological parameters and bio-potentials recording **(K2)**
CO2 - Measure the biochemical and non-electrical physiological parameters **(K2)**
CO3 - Interpret the various assist devices used in the hospitals **(K3)**
CO4 - Identify physical medicine methods and biotelemetry **(K3)**
CO5 - Analyse recent trends in medical instrumentation **(K3)**

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING (9 Hrs)

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT (9 Hrs)

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III ASSIST DEVICES (9 Hrs)

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters, Heart-Lung Machine.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY (9 Hrs)

Diathermies - Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry - Single Channel and Multiple Channel.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION (9 Hrs)

Telemedicine, Insulin Pumps, Radio pill, Endo-microscopy, Brain machine interface, Lab on a chip, Cryogenic Technique.

Text Books

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2011.
2. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA McGraw-Hill, New Delhi, 2017.
3. John G.Webster, "Medical Instrumentation Application and Design", Third Edition, Wiley India , 2012.

Reference Books

1. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2011.
2. R.Anandanatarajan, "Biomedical Instrumentation and Measurements", Second Edition, PHI Learning, 2016.
3. Mandeep singh, "Introduction to Biomedical Instrumentation", Second Edition, Prentice Hall of India, New Delhi,2014
4. Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation Systems", Cengage Learning, 2012
5. C.Raja Rao, Sujoy K.Guha, " Principles of Medical Electronics and Biomedical Instrumentation", Universities Press, 2010

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3. https://nptel.ac.in/courses/127/106/127106136/
4. medicinenet.com/script/main/art.asp?articlekey=6414
5. https://www.verywellhealth.com/cardiopulmonary-bypass-machine-used-for-surgery-3157220

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	2	2	2	-	1	-	-	-	-	2	-	-
2	3	2	-	2	2	2	-	1	-	-	-	-	2	-	-
3	3	-	-	2	3	3	-	1	-	-	-	-	2	-	-
4	3	-	2	2	3	2	-	1	-	-	-	-	2	-	-
5	3	2	2	3	3	2	-	1	-	-	-	-	2	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19CCO41	**BASIC DBMS** (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME Branches)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand about basics of Database Management System.
- To provide a general introduction to relational model and relational algebra.
- To study about normalization and SQL.
- To acquire knowledge about storage indexing and transaction management.
- To gain knowledge about the backup and recovery in database.

Course Outcomes

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

CO1 - Explain the concept of database management system.**(K2)**
CO2 - Create conceptual data model using entity relationship diagram.**(K2)**
CO3 - Analyze the various normalization.**(K4)**
CO4 - Describe the concept of storage indexing and transactions.**(K2)**
CO5 - Explain the database recovery and security.**(K2)**

UNIT I INTRODUCTION TO DATABASE MANAGEMENT (9 Hrs)

Introduction to Database Management systems – History - Characteristics – Users- three-level architecture- Entity-- relationship data model.

UNIT II THE RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA (9 Hrs)

Data structures – Mapping E-R Model to Relational model – data manipulation – integrity – advantages – rules for fully relational systems – relational algebra – relational algebra queries.

UNIT III STRUCTURED QUERY LANGUAGE AND NORMALIZATION (9 Hrs)

SQL – Data definition – manipulation – views SQL in procedural programming – data integrity and constraints – triggers – data control – database security. Normalization – Undesirable properties – single-valued normalization – desirable properties of decompositions – multivalued dependencies

UNIT IV STORAGE INDEXING AND TRANSACTIONS MANAGEMENT (9 Hrs)

Different types of memories – secondary storage – buffer management – file structures – heap files – sorted files – index and types – indexed sequential file – B-tree – B+ tree. Transaction management – concepts – examples – schedules – serializability – concurrency control – deadlocks – lock and multiple granularity – nonlocking techniques.

UNIT V DATABASE BACKUP, RECOVERY AND SECURITY (9 Hrs)

Database system failure – backup – recovery and concept of log – log-based recovery techniques – types of recovery – log-based immediate update recovery technique. Database Security – violations – identifications and authentication – authorization / access control – security of statistical databases – audit policy – internet applications and encryption.

Text Books

1. Gupta.G.K, "Database Management Systems", Tata McGraw Hill, 2011
2. Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts 7th Edition, McGraw-Hill International Edition, 2019.
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, "Fundamentals of Database Systems", Pearson Education, United States of America, 2018.

Reference Books

1. Silberschatz, Korth.H and Sudarshan.S, "Database System Concepts", 6th Edition, McGraw-HillInternational, 2011.
2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, "Database System The Complete Book, 1st Edition, Pearson 2002.

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3. Date CJ, Kannan A, Swamynathan S, An Introduction to Database System, 8th Edition, Pearson Education-2006.
4. Raghu Ramakrishna, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill, 2014.
5. Ramez Elmasri, Durvasul VLN Somyazulu, Shamkant B Navathe, Shyam K Gupta, Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

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2. http://dev.mysql.com/doc/
3. http://www.rjspm.com/PDF/BCA-428%20Oracle.pdf
4. http://www.w3schools.com/
5. https://www.codecademy.com/learn/learn-

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
2	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
3	3	3	1	-	1	-	-	-	-	-	1	1	-	-	1
4	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
5	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CCO42	INTRODUCTION TO COMMUNICATION SYSTEMS (Common to EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge of signals
- To study the various analog and digital modulation techniques
- To study the pulse modulation and multiplexing
- To infer Digital transmission techniques
- To provide knowledge about various multiple access technology and advanced communication techniques

Course Outcomes

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

CO1 - Comprehend the basic Characteristics of the signals.**(K2)**
CO2 - Comprehend needs of modulation and various analog modulation techniques **(K2)**
CO3 - Illustrate pulse modulation and multiplexing **(K3)**
CO4 - Explain Digital transmission techniques **(K2)**
CO5 - Describe multiple access techniques and advanced communication systems.**(K2)**

UNIT I SIGNAL ANALYSIS (9 Hrs)

Introduction to Signals- Representation and classification of Signals, Representation of signal in frequency domain, introduction to Spectrum of signal- Introduction to Fourier series and Fourier Transform

UNIT II ANALOG COMMUNICATION (9 Hrs)

Need for Modulation-– Block diagram of analog communication System- Amplitude Modulation – AM, DSBSC, SSBSC, modulators and demodulators – Angle modulation – PM and FM – modulators and demodulators – Superheterodyne receivers

UNIT III PULSE COMMUNICATION (9 Hrs)

Low pass sampling theorem – Quantization – PAM – PCM, DPCM, DM, and ADPCM And ADM - Time Division Multiplexing, Frequency Division Multiplexing

UNIT IV DIGITAL COMMUNICATION (9 Hrs)

Comparison of digital and analog communication system- Block diagram of digital communication system Phase shift keying – BPSK, DPSK, QPSK

UNIT V MULTIPLE ACCESS TECHNIQUES AND ADVANCED COMMUNICATION (9 Hrs)

Multiple Access techniques- FDMA, TDMA, CDMA- Frequency reuse, Handoff- Block diagram of advanced communication systems – satellite communication – Cellular Mobile Communication – Fibre Optical Communication System.

Text Books

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems", 3rd edition, TMH 2007
2. S. Haykin, "Digital Communications", John Wiley, 2005
3. B.P.Lathi," Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007

Reference Books

1. H P Hsu, Schaum Outline Series, "Analog and Digital Communications", TMH 2006
2. B.Sklar," Digital Communications Fundamentals and Applications", 2nd edition Pearson Education 2007.
3. A.Bource Carson and Paul B.Crilly, "Communication Systems", 5th Edition, Mc Graw Hill, 2010
4. Torrieri, Don, "Principles of Spread Spectrum Communication Systems", Springer, 2015
5. Simon Haykin, "Communication Systems", 4th Edition, John Wiley and Sons, 2001.

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3. http://www.electronics-tutorials.ws
4. www.tutorialspoint.com
5. https://nptel.ac.in/courses/108/104/108104091/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
2	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
3	3	3	1	-	1	-	-	-	-	-	1	1	-	-	1
4	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
5	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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OPEN ELECTIVE- II

U19EEO53	CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To get knowledge on the status of conventional and non-conventional energy resources in world.
- To have a clear idea about the operation of conventional power plant and its associated equipment's.
- To learn about the concept of energy harvesting of solar through thermal and PV module
- To understand the technological basis for harnessing wind energy.
- To get a clear knowledge on power generation using Ocean, Tidal Energy and Bio-Energy

Course Outcomes

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

CO1 - Identify the world and Indian energy scenario and the necessity of renewable energy sources **(K1)**
CO2 - Gain knowledge for the generation of electrical power from various power plants **(K1)**
CO3 - Analyze and compare the various solar harvesting techniques **(K3)**
CO4 - Describe the aerodynamics of wind turbines and calculate their power, energy production **(K1)**
CO5 - Describe the construction and working principle of various equipment's used in Ocean, Tidal Energy and Bio-Energy power plants **(K2)**

UNIT I ENERGY RESOURCES (9 Hrs)

Perspective of energy resources – Forms of Energy – Conventional and non-conventional sources of energy– World's energy status - Energy reserves in India. Limitations of Conventional sources of energy efficiency – Renewable Energy Sources – Energy parameters – Energy Intensity - Gross Domestic product.

UNIT II POWER PLANTS (9 Hrs)

Thermal power plant – layout, working principle. Gas turbine power plant – layout, working principle. Nuclear power plants: fuels, nuclear fuel cycle, reactors and nuclear waste management. Hydro Electric plants – Types, energy conversion schemes, environmental aspects.

UNIT III SOLAR ENERGY SYSTEMS (9 Hrs)

Solar radiation - Principles of solar energy collection –Types of collector – working principles - Characteristics - efficiency - Solar Energy applications – water heaters, air heaters, solar cooling; solar drying and power generation – solar tower concept – solar pump. Photovoltaic (PV) technology – photovoltaic effect – modelling - Characteristics – efficiency of solar cells.

UNIT IV WIND ENERGY SYSTEMS (9 Hrs)

General theory of wind mills – Types of wind mills – performance of wind machines–wind power – efficiency. Merits and Limitations of Wind energy system – Modes of wind power generation.

UNIT V ALTERNATE ENERGY SYSTEMS (9 Hrs)

Ocean and Tidal energy conversion - working principle of OTEC – Anderson closed cycle OTEC System. Tidal power – tides - tidal range - types of tidal power plants, single basin and double basins schemes. Bio-mass Energy – Biogas plants.

Text Books

1. S. Rao and Dr. B. B. Parulekar, "Energy Technology", Khanna Publication, 3rd Edition, 1999.
2. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill Education, 2nd Edition, 2009.
3. D. P. Kothari, K. C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI, 2011

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Reference Books

1. G. D. Rai, "Non-conventional energy sources", Khanna Publication. 4th Edition, 2002.
2. Pulfrey, David. L, "Photo voltaic Power Generation", Van Nostrand reinhold Company, 1983.
3. Abbasik, "Renewable Energy Sources and their Environment", PHI, 2008.
4. Steve Doty, Wayne C. Turner, "Energy Management Handbook", Fairmont Press, 8th Edition, 2012.
5. S.A.Abbasi and N. Abbasi, "Renewable Energy Sources and Their Environmental Impact", PHI, 2001.

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3. https://byjus.com/physics/conventional-and-nonconventional-sources-of-energy/
4. https://www.jagranjosh.com/general-knowledge/nonconventional-sources-of-energy-1448698715-1
5. https://wb.gov.in/departments-power-and-non-conventional-energy-sources.aspx

COs/POs/PSOs Mapping

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19EEO54 | **INDUSTRIAL DRIVES AND CONTROL** (Common to ECE, ICE, MECH, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To introduce the concept of selection and Utilization of Electric drives.
- To understand power flow diagram for industrial process and drives.
- To introduce effect of heating and cooling characteristics of drives.
- To introduce the various speed control techniques for DC drives.
- To introduce the various speed control techniques for AC drives.

Course Outcomes

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

CO1 - Select the appropriate motors to meet the load requirements. **(K3)**
CO2 - Explain the industrial process and selection of drives for various applications .**(K2)**
CO3 - Describe the thermal characteristics of electric motors. **(K1)**
CO4 - Analyze the speed torque characteristics of converter and chopper fed DC drives. **(K3)**
CO5 - Apply the various speed control methods for induction and synchronous motor. **(K3)**

UNIT I INTRODUCTION TO ELECTRIC DRIVES (9 Hrs)

Need for Drive – Concept of electric drives – Motors used in drives – Types of loads – Choices – Classification – Multi quadrant operation – Fundamental torque equation – Nature and classification of load torques.

UNIT II INDUSTRIAL PROCESS AND DRIVES (9 Hrs)

Process flow diagram of paper mill – Cement mill – Sugar mill – Steel mill –Textile mills – Hoists and cranes – Centrifugal pumps and compressors – Solar powered pump drives –Selection of drives.

UNIT III THERMAL CHARACTERISTICS OF ELECTRIC MOTORS (9 Hrs)

Effect of heating – Heating and cooling characteristics – Loading condition and classes of duty – Determination of rating of motors – Effect of load inertia – Load equalization – Environmental factors.

UNIT IV SPEED CONTROL OF DC DRIVES (9 Hrs)

Controlled rectifier fed separately excited DC drives – Single phase drives – Three phase drives – Four quadrant operation fully controlled rectifier – Rectifier control of DC series motor – Chopper control of separately excited and series DC motor.

UNIT V SPEED CONTROL OF AC DRIVES (9 Hrs)

VSI and CSI driven induction motor – Closed loop speed control - static rotor resistance control – Slip power recovery schemes – performance comparison of CSI and VSI fed drives – Variable frequency control of multiple synchronous motors.

Text Books

1. B. N. Sarkar, "Fundamentals of industrial drives", PHI Learning Pvt Ltd Education, 2011.
2. Gobal K. Dubey, "Fundamentals of Electrical Drives", Alpha Science Int. Ltd., Pangbourne, 2nd Edition, 2002.
3. R. Krishnan, "Electric Motor Drives–Modeling, Analysis and Control", Pearson Education, 1st Edition, 2002.

Reference Books

1. S. B. Dewan, G. R. Slemon & A. Stranghan, "Power Semiconductor controlled Drives", John willey Publication
2. KokKiong Tan & Andi Sudjana Putra, "Drives and Control for Industrial Automation Advances in Industrial Control", Springer Science & Business Media, 2010.
3. Juha Pyrhonen, Valeria Hrabovcova, R. Scott Semken, "Electrical Machine Drives Control: An Introduction", John Wiley & Sons, 2016.

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6. www.voith.paper.com
7. www.abb.com/drives

COs/POs/PSOs Mapping

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ECO53	ELECTRONIC PRODUCT DESIGN AND PACKAGING (Common to ECE, ICE, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge about Electronic Product and Packaging
- To introduce and discuss various issues related to the system packaging
- To get clear idea about design of packages which can withstand higher temperature, vibrations and shock
- To Design of PCBs which minimize the EMI and operate at higher frequency
- To acquire depth knowledge about the concepts of Testing and testing methods

Course Outcomes

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

CO1 - Explain the basics of Electronic Product and Packaging. **(K2)**
CO2 - Infer various issues related to the system packaging.**(K2)**
CO3 - Summarize the clear idea about design of packages which can withstand higher temperature, vibrations and shock **(K2)**
CO4 - Describe the design of PCBs which minimize the EMI and operate at higher frequency **(K2)**
CO5 - Explain the various testing methods **(K2)**

UNIT I OVERVIEW OF ELECT RONIC SYSTEMS PACKAGING (9 Hrs)

Definition of a system and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding, TAB and flip chip.

UNIT II SEMICONDUCTOR PACKAGES (9 Hrs)

Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits.

UNIT III ELECTRICAL ISSUES IN PACKAGING (9 Hrs)

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps – Hybrid circuits – Resistive, Capacitive and Inductive parasitics.

UNIT IV CHIP PACKAGES (9 Hrs)

IC Assembly – Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in – package (SIP); Passives: discrete, integrated, and embedded.

UNIT V TESTING (9 Hrs)

Testing Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures -thermo mechanically induced -electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability

Text Books

1. Tummala, Rao R., Fundamentals of Microsystems Packaging, McGraw Hill, 2001
2. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
3. Tummala, Rao R, Microelectronics packaging handbook, McGraw Hill, 2008.

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Reference Books

1. Blackwell (Ed), "The electronic packaging handbook", CRC Press, 2000.
2. R.S.Khandpur, "Printed Circuit Board", Tata McGraw Hill, 2005
3. R. K. Ulrich, "Recent literature in Electronic Packaging", 2005
4. Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed signal VLSI Circuits", Kluwer Academic Publishers.2000.
5. M. Abramovici, M. A. Breuer, and A.D. Friedman, "Digital System Testing and Testable Design", Computer Science Press.

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2. https://www.pinterest.com/PackagingTPI/electronic-packaging/
3. https://www.einfochips.com/blog/semiconductor-and-electronic-design-networks-and-profiles-to-follow-in-2018/
4. https://en.wikipedia.org/wiki/Electronic_packaging
5. https://nptel.ac.in/courses/108/108/108108031/

COs/POs/PSOs Mapping

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3	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
4	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
5	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19ECO54 **AUTOMOTIVE ELECTRONICS** (Common to EEE, ECE, ICE, MECH)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide basic knowledge about Autotronics
- To introduce and discuss the fundamentals of Automotive Electronics
- To get clear idea about various Sensors and Actuators for automobiles.
- To acquire depth knowledge about the Microcontrollers/Microprocessors in Automotive Domain.
- To study the Current Trends in Automotive Electronics.5

Course Outcomes

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

CO1 - Explain the basics of Autotronics. **(K2)**
CO2 - Infer the fundamentals of Automotive Electronics. **(K2)**
CO3 - Summarize the clear idea about Sensors and Actuators**(K2)**
CO4 - Demonstrate the role of Microcontrollers/Microprocessors in Automotive Domain **(K3)**
CO5 - Use Current Trends in Automotive Electronic Engine Management System **(K3)**

UNIT I INTRODUCTION TO AUTOTRONICS (9 Hrs)

Autotronics- Definition- need, Field effect transistor-construction and working-applications, Silicon controlled rectifiers-construction and working-applications, logic gates-concept-AND-OR-NOT gates-working with truth tables, Flip flops-concept-applications, registers-concept, Integrated circuits-concept-types, Binary number system- need-conversion process, analog and digital signals-signal conditioning-need-steps, analog to digital conversion-steps

UNIT II FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS (9 Hrs)

Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile

UNIT III SENSORS AND ACTUATORS (9 Hrs)

Types of Sensors: Sensor for Speed- Throttle Position- Exhaust Oxygen Level- Manifold Pressure- Crankshaft Position- Coolant Temperature- Exhaust Temperature- Air Mass Flow for Engine Application. Solenoids- Stepper Motors- Relay.

UNIT IV MICROCONTROLLERS/MICROPROCESSORS IN AUTOMOTIVE DOMAIN (9 Hrs)

Critical review and overview of development within the automotive context of microprocessors, microcontrollers and digital signal processors (architecture of 8/16 bit microcontrollers with emphasis on Ports, Timer/Counters, Interrupts, Watchdog timers and PWM). Criteria to choose the right microcontroller/processor for various automotive applications. Understanding various architectural attributes relevant to automotive applications. Automotive grade processors viz. Renesas, Quorivva, Infineon.

UNIT V ELECTRONICS SYSTEMS (9 Hrs)

Current Trends in Automotive Electronic Engine Management System- Types of EMS Electromagnetic Interference Suppression- Electromagnetic Compatibility- Electronic Dashboard Instruments- Onboard Diagnostic System-Security - Warning System infotainment and Telematics

Text Books

1. William Ribben Butterworth-Heinemann, "Understanding Automotive Electronics" 5th edition, Elsevier, 1998
2. Jack Erjavec, "A Systems Approach to Automotive Technology", Cengage Learning, 5th edition, 2009
3. Steve.V.Hatch, "Electronic Engine Controls", Cengage Learning, 2012

Reference Books

1. G. Meyer, J. Valldorf and W. Gessner: "Advanced Microsystems for Automotive Applications", Springer, 2009.
2. Mehrdad Ebsani, Ali Emadi & Yimin Gao: "Modern Electronic Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2 nd Edition, CRC Press, 2009.

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3. Ronald K Jurgen: "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill
4. Bennett , "Truck engines Fuel & computerized management systems Sean", Cengage Learning, 2016

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3. https://en.wikipedia.org/wiki/Signal_conditioning
4. https://en.wikibooks.org/wiki/Electronics/Digital to Analog %26
5. http://www.allaboutcircuits.com/textbook/digital/chpt-13/delta-sigma-adc/

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3	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
4	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
5	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CSO54 **PLATFORM TECHNOLOGY**
(Common to EEE, ECE, ICE, MECH, CIVIL & BME

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the fundamentals of developing modular application by using object oriented concepts.
- To utilize the C# and .NET framework to build distributed enterprise applications.
- To develop Console Application, Windows Application and Web Applications.
- To connect to multiple data sources and managing them effectively.
- To develop the Enterprise kind of applications

Course Outcomes

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

CO1 - Understand the concept of .NET Framework. **(K2)**
CO2 - Develop, implement and creating Applications with C#. **(K4)**
CO3 - Evaluate various graphics and window forms. **(K5)**
CO4 - Integrating front end applications with Database connectivity. **(K3)**
CO5 - Classifying various Enterprise applications into real world problems. **(K3)**

UNIT I INTRODUCTION TO .NET FRAMEWORK (9 Hrs)

.NET Framework - Common language Runtime (CLR) – Common Type System (CTS) – Common language Specification (CLS) – Compilation process – Assemblies – Namespaces – Command line compiler.

UNIT II C# FUNDAMENTALS (9 Hrs)

C# class - object - string formatting - Types - scope - Constants - C# iteration - Control flow - Operators - Array - String - Enumerations - Structures - Custom namespaces. Programming constructs – value types and reference types – object oriented concepts – Encapsulation – Inheritance – polymorphism – Interfaces – collections – Multithreading.

UNIT III GRAPHICS AND WINDOWS FORMS (9 Hrs)

Tool box controls – Container control – Menu – Tool bar – Tool tip Controls during design time – Run time – Graphics programming GDI+.

UNIT IV DATABASE PROGRAMMING (9 Hrs)

Data Access with ADO.NET – Architecture – Data reader – Data Adapter – Command – Connection – Data set – Data binding – Data Grid Control – XML based Data sets.

UNIT V J2EE (9 Hrs)

Enterprise Edition Overview – Multi-Tier Architecture – Best Practices – Comparison between J2EE and .NET.

Text Books

1. David Chappell, "Understanding .NET – A Tutorial and Analysis", Addison Wesley, 2002.
2. Herbert Schildt, "C# 3.0 The Complete Reference", McGraw-Hill Professional, Third Edition, 2008.
3. Keogh, "J2EE The Complete Reference", Tata McGraw-Hill, 2008.

Reference Books

1. Andrew Troelsen, "Pro C# 5.0 and the .NET 4.5 Framework", Sixth edition, A Press, 2012.
2. Joh Skeet, "C# in depth, Manning publications", Third Edition, 2014.
3. Adrew Stellman and Jennifer Greene, "Head First C#", Third Edition, O'Reilly, 2013.
4. Rod Johnson, "J2EE Design and Development", Wrox, 2002
5. Michael Schmalz, "C# Database Basics", O'Reilly Media, January 2012.

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2. https://www.c-sharpcorner.com/csharp-tutorials
3. https://www.guru99.com/c-sharp-tutorial.html

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	3	2	-	-	-	-	-	-	-	-	-
2	1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
3	2	3	-	3	3	-	2	-	-	-	-	-	-	-	-
4	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-
5	2	2	2	2	-	1	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

Deepa
(K.VELMURUGAN)

U19CSO54	GRAPHICS DESIGNING (Common to EEE, ECE, ICE, MECH, CIVIL & BME	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To develop basic skills using graphics and theory used in design process.
- Create computer-based projects using Adobe Photoshop.
- Understand, develop and employ visual hierarchy using images and text
- Use a computer to create and manipulate images and layers for use in various print and digital mediums.
- To acquire the knowledge of Animation

Course Outcomes

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

CO1 - Develop the basic design elements of graphics. **(K3)**
CO2 - Apply the various photoshop tools. **(K3)**
CO3 - Modify the image size, selection and grids using tools. **(k3)**
CO4 - Create and Work with colored layers. **(K4)**
CO5 - Apply different methods for Animation & Panoramic Picture creation. **(K5)**

UNIT I BASIC CONCEPTS **(9 Hrs)**

Basic Concepts of Designing - Design Principles – Basics of design elements – Typography – Color theory - Introduction to Graphics - Introduction to Photoshop - Bitmap and Vector Images - Understanding Image Size and Resolution

UNIT II INTRODUCTION TO PHOTOSHOP **(9 Hrs)**

Introduction to Tools - Environment - layout of Photoshop - Design layout setup - color - resolution setting - using basic marquee - selection tools Usage of lasso tools - Using brushes - using and filling colors - layers Using text tool - free transform tool - Exercise: Designing Greeting card / Advertisement

UNIT III IMAGE SIZE, SELECTION, GRID AND GUIDES **(9 Hrs)**

Modifying Image Size - Resolution, Marquee - Lasso - Magic Wand - Selection Tools – Selecting – Saving - Crop tool - Coping Selection And Image - Grid and Guide Options – Masks – Channel - Painting and editing - Working with quick masks - Painting (Brush, and its effects) - Blending Modes, Color palettes – Editing - Background - Color - Touchup - Cleanup - Gradient tools - layer blending modes - all types of text tools - shape tools Exercise : Designing Magazine cover - Poster - Brochure

UNIT IV LAYERS **(9 Hrs)**

The layer Palette - Changing and controlling layer order - Editing layers - Adjustment layers - Layer Effects Filters - Actions - Automation - Extract - Filter Gallery - Liquefy , Pattern making - Vanishing point - Built in Bitmap Filters - 3rd party Plug-ins - Using predefined Actions - Creating and Recording Actions - Using built in automation - Learning Filter effects - managing the files with layers and layer effects - plugins Manipulation tools - Image control options – HUE - Levels - brightness control Using image – modifying - changing color Exercise : Converting black and white photo to color - designing a photo album

UNIT V ANIMATION AND PANORAMIC PICTURE CREATION **(9 Hrs)**

Creating product Packaging designs - CD cover - Book and magazine front cover - Envelope - Visiting card - Color correction and color channel management - Design automation theory and Practical's Samples and demos - guidelines for freelance work - website links - resource sharing - Preparing Image For Print and Web - Calculating Image size and Resolution, Changing Image Dimensions - Layout Preview - Color Separation - Optimizing Images for Web - File Formats - Creating Webpages - web photo galleries

Text Books

1. Adobe Creative Team, "Adobe Photoshop – Classroom in a Book", Adobe system incorporation, Adobe Press, 2010.
2. Katherine A.Hughes, "Graphic Design", Learn It,Do It,CRC Press 2019.
3. Ken Pender, "Digital color in Graphics Design", CRC Press 2012.

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Reference Books

1. Mike Wooldridge , "Teach Yourself Visually Adobe Photoshop CS 5", Wiley Publishing , 2010
2. Lesa Snider, "Photoshop the missing Manual", O'Reilly Media, Inc, 2010.
3. Poppy Evans, Aaris Sherin, Irina Lee, "The Graphic Design", Rockport, 2013.
4. Peter Bauer, "Photoshop CC for Dummies", Wiley, 2013.
5. Scott Onstott, "Enhancing CAD Drawings with Photoshop", Wiley,2006

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2. https://www.cs.montana.edu/courses/spring2004/352/lectures/CS351-GUIDesign.pdf
3. https://www.university.youth4work.com/study-material/graphic-design-lecture
4. https://kmayeunhia.wordpress.com/lecture-notes/
5. https://nptel.ac.in/courses/106/106/106106090/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	-	1	-	-	-	-	-	-	2	1	2
2	3	2	2	1	-	1	-	-	-	-	-	-	1	3	1
3	3	2	-	1	-	2	-	-	-	-	-	-	1	2	1
4	-	2	-	3	-	-	-	-	-	-	-	-	3	3	-
5	3	2	1	-	-	2	-	-	-	-	-	-	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K. VELMURUGAN)

U19ITO53	ESSENTIALS OF DATA SCIENCE (Common to EEE, ECE, ICE, MECH, CIVIL & BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about the concepts involved in data analytics.
- To discover insights in data using R programming.
- To summarize the operations involved in Hadoop Map Reduce.
- To make use of algorithms related to regression and classification.
- To examine data using time series analysis and text analysis

Course Outcomes

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

CO1 - Experiment with data analytics using R language. **(K3)**
CO2 - Demonstrate clustering algorithms and association rules. **(K3)**
CO3 - Use algorithms related to regression and classification. **(K3)**
CO4 - Explore data using time series analysis and text analysis. **(K2)**
CO5 - Summarize Hadoop platform to solve map reduce problems. **(K2)**

UNIT I DATA ANALYTICS USING R **(9 Hrs)**

Big Data Overview-Examples of Big Data Analytics-Data Analytics Lifecycle overview-Phases in the lifecycle-GINA Case Study-Introduction to R programming-Exploratory Data Analysis-Statistical Methods for Evaluation.

UNIT II CLUSTERING AND ASSOCIATION RULES **(9 Hrs)**

Overview of clustering-Scope of Clustering Techniques- K Means clustering- Additional Algorithms- Clustering in practise: Fake news identification-Overview of Association rules-Apriori Algorithm-Evaluation of Candidate Rules-Applications of Association Rules-An Example: Transactions in a grocery store-Validation and Testing-Diagnosis

UNIT III REGRESSION AND CLASSIFICATION **(9 Hrs)**

Scope of Regression Techniques-Linear Regression-Logistic Regression-Additional Regression models-Scope of Classification Techniques-Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional Classification Methods-Applications: Prediction of crop yield

UNIT IV TIME SERIES ANALYSIS AND TEXT ANALYSIS **(9 Hrs)**

Overview of Time Series Analysis-ARIMA Model-Additional Methods-Text Analysis Steps-A Text Analysis Example-Collecting Raw Text-Representing Texts-TFIDF-Categorizing documents by topics-Determining Sentiments-Gaining Insights.

UNIT V HADOOP MAP REDUCE AND DATA ANALYTICS **(9 Hrs)**

Installing and Understanding Hadoop-HDFS and Map Reduce Architecture-Hadoop Map Reduce Example-Hadoop Map Reduce in R-Data Analytics Problems: Exploring web pages categorization - Computing the frequency of stock market change-Real Time Recommender model using Apache Spark.

Text Books

1. David Dietrich, Barry Heller and Beibei Yang, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services, Reprint 2015, Wiley, ISBN: 9788126556533.
2. VigneshPrajapathi, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013, Birmingham, Mumbai.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding opportunities in Huge DataStreams with Advanced Analytics", John Wiley & sons, 2012.

Reference Books

1. Roger D. Peng, "R Programming for Data Science", LeanPub, 2015.
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014.

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1. www.ibm.com/Data Analytics/
2. https://www.ijser.org/researchpaper/Importance-of-Clustering-in-Data-Mining.pdf
3. https://datafloq.com/read/7-innovative-uses-of-clustering-algorithms/6224
4. https://publications.waset.org/10011058/improving-fake-news-detection-using-k-means-and-support-vector-machine-approaches
5. https://statisticsbyjim.com/regression/when-use-regression-analysis/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	-	-	-	-	-	-	-	-	-	-
2	3	2	1	1	2	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	2	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	2	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	2	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ITO54	MOBILE APPLICATION DEVELOPMENT	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, MECH, CIVIL, BME, MECHATRONICS)	3	0	0	3	45

Course Objectives

- To understand the basic concepts of mobile computing.
- To be familiar with the network protocol stack
- To learn the basics of mobile telecommunication system
- To be exposed to Ad-Hoc networks
- To gain knowledge about different mobile platforms and application development

Course Outcomes

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

CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K2)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER (9 Hrs)

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT III MOBILE TELECOMMUNICATION SYSTEM (9 Hrs)

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS).

UNIT III MOBILE AD-HOC NETWORKS (9 Hrs)

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

UNIT V MOBILE PLATFORMS AND APPLICATIONS (9 Hrs)

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M- Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Text Books

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schiller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007
3. C.K.Toh, "AdHoc Mobile Wireless Networks", First Edition, Pearson Education, 2002.

Reference Books

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
2. William.C.Y.Lee,"Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition,TataMcGraw Hill Edition ,2006.
3. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.

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2. Apple Developer : https://developer.apple.com/
3. http://developer.windowsphone.com
4. BlackBerry Developer : http://developer.blackberry.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	-	1	-	-	-	-	-	-	-	-	-
5	3	2	1	1	2	1	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VELMURUGAN)

U19ITO55	DATA STRUCTURES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart the basic concepts of data structures and its terminologies.
- To understand concepts about stack and queue operations.
- To understand basic concepts about linked list and its various operations.
- To understand concepts about Tree and its applications.
- To understand basic concepts about Sorting, Hashing and Graph.

Course Outcomes

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

CO1 - Compute time and space complexity for given problems **(K3)**

CO2 - Demonstrate stack, queue and its operation. **(K3)**

CO3 - Illustrate the various operations of linked list. **(K3)**

CO4 - Use the concepts of tree for various applications. **(K3)**

CO5 - Outline the various sorting, hashing and graph techniques. **(K3)**

UNIT I BASIC TERMINOLOGIES OF DATA STRUCTURES (9 Hrs)

Introduction: Basic Terminologies: Elementary Data Organizations. Data Structure Operations: insertion, deletion, traversal. Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Array and its operations. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

UNIT II STACK AND QUEUE OPERATIONS (9 Hrs)

Stacks and Queues: ADT Stack and its operations, Applications of Stacks: Expression Conversion and evaluation. ADT Queue: Types of Queue: Simple Queue, Circular Queue, Priority Queue. Operations on each type of Queues.

UNIT III LINKED LIST OPERATIONS (9 Hrs)

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion, Deletion in linked list; Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.

UNIT IV TREES (9 Hrs)

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, Binary Tree Traversals, AVL Tree. Introduction to B-Tree and B+ Tree.

UNIT V SORTING, HASHING AND GRAPHS (9 Hrs)

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Heap Sort, Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table, Hash Function and its characteristics. Graph: Basic Terminologies and Representations, Graph traversal algorithms.

Text Books

1. Ellis Horowitz, Sartaj Sahni,"Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4th Edition, 2009

Reference Books

1. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Illustrated Edition, Addison-Wesley Publishing Company, 1995.
2. E.Balagurusamy," Data Structures using C", McGraw Hill Education, 1stEdition, 2017.
3. Aaron M. Tenenbaum, Yedidyah Langsam, "Data Structures Using C ", Pearson, First Edition, 2019.
4. Reema Thareja," Data Structures Using C", Oxford, 2nd Edition, 2014.
5. Salaria," Data Structures & Algorithms using C", 1st Edition, Khanna Publishers,2018.

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2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19CEO53 DISASTER MANAGEMENT

(Common to EEE, ECE, CSE, IT, ICE, MECH, BME)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the basic conceptual understanding of disasters
- Understand approaches of Disaster Management
- Build skills to respond to disaster
- Understand the safety precaution
- Understand the basic planning and policy act of the disaster

Course Outcomes

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

CO1 - Understanding Disasters, man-made Hazards and Vulnerabilities **(K2)**
CO2 - Understanding the flood management studies **(K2)**
CO3 - Understanding disaster mitigation and management mechanism **(K1)**
CO4 - Understanding the disaster safety precaution **(K2)**
CO5 - Understanding the disaster plan and act **(K3)**

UNIT I DEFINITION AND TYPES (9 Hrs)

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

UNIT II STUDY OF IMPORTANT DISASTERS (9 Hrs)

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

UNIT III MITIGATION AND MANAGEMENT (9 Hrs)

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

UNIT IV SAFETY PROCESS (9 Hrs)

Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT V PLANNING AND ACT (9 Hrs)

Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

Text Books

1. Dr. Mrinalini Pandey, Disaster Management, Wiley India Pvt. Ltd
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd.
3. Jagbir Singh, Disaster Management: Future Challenges and Opportunities, K W Publishers Pvt. Ltd.
4. J. P. Singhal, Disaster Management, Laxmi Publications
5. C. K. Rajan, Navale Pandharinath, Earth and Atmospheric Disaster Management : Nature and Manmade, B S Publication

Reference Books

1. Disaster Management by Mrinalini Pandey Wiley 2014.
2. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
3. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
4. National Disaster Management Plan, Ministry of Home affairs, Government of India
5. Manual on Disaster Management, National Disaster Management, Agency Govt of India.

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2. http://nidm.gov.in/pdf/guidelines/new/sdmp.pdf
3. http://sdmassam.nic.in/pdf/publication/undp/disaster_management_in_india.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
2	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
3	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
4	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3
5	3	2	3	2	3	3	2	-	2	2	2	3	1	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19CEO54	AIR POLLUTION AND SOLID WASTE MANAGEMENT (Common to EEE, ECE, CSE, IT, ICE, MECH, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Provide general understanding of air pollution, air pollutants, their sources and their effects
- Provide knowledge about meteorological parameters, air sampling and measurement of pollutants.
- Provide knowledge of air pollution controlling technologies, air pollution due to automobiles and general Idea of noise pollution.
- Study the importance of solid waste management by processing, treatment, disposal and reuse of solid waste.
- Study about the equipment used for waste collection and transportation of solids waste.

Course Outcomes

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

CO1 - understand the type, sources & effect of air pollutants **(K2)**
CO2 - know the parameters affecting air pollution and various methods of measurement and estimation of pollutants **(K3)**
CO3 - gain knowledge of basics of noise pollution **(K2)**
CO4 - understand various air pollution control equipment's & pollution caused due to automobile exhaust **(K4)**
CO5 - understand the concepts of solid waste management **(K2)**

UNIT I INTRODUCTION TO AIR POLLUTION **(8 Hrs)**

Introduction to air pollution: Air pollution episodes, Atmosphere and its zones, classification and sources of air pollutants, effects of air pollutants on man, plants animal & materials

UNIT II METEOROLOGICAL ASPECTS **(8 Hrs)**

Meteorological Aspects: Atmospheric stability, plume behavior, Ambient air sampling and stack sampling, collection of particulates and gaseous pollutants, methods of estimation.

UNIT III AIR POLLUTION CONTROL METHODS **(9 Hrs)**

Air pollution control methods and equipment: Principle of control methods for particulates and gaseous pollutants, gravity settlers, electrostatic precipitators, bag filters cyclones, wet scrubbers, automobile exhaust: Pollution due to diesel and petrol engines, exhaust treatment and abatement, noise Pollution: Sources, ill effects, control measures.

UNIT IV SOLID WASTE MANAGEMENT **(8 Hrs)**

Introduction to solid waste management, sources, quantification and characterisation, classification and components, sampling and analysis, Method of collection

UNIT V EQUIPMENT **(12 Hrs)**

Equipment used for collection and transportation, transfer stations, solid waste processing and management. Treatment and disposal methods: composting, sanitary landfills, Incineration – concept, components and applications, leachate management.

Text Books

1. M.N. Rao & H.V.N. Rao, 1988, Air Pollution, Tata McGraw Hill Publishing Co. Ltd.
2. C.S. RAO, 2007, Environmental Pollution Control Engineering, New Age International, Wiley Estern Ltd. New Delhi.
3. Stern A. C., 1973, Air pollution, Academic Press.
4. A.D. Bhide & Sunderesan B.B., 1983, Solid Waste Management in Developing countries, INSDOC, New Delhi.
5. Tohobanoglous, 1993, Intgrated Solid Waste Management Engineering Principle and Management Issues, McGraw-Hill publication Ltd.

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1. P. Aarne Vesilind, William Worrell & Debra Reinhart, 2002, Solid Waste Engineering, Cengage Learning India pvt. Ltd.
2. Dr. Y Anjaneyulu, 2002, Air Pollution and Control Technologies, Allied Publisher pvt. Ltd.

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3. Waste Management: A Reference Handbook. Contributors: Jacqueline Vaughn - Author. Publisher: ABC-Clio
4. K. V. S. G. Murlikrishna, 1995, Air Pollution, Kaushal& Company.

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3. https://nptel.ac.in/content/storage2/courses/104103022

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	3	2	3	3	3	3	3	2	3	3	2	3
2	3	3	2	3	3	3	3	2	3	2	2	3	3	3	3
3	3	3	3	2	2	2	3	3	3	3	2	3	3	3	2
4	2	3	2	3	2	3	2	3	3	2	2	3	3	3	3
5	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19BMO53

BIOMETRIC SYSTEMS

(Common to CSE, IT, MECH, MECHATRONICS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basics of Biometric systems
- To gain knowledge in different fingerprint technologies
- To understand the classification of face recognition methods.
- To understand multimodal Biometrics and its performance evaluation.
- To know personal privacy and security implications of biometrics systems

Course Outcomes

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

CO1 - Explain the fundamentals of biometric systems. **(K2)**
CO2 - Describe the various fingerprint technologies. **(K3)**
CO3 - Distinguish different face recognition and hand geometry pattern. **(K3)**
CO4 - Analyse the multimodal biometrics and performance evaluation of biometrics. **(K4)**
CO5 - Recognize various Biometric authentication methods. **(K3)**

UNIT I INTRODUCTION TO BIOMETRICS (9 Hrs)

Introduction– biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrolment – templates – algorithm – verification – Authentication technologies –Need for strong authentication - Protecting privacy and biometrics policy – Biometric applications – biometric characteristics.

UNIT II FINGERPRINT TECHNOLOGY (9 Hrs)

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modelling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY (9 Hrs)

Introduction to face recognition - face recognition from correspondence maps - Hand geometry- scanning - feature extraction - Adaptive Classifiers - Visual Based feature extraction and Pattern Classification -types of algorithm - Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION (9 Hrs)

Voice scan - Physiological biometrics – Behavioural biometrics - Introduction to multimodal biometric system- Integration strategies - Architecture -level of fusion - combination strategy – training and adaptability - examples of multimodal biometric systems - Performance evaluation - Statistical Measures of Biometrics- FAR - FRR - FTE - EER -Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION (9 Hrs)

Introduction - Biometric Authentication Methods - Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines- Biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.

Text Books

1. Anil K. Jain, Arun Ross, and Karthik Nandakumar "Introduction to Biometrics", Springer, 2011.
2. Richard O. Duda, David G.Stork,Peter E. Hart, "Pattern Classification,", Wiley 2007.
3. S.Y.Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2005.

Reference Books

1. Anil K. Jain, Patrick Flynn, and Arun A. Ross, "Handbook of Biometrics", Springer, 2008.
2. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley, 2003.
3. John R. Vacca, "Biometric Technologies and Verification Systems", Elsevier Inc, 2007.

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4. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation",Springer,2005
5. Nikolaos V. Boulgouris,Konstantinos N. Plataniotis ,Evangelia Micheli-Tzanakou,"Biometrics: Theory, Methods, and Applications" , Wiley 2009.

Web References

1. http://www.findbiometrics.com/Pages/glossary.html
2. http://www.biometrics.gov/Documents/privacy.pdf
3. http://zing.ncsl.nist.gov/biousa/docs/Usability_and_Biometrics_final2.pdf
4. User Interface, System Design
5. http://www.cesg.gov.uk/site/ast/biometrics/media/BEM_10.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	-	1	-	1	-
2	3	2	2	1	1	2	-	-	-	-	-	1	-	1	-
3	3	2	2	1	2	2	-	-	-	-	-	1	-	1	-
4	3	1	1	1	1	1	-	-	-	-	-	1	-	1	-
5	3	1	2	1	2	2	-	-	-	-	-	1	-	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19BMO54

MEDICAL ROBOTICS

(Common to CSE, IT, MECH, MECHATRONICS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basics of Robotics
- To gain knowledge in Kinematics
- To know about the robot vision
- To describe various motion planning solutions
- To explain various applications of Robots in Medicine

Course Outcomes

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

CO1 - Understand the basics of robotic systems. **(K2)**
CO2 - Explore workspace and related motion of the Robots **(K3)**
CO3 - Analyse and extract information from the image using Robots **(K3)**
CO4 - Design of task planning and simulating the task. **(K4)**
CO5 - Construct Robots for Medical applications **(K4)**.

UNIT I INTRODUCTION (9 Hrs)

Introduction- Automation and Robots – Classification - Applications- Specifications – Direct Kinematics Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates Link coordination arm equation – Four-axis robot -Five-axis robot - Six-axis robot.

UNIT II KINEMATICS (9 Hrs)

Inverse Kinematics – General properties of solutions tool configuration – Workspace analysis and trajectory planning work envelope - examples- workspace fixtures – Pick and place operations – Continuous path motion – Interpolated motion – Straight-line motion.

UNIT III ROBOT VISION (9 Hrs)

Robot Vision- Image representation – Template matching – Polyhedral objects – Shane analysis – Segmentation – Thresholding – region labelling – Shrink operators – Swell operators – Euler numbers – Perspective transformation – Structured illumination – Camera calibration.

UNIT IV PLANNING (9 Hrs)

Task Planning – Task level programming – Uncertainty – Configuration – Space, Gross motion – Planning – Grasp Planning – Fine-motion planning – Simulation of planar motion – Source and Goal scenes – Task Planner simulation.

UNIT V BIOMETRIC AUTHENTICATION (9 Hrs)

Applications in Biomedical Engineering – Biologically Inspired Robots – Application in Rehabilitation – Interactive Therapy – Bionic Arm – Clinical and Surgical – Gynaecology – Orthopaedics – Neurosurgery.

Text Books

1. Robert Schilling, "Fundamentals of Robotics-Analysis and control", Prentice Hall, 2003.
2. Paula Gomes, "Biomedical Instrument and Robotic Surgery System: Design and Development for Biomedical Applications", Woodhead Publishing, 2012
3. Klafter, Chmielewski and Negin, "Robotic Engineering - An Integrated approach", PHI, first edition, 2009.

Reference Books

1. J.J.Craig, "Introduction to Robotics", Pearson Education, 2005.
2. Fu, Lee and Gonzalez., "Robotics, control vision and intelligence", McGraw Hill International, 2nd edition, 2007
3 John J. Craig, "Introduction to Robotics", Addison Wesley Publishing, 3rd edition, 2010.
4. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, "Robotics", McGraw Hill, 2008.

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Web References

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://www.intechopen.com/books/medical_robotics/motion_tracking_for_minimally_invasive_ robotic_surgery
3. https://www.intechopen.com/books/medical_robotics/robotic_applications_in_neurosurgery
4. https://www.intechopen.com/books/medical_robotics/medical_robotics_in_cardiac_surgery
5. https://www.worldscientific.com/worldscinet/jmrr

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	-	1	-	2	-
2	3	2	-	1	1	1	-	-	-	-	-	1	-	2	-
3	3	2	-	1	1	1	-	-	-	-	-	1	-	2	-
4	3	1	1	1	1	1	-	-	-	-	-	1	-	2	-
5	3	1	1	-	1	1	-	-	-	-	-	1	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CCO53	NETWORK ESSENTIALS (Common to EEEMECH, CIVIL, ICE MECHATRONICS, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamental concepts of computer communication and data networks
- To gain the necessary knowledge and skills to work effectively with network engineering and administrators
- To learn how to research ,communicated network and IT issuing by reading relevant industry information
- To understanding the basic technologies and step required for setting up managing small LAN
- To understand the various technologies of security to protect the information in network

Course Outcomes

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

CO1 - Understand the basic knowledge and skills to implement defined network architecture
CO2 - Explain the performances of data link control and their access medium
CO3 - Describe about internet Protocol and their working processes in IPV.
CO4 - Explain the basic concepts of Transport Protocols and working of TCP layer
CO5 - Design and study the operations of Security and their different algorithm

UNIT I NETWORK MODELS (9 Hrs)

Data communications- Networks-PAN,LAN, MAN and WAN- Internet, Intranet and Extranets- Protocols and standards- OSI/ISO reference model- TCP/IP protocol suite-Broadband ISDN-ATM protocol reference model-- SONET/SDH architecture-Bluetooth and UWB –WiFi-WiMax Cognitive Radios- Adhoc and Sensor Networks-Green communications.

UNIT II DATA LINK CONTROL AND MEDIUM ACCESS (9 Hrs)

Types of errors- Error detection and correction- Checksum- Framing-Flow control-Stop and wait protocol-Go-back N- Selective repeat protocols HDLC-Random access protocols- Controlled access- Wired LANs- IEEE standards, IEEE 802.3, 802.4, 802.5 and 802.6- - Fast Ethernet- Gigabit Ethernet –Wireless LANs- IEEE 802.11.

UNIT III NETWORK ROUTING (9 Hrs)

Logical addressing- IPv4 addresses- IPv6- Internet protocol- Transition from IPv4 to IPv6- Mapping logical to physical address- Mapping physical to logical address- ICMP-Direct Vs Indirect delivery- Forwarding-Unicast and Multicast routing protocols- Different Routing Algorithms-Internetworking-Routers and gateways.

UNIT IV TRANSPORT AND CONGESTION (9 Hrs)

Elements of Transport Protocols: addressing, Connection Establishment, Connection Release, Error Control and Flow Control – Congestion control: Desirable Bandwidth Allocation, Regulating the Sending Rate, Wireless Issues-UDP, RPC -TCP Protocol, TCP connection management, TCP sliding window and congestion control

UNIT V SECURITY (9 Hrs)

Introduction to Cryptography, Cipher text, symmetric key cryptography – AES and DES, RSA public key and private keys- Digital signature .Security in the Internet: IPSec, PGP, VPN and Firewalls. Authentication Protocols: Shared Secret Key, The Diffie-Hellman Key Exchange, Authentication Using Kerberos. Wireless Security- issues and challenge

Text Books

1. William Stallings, "Data and computer communications", Ninth Edition,Pearson Education, New Delhi, 2014.
2. Behrouz. A. Forouzan, "Data Communication and Networking", Fifth Edition,McGraw Hill, New Delhi, 2013.
3. Pallapa Venkatram and Sathish Babu.B, "Wireless &Mobile Network security",Tata McGraw Hill, New Delhi, 2010

Reference Books

1. Douglas E. Comer, "Internetworking with TCP/IP (Volume I) Principles, Protocols and Architecture",6th Edition, Pearson Education, 2013.
2. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach",McGraw

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Hill Publisher, 2011.
4. Behrouz A. Forouzan and Firouz Mosharraf, "Computer Networks a Top Down Approach", TataMcGraw-Hill, 2017.
5. Rich Seifert, James Edwards, "The All New Switch Book: The Complete Guide to LAN SwitchingTechnology", 2nd Edition , Wiley Publishing Inc, 2011

Web References

1. https://tinyurl.com/ycy6x454
2. https://tinyurl.com/yapn9ac7
3. https://tinyurl.com/ydf33ye6
4. https://nptel.ac.in/courses/106/105/106105081/
5. https://nptel.ac.in/courses/106/105/106105183/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1		1	-	-	-	-	-	1	-	-	-
2	2	1	2	1		1	-	-	-	-	-	1	-	-	-
3	2	1	2	1		1	-	-	-	-	-	1	-	-	-
4	2	1	1	1		1	-	-	-	-	-	1	-	-	-
5	2	1	1	1	1	1	-	-	-	-	-	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CCO54	WEB PROGRAMMING (Common to EEE,ECE, MECH, CIVIL, ICE MECHATRONICS, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Learn the fundamentals of web application development
- To understand the design components and tools using CSS
- To learn the concepts of JavaScript and programming fundamentals.
- To understand the working procedure of XML
- To study about advance scripting and Ajax applications

Course Outcomes

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

CO1 - Comprehend basic web applications using HTML **(K2)**
CO2 - Use CSS to design web applications **(K3)**
CO3 - Use java scripts functions for the web page creation **(K3)**
CO4 - Explain XML structure **(K2)**
CO5 - Demonstrate the web 2.0 application to advance scripts **(K2)**

UNIT I INTRODUCTION TO WWW & HTML (9 Hrs)

Protocols, secure connections, application and development tools, the web browser, What is server, dynamic IP, Web Design: Web site design principles, planning the site and navigation. HTML: The development process, Html tags and simple HTML forms.

UNIT II STYLE SHEETS (9 Hrs)

CSS: Need for CSS, Introduction to CSS, basic syntax and structure, using CSS, background Images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2.

UNIT III JAVA SCRIPTS (9 Hrs)

Client side scripting, JavaScript, develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition.

UNIT IV XML (9 Hrs)

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT.

UNIT V ADVANCE SCRIPT (9 Hrs)

JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations DHTML: Combining HTML, CSS and JavaScript, events and buttons, controlling your browser, AJAX: Introduction, advantages & disadvantages, AJAX based web application, alternatives of AJAX.

Text Books

1. Ralph Moseley, M.T. Savaliya, "Developing Web Applications", BPB Publications, 2017.
2. Hirdesh Bhardwaj,, "Web Designing", Pothi.com, 2016
3. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education, 2009.

Reference Books

1. Ralph Moseley, "Developing Web Applications", Wiley India Pvt. Ltd, 2013
2. Joel Sklar, " Principles of Web Design", 6th edition, Cengage Learning, Inc, 2014
3. B. M. Harwani," Developing Web Applications in PHP and AJAX", Tata McGraw-Hill Education, 2010
4. UttamK.Roy, Web Technologies, Oxford University Press

Web References

1. https://nptel.ac.in/courses/106/106/106106156/
2. https://www.coursera.org/learn/html-css-javascript-for-web-developers

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3. https://code.tutsplus.com/courses/how-to-become-a-web-developer
4. https://webdesignerwall.com/
5. https://www.smashingmagazine.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2	1	-	-	-	-	-	1	-	-	-
2	2	1	2	1	2	1	-	-	-	-	-	1	-	-	-
3	2	1	2	1	2	1	-	-	-	-	-	1	-	-	-
4	2	1	1	1	2	1	-	-	-	-	-	1	-	-	-
5	2	1	1	1	2	1	-	-	-	-	-	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	T	P	C	Hrs
U19ADO51	**PRINCIPLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE)	3	0	0	3	45

Course Objectives

- To understand basic principles of Artificial Intelligence
- To learn and design Knowledge representation
- To understand the concept of reasoning
- To master the fundamentals of machine learning, mathematical framework and learning algorithms
- To understand the reinforcement and statistical learning.

Course Outcomes

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

CO1 - Understand foundational principles of artificial intelligence. **(K2)**
CO2 - Understand formal methods of knowledge representation. **(K2)**
CO3 - Understand the fundamental issues and challenges of Reasoning. **(K2)**
CO4 - Analyze the underlying mathematical relationships with Machine Learning algorithms. **(K3)**
CO5 - Apply various models for Artificial Intelligence programming techniques. **(K4)**

UNIT I INTRODUCTION **(9 Hrs)**

Introduction to Artificial Intelligence - Artificial Intelligence Problems -Timelines of Artificial Intelligence - Production Systems - State Space Representation - Branches of Artificial Intelligence - Application of Artificial Intelligence.

UNIT II KNOWLEDGE REPRESENTATION **(9 Hrs)**

Knowledge Management - Types of Knowledge - Knowledge representation - Approaches to Knowledge representation - Issues in Knowledge representation - Knowledge base. First order Logic – Frames — Conceptual Dependency.

UNIT III REASONING **(9 Hrs)**

Types of reasoning - reasoning with Fuzzy Logic - Rule based Reasoning - Diagnosis Reasoning.

UNIT IV LEARNING **(9 Hrs)**

Types of Learning - Machine Learning - Intelligent agents - Association Learning: Apriori Algorithm - Case Study: Customer Sequence and SCADA Application – k-Means Clustering - Fuzzy Clustering - Cluster Similarity.

UNIT V REINFORCEMENT AND STATISTICAL LEARNING **(9 Hrs)**

Markov Decision Problem - Hidden Markov Model - Linear Classifier - decision Trees: Random forest - Bayesian Network – ANN - ANN Learning process - Types of Network – Perceptron - RBF Network - Case studies: Character recognition.

Text Books

1. Anand Hareendran S., Anand Hareendran, And Vinod Chandra S.S. "Artificial Intelligence and Machine Learning" PHI Publication, 2014.
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Science, 1997.
3. Peter Harrington, "Machine Learning in action", Manning Publication, 2012.

Reference Books

1. Charu C. Aggarwal "Data Classification Algorithms and Applications", Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
2. Andreas C. Mueller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, Inc. First Edition, 2016.
3. Eremy Watt, Reza Borhani, and Aggelos K. Katsaggelos "Machine Learning Refined Foundations, Algorithms, and Applications", Cambridge University Press, 2016.
4. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.

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Web Resources

1. https://www.coursera.org/learn/machine-learning
2. https://ml-cheatsheet.readthedocs.io/en/latest/regression_algos.html
3. https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	–	1	-	-	-	-	-	-	-	2	2	2
2	1	2	2	–	–	-	-	-	-	-	-	-	1	1	-
3	2	2	1	2	–	-	-	-	-	-	-	-	-	1	1
4	3	2	2	2	1	-	-	-	-	-	-	-	1	-	1
5	2	2	2	2	1	-	-	-	-	-	-	-	1	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19ADO52	DATA SCIENCE APPLICATION OF VISION (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the capability of a machine to get and analyze visual information and make decisions
- To learn methods and algorithms for Vision
- To learn how to use deep learning for Vision tasks
- To understand the neural network concepts
- To study the real world applications using computer vision

Course Outcomes

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

CO1 - Understand the methods and algorithms for image processing. **(K2)**
CO2 - Apply object detection and segmentation concepts for image processing. **(K4)**
CO3 - Apply scalable algorithms for large datasets in vision. **(K4)**
CO4 - Analyze deep learning and neural network architectures for image and video processing. **(K3)**
CO5 - Apply vision-based solutions for specific real-world applications. **(K4)**

UNIT I IMAGE FUNDAMENTALS (9 Hrs)

Pixels - The Building Blocks of Images - The Image Coordinate System - RGB and BGR Ordering - Scaling and Aspect Ratios. Image filters - Gaussian blur - Median filter - Dilation and erosion - Custom filters - Image thresholding - Edge detection - Sobel edge detector - Canny edge detector.

UNIT II OBJECT DETECTION AND SEGMENTATION (9 Hrs)

Image Features - Harris corner detection - Local Binary Patterns - Image stitching - Segmentation: Contour detection - The Watershed algorithm - Super pixels - Normalized graph cut.

UNIT III MACHINE LEARNING WITH COMPUTER VISION (9 Hrs)

Data pre-processing - Image translation through random cropping - Image rotation and scaling - Applications of machine learning for computer vision - Logistic regression - Support vector machines - K-means clustering.

UNIT IV IMAGE CLASSIFICATION USING NEURAL NETWORKS (9 Hrs)

Image Classification Basics Types of Learning - The Deep Learning Classification Pipeline - Introduction to Neural Networks - The Perceptron Algorithm - Backpropagation and Multi-layer Networks - The Four Ingredients in a Neural Network Recipe - Weight Initialization - Constant Initialization - Uniform and Normal Distributions - LeCun Uniform and Normal - Understanding Convolutions - CNN Building Blocks - Common Architectures and Training Patterns.

UNIT V COMPUTER VISION AS A SERVICE (9 Hrs)

Computer vision as a service – architecture - Developing a server-client model - Computer vision engine.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2009.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, Cengage Learning, 2007.
3. Gary Bradski, "Learning OpenCV", First Edition, 2008.

Reference Books

1. Alok Kumar Singh Kushwaha, Rajeev Srivastava, "Recognition of Humans and Their Activities for Video Surveillance", IGI Global, 2014.
2. Ying-li Tian, Arun Hampapur, Lisa Brown, Rogerio Feris, Max Lu, Andrew Senior, "Event Detection, Query, and Retrieval for Video Surveillance", IGI Global, 2009.
3. Matthew Turk, Gang Hua, "Vision-based Interaction", First Edition, Morgan Claypool, 2013.
4. Ian Goodfellow, Yoshuo Bengio, Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning series)", MIT Press, 2017.

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5. Fan Jiang, "Anomalous Event Detection from Surveillance Video", ProQuest, 2012.

Web Resources

1. https://www.kaggle.com/learn/computer-vision
2. https://machinelearningmastery.com/what-is-computer-vision/
3. https://www.udemy.com/course/pythoncv/
4. https://www.analyticsvidhya.com/blog/2019/03/opencv-functions-computer-vision-python/
5. https://www.youtube.com/watch?v=N81PCpADwKQ&ab_channel=ProgrammingKnowledge

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	1	-	-	-	-	-	-	-	2	2	-
2	2	1	1	2	–	-	-	-	-	-	-	-	1	1	1
3	2	2	2	1	–	-	-	-	-	-	-	-	-	-	1
4	1	2	2	2	1	-	-	-	-	-	-	-	1	2	-
5	2	1	2	2	1	-	-	-	-	-	-	-	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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OPEN ELECTINE - III

U19HS061 **PRODUCT DEVELOPMENT AND DESIGN**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide the basic concepts of product design, product features and its architecture.
- To have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To enhance team working skills.
- To design some products for the given set of applications.
- To compete with a set of tools and methods for product design and development.

Course Outcomes

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

CO1 - Apply the concept for new product development. **(K3)**
CO2 - Validate knowledge on the concepts of product specification. **(K5)**
CO3 - Describe the principles of industrial design and prototyping. **(K2)**
CO4 - Apply knowledge on product architecture. **(K3)**
CO5 - Review the concept of product development and customer needs. **(K5)**

UNIT I INTRODUCTION TO PRODUCT DEVELOPMENT (9 Hrs)

Product development versus design, product development process, product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method.

UNIT II PRODUCT SPECIFICATIONS (9 Hrs)

Establishing the product specifications– Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically - Reflect on the Results and the Process.

UNIT III PRODUCT CONCEPTS (9 Hrs)

A: Concept generation, product configuration, concept evaluation and selection, product embodiments.
B: Quality function deployment, product design specification, physical prototypes-types and technique, dimensional analysis, design of experiments.

UNIT IV PRODUCT ARCHITECTURE (9 Hrs)

Concept selection- Screening – scoring, Product architecture – Implication of architecture - Establishing the architecture – Related system level design issues.

UNIT V PROTOTYPING (9 Hrs)

Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging.

Text books

1. Karl T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGraw-Hill International Edns.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood,
3. Otto, K. N. Product design: techniques in reverse engineering and new product development.

Reference books

1. Ashby, M. F., & Johnson, K... Materials and design: the art and science of material selection in product design. Butterworth-Heinemann.
2. Kevin Otto and Kristin Wood, "Techniques in Reverse Engineering and New Product Development", Pearson Education, Chennai, Edition III.

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3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 6th Edition, PHI.
4. Taurt Pugh,"Tool Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY
5. Kumar, A., Jain, P. K., & Pathak, P. M. Reverse engineering in product manufacturing: an overview. DAAAM international scientific book.

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2. https://www.pdfdrive.com/product-design-and-development-e38289913.html
3. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
4. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
5. https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes/clas1_int_crse_6.pdf
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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	-	-	-	-	-	-	2	-	-	-
2	1	-	2	-	3	-	-	-	-	-	-	3	-	-	-
3	1	-	3	-	2	-	-	-	-	-	-	2	-	-	-
4	3	-	1	-	3	-	-	-	-	-	-	1	-	-	-
5	1	-	3	-	3	-	-	-	-	-	-	2	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19HS062	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- Awareness about current trends in IPR and Government steps in fostering IPR

Course Outcomes

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

CO1 - Complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works **(K2)**

CO2 - Presenting useful insight on novelty of their idea from state-of-the art search during their project work period.**(K3)**

CO3 - Posting Intellectual Property as a career option like R&D IP Counsel, Government Jobs – Patent Examiner, Private Jobs, Patent agent and/or Trademark agent and Entrepreneur **(K5)**

CO4 - To disseminate knowledge on Design, Geographical Indication, Plant Variety and Layout Design Protection and their registration aspects **(K1)**

CO5 - Organizing their idea or innovations and analyse ethical and professional issues which arise in the intellectual property law context. **(K4)**

UNIT I OVERVIEW OF INTELLECTUAL PROPERTY **(9 Hrs)**

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

UNIT II PATENTS **(9 Hrs)**

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

UNIT III COPYRIGHTS **(9 Hrs)**

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

UNIT IV TRADEMARKS **(9 Hrs)**

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

UNIT V OTHER FORMS OF IP **(9 Hrs)**

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection.

(K.VELMURUGAN)

Text books

1. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited, 2019
2. Neeraj, P., & Khusdeep, D. Intellectual Property Rights. India, IN: PHI learning Private Limited. 2014

Reference books

1. Ahuja, V K. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis, 2017.
2. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
4. Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.
5. S.V. Satakar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
6. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

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1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
6. Journal of Intellectual Property Rights (JIPR): NISCAIR

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	3	-	2	-	1	2	-	-	-	2	-	-	-
2	1	-	3	-	2	-	2	2	-	-	-	2	-	-	-
3	-	-	2	-	1	-	3	3	-	-	-	2	-	-	-
4	2	-	3	-	2	-	2	2	-	-	-	2	-	-	-
5	1	-	1	-	2	-	1	2	-	-	-	2	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K. VELMURUGAN)

U19HS063	MARKETING MANAGEMENT AND RESEARCH	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To facilitate understanding of the conceptual framework of marketing in engineering.
- To understand the concepts of product and market segmentation for engineering services and technological products.
- Analyzing the various pricing concepts and promotional strategies for engineering and technology markets.
- Learn to focus on a research problem using scientific methods in engineering and technological enterprises.
- To be able to design and execute a basic survey research reports in in engineering and technological enterprises

Course Outcomes

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

CO1 - Analyze the fundamental principles involved in managing engineering and technological markets **(K3)**

CO2 - Understand and develop product, and Market Segmentation for engineering services and technological Products **(K4)**

CO3 - Develop pricing and promotional strategies for engineering and technology markets **(K6)**

CO4 - Analyze market problems and be capable of applying relevant models to generate appropriate solutions to meet challenges in engineering and technological enterprises **(K3)**

CO5 - Identify the interrelationships between market trends, innovation, sustainability and communication in engineering and technological enterprises **(K5)**

UNIT I MARKETING – AN OVERVIEW (9 Hrs)

Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environment, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods.

UNIT II PRODUCT AND MARKET SEGMENTATION (9 Hrs)

Product, Classifications of product, Product Life Cycle, New product development, Branding, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns. Services marketing and Industrial marketing.

UNIT III PRICING AND PROMOTIONAL STRATEGIES (9 Hrs)

Price: Objectives, Pricing Decisions and Pricing Methods, Pricing Management. Advertising-Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics.

UNIT IV RESEARCH AND ITS FUNDAMENTALS (9 Hrs)

Research: Meaning, Objectives of Research, Types of Research, Significance of Research - Methods Vs Methodology - Research Process – Components of Research Problem, Literature Survey – Primary Data and Secondary Data, Questionnaire design, Measurement and Scaling Techniques.

UNIT V BASIC STATISTICAL ANALYSIS AND REPORT WRITING (9 Hrs)

Fundamentals of Statistical Analysis and Inference- Measures of Central Tendency -Measures of Dispersion - Measures of Asymmetry - Report Writing: Types of research reports, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Report Writing, Layout of Research Report, Mechanics of Writing Research Report, Ethics in Research

Text books

1. Philip Kolter & Keller, "Marketing Management", Prentice Hall of India, 14th edition, 2012.
2. Lilien, Gary L., and Arvind Rangaswamy. "Marketing managers make ongoing decisions about product features, prices, distribution options", The Handbook of Marketing Research: Uses, Misuses, and Future Advances (2006).

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(K.VELMURUGAN)

Reference books

1. Chandrasekar, K.S., "Marketing Management Text and Cases", 1st Edition, Tata McGraw Hill - Vijaynicole, 2010.
2. Kothari, C. "Research Methodology Methods and Techniques", New Age International (P) Ltd., 2017
3. RajanSexena. Marketing Management: Text cases in Indian Context.(3rd edition) New Delhi, Tata McGraw hill, 2006
4. Moisander J, Valtonen A, "Qualitative marketing research: A cultural approach", Sage Publisher, 2006.
5. Malhotra NK, Satyabhushan Dash, "Marketing Research: An Applied Orientation", 7th ed, Pearson Education, 2019

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1. https://swayam.gov.in/nd1_noc20_mg26/preview
2. https://swayam.gov.in/nd1_noc20_mg26/preview
3. https://www.entrepreneur.com/encyclopedia/market-research

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	1	-	1	-	-	-
2	-	1	2	-	1	-	3	-	-	2	-	1	-	-	-
3	-	-	1	-	1	-	-	-	2	1	-	1	-	-	-
4	-	3	2	2	-	1	-	1	1	2	-	1	-	-	-
5	-	2	2	1	2	2	-	2	2	2	-	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19HS064 PROJECT MANAGEMENT FOR ENGINEERS

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the various concepts and steps in project management.
- To familiarize the students with the project feasibility studies and project life cycle
- To enable the students to prepare a project schedule
- To understand the risk management and project Control process.
- To learn about the closure of a project and strategies to be an effective project manager.

Course Outcomes

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

CO1 - Interpret the different concepts and the various steps in defining a project. **(K2)**

CO2 - Examining the feasibility of a project. **(K3)**

CO3 - Build a schedule for a Project. **(K6)**

CO4 - Predict the risk associated with a project and demonstrate the project audit. **(K2)**

CO5 - Analyse the project team and outline the Project closure. **(K4)**

UNIT I PROJECT MANAGEMENT CONCEPTS (9 Hrs)

Project: Meaning, Attributes of a project, Project Life cycle, Project Stakeholders, Classification, Importance of project management, Project Portfolio Management System, Different Project Management Structure, Steps in Defining the Project, Project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints

UNIT II PROJECT FEASIBILITY ANALYSIS (9 Hrs)

Opportunity Studies, Pre-Feasibility studies, and Feasibility Study: Market Feasibility, Technical Feasibility, Financial Feasibility and Economic Feasibility. Financial and Economic Appraisal of a project, Social Cost Benefit Analysis in India and Project Life Cycle.

UNIT III PROJECT SCHEDULING & NETWORK TECHNIQUES (9 Hrs)

Scheduling Resources and reducing Project duration: Types of project constraints, classification of scheduling problem, Resources allocation methods, Splitting, Multitasking, Benefits of scheduling resources, Rationale for reducing project duration, Options for accelerating Project completion

Developing and Constructing the Project Network (Problems), PERT, CPM; Crashing of Project Network.

UNIT IV PROJECT RISK MANAGEMENT AND PROJECT CONTROL (9 Hrs)

Project Risk management; Risk concept, Risk identification, Risk assessment, Risk response development, Contingency planning, Contingency funding and time buffers, Risk response control, and Change control management.

Budgeting and Project Control Process, Control issues, Tendering and Contract Administration. Steps in Project Appraisal Process and Project Audits

UNIT V PROJECT CLOSURE AND MANAGING PROJECT (9 Hrs)

Project Closure: Team, Team Member and Project Manager Evaluations. Managing versus Leading a Project: Qualities of an Effective Project Manager, Managing Project Stakeholders, Managing Project Teams: Five Stage Team Development Model, Situational factors affecting team development and project team pitfalls.

Text books

1. Erik Larson and Clifford Gray. "Project Management: The Managerial Process", 6th Edn. McGraw Hill Education; 2017.
2. Harold Kerzner. "Project Management: A systems approach to Planning, Scheduling and Controlling. 12th Edn. John Wiley & Sons; 2017

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Reference books

1. Meredith, J.R. & Mantel, S. J. "Project Management- A Managerial Approach". John Wiley.:2017
2. Prasanna Chandra. "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review", 9th Edn. McGraw Hill Education; 2019.
3. B C Punmia by K K Khandelwal. "Project Planning and Control with PERT and CPM". 4th Edn. Laxmi Publications Private Limited; 2016.
4. Hira N Ahuja, S.P.Dozzi, S.M.Abourizk. "Project Management". 2nd Edn. Wiley India Pvt Ltd; 2013.
5. "A guide to Project Management Body of Knowledge". 6th Edn. Project Management Institute; 2017.

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2. www.projectmanagement.com
3. https://www.sciencedirect.com/journal/international-journal-of-project-management
4. https://nptel.ac.in/courses/110/107/110107081/
5. https://nptel.ac.in/courses/110/104/110104073/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	-	-	2	-	2	2	-	-	-
2	-	2	1	-	-	1	-	-	1	1	1	1	-	-	-
3	-	1	3	-	-	-	-	-	-	-	1	-	-	-	-
4	3	1	1	-	-	1	1	-	-	1	1	3	-	-	-
5	3	-	3	-	-	-	-	3	3	2	3	2	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19HS065 **FINANCE FOR ENGINEERS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To develop a deeper understanding of the fundamentals of Accounting and Finance
- To learn how to apply mathematical principles in Finance and the concepts of Risk and Return
- To understand the need and procedure for conducting Financial Analysis for better decision-making
- To be familiar with the modes of generating funds for business and their implications
- To understand the scientific ways to determine deployment of funds in business

Course Outcomes

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

CO1 - Understand basic concepts in accounting and finance and their importance for engineers **(K2)**
CO2 - Demonstrate knowledge and understanding of the applications of mathematics in finance **(K3)**
CO3 - Conduct Financial Analysis and use the outcome in making informed decisions in investing **(K4)**
CO4 - Identify and Appreciate various sources of procurement of funds in business and their critical evaluation **(K2)**
CO5 - Know how to scientifically determine the investing in long-term and short-term assets in business **(K3)**

UNIT I UNDERSTANDING THE FUNDAMENTALS **(9 Hrs)**
Assets – Need and Functions of Assets – Types of Assets – Factors determining Investments in Assets. Liabilities – Meaning and Functions of Liabilities – Types of Liabilities – Capital as a Liability: Why and How – Concept and Meaning of Finance – Distinction between Accounting and Finance – Significance of Accounting and Finance for Engineers.

UNIT II MATHEMATICS OF FINANCE **(9 Hrs)**
Time Value of Money – Computation of Present Value and Future Value – Implications of TVM in Financial Decisions – Concept of Risk and Return – Measuring Risk and Return – Concept of Required Rate of Return and its significance in Investment Decisions.

UNIT III FINANCIAL ANALYSIS **(9 Hrs)**
Meaning and Objectives of Financial Analysis – Annual Report As an Input for Analysis – Basic Understanding of Annual Reports - Tools of Financial Analysis – Horizontal Analysis – Vertical Analysis – Trend Analysis – Accounting Ratios – Significance of Ratio Analysis in Decision-making – Snap-shot of the Past to predict the Future – Computation of Key Ratios – Liquidity Ratios – Profitability Ratios – Performance Ratios – Ratios that are helpful for Potential Investors.

UNIT IV FUNDS PROCUREMENT **(9 Hrs)**
Meaning of Funds – Sources of Funds – Long-Term Sources – Short-Term Sources – Financing Decisions in Business – Capital Structure – Need and Importance of Capital Structure – Determining Optimum Capital Structure – Concept and Computation of Earnings Before Interest and Tax (EBIT), Earnings Before Tax (EBT), and Earnings After Tax (EAT)(Simple Problems) - Leverage in Finance – Types and Computation of Leverages – Operating Leverage, Financial Leverage, and Combined Leverage.

UNIT V FUNDS DEPLOYMENT **(9 Hrs)**
Investment Decisions – Types of Investment Decisions: Long-Term Investment Decisions. Significance – Methods: Pay-Back Period Method, Net Present Value Method and Benefit-Cost Ratio Method. Short-Term Investment Decisions – Concept of Working Capital – Need and Importance of Working Capital in Business – Determinants of Working Capital in a Business. Components of Working Capital. Dividends: Concept and Meaning – Implications of Dividend Decisions on Liquidity Management.

Text books

1. R. Narayanaswamy, Financial Accounting – A managerial perspective, PHI Learning, New Delhi. (2015 or later edition)
2. C. Paramasivan and T. Subramanian. Financial Management. New Age International, New Delhi. (2015 or later edition)

(K. VELMURUGAN)

Reference books

1. S.N. Maheswari, Sharad K. Maheswari & Suneel K. Maheswari. Accounting For Management. Vikas Publishing (2017 or later edition)
2. Varun Dawar & Narendar L. Ahuja. Financial Accounting and Analysis. Taxmann Publications. (2018 or later edition)
3. Athma. P. Financial Accounting and Analysis. Himalaya Publishing House. (2017 or later edtion)
4. Prasanna Chandra. Financial Management. Tata-McGraw Hill Publishers, New Delhi. (2019 or later edition)
5. S.C. Kuchhal. Financial Management. Chaitanya Publishing House, Allahabad. (2014 or later edition)

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2. http://www.mmachennai.org/
3. https://finance.yahoo.com/
4. https://icmai.in/icmai/
5. https://nptel.ac.in/courses/110/107/110107144/
6. https://web.utk.edu/~jwachowi/wacho_world.html
7. https://www.icai.org/indexbkp.html
8. https://www.icsi.edu/home/
9. https://www.investopedia.com/
10. https:/www.moneycontrol.com/
11. https://www.rbi.org.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	1	2	1	-	-	-
2	-	1	2	-	1	-	3	-	-	2	2	1	-	-	-
3	-	-	1	-	1	-	-	-	2	1	2	1	-	-	-
4	-	3	2	2	-	1	-	1	1	2	2	1	-	-	-
5	-	2	2	1	2	2	-	2	2	2	2	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19EEO75	HYBRID AND ELECTRICAL VEHICLE (Common to ECE, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize with the fundamental concept of electrical vehicle
- To understand the concept of hybrid and electrical vehicle architecture, component sizing and electrical motor drive.
- To determine various drives suitable for electrical vehicles.
- To understand the design concepts of electrical vehicle
- To overview the energy storage technologies used for hybrid and electrical vehicle.

Course Outcomes

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

CO1 - Summarize the basics of electrical vehicle based on working principle. **(K2)**
CO2 - Describe the working of different configurations of hybrid vehicles. **(K2)**
CO3 - Apply suitable drives for electrical vehicles. **(K2)**
CO4 - Review the working of different configurations of electrical vehicle and its design concepts **(K2)**
CO5 - Combine the different energy storage and their technologies on implementing hybrid vehicle. **(K3)**

UNIT I INTRODUCTION TO ELECTRICAL VEHICLE (9 Hrs)

History of hybrid and electrical vehicles - social and environmental importance - impact of modern drive - trains on energy supplies - Fundamentals of vehicle propulsion and Braking: Dynamic Equation - Vehicle Power Plant and Transmission Characteristics - Vehicle Performance - Braking Performance.

UNIT II HYBRID VEHICLE (9 Hrs)

Classification - Series and Parallel HEVs - Advantages and disadvantages - Series-Parallel Combination - Internal Combustion Engines: Reciprocating Engines - Gas Turbine Engine- Design of an HEV: Hybrid Drive train - Sizing of Components.

UNIT III ELECTRIC PROPULSION DRIVE SYSTEMS (9 Hrs)

Electric drives used in EV/HEV: Induction motor drives - DC motor drives - Permanent magnet motor drives - their Configuration - Control and Applications in EV/HEV.

UNIT IV DESIGN OF ELECTRICAL VEHICLE (9 Hrs)

Components of EV - advantages - EV transmission configuration: Transmission components - gear ratio - EV motor sizing - EV market.

UNIT V ELECTRICAL VEHICLE STORAGE TECHNOLOGY (9 Hrs)

Battery Types - Parameters - Technical characteristics – modelling and equivalent circuit - Methods of battery charging - Fuel cells: Types - Fuel cell electrical vehicle – Ultra capacitors - Hydrogen storage systems – Flywheel technology.

Text Books

1. Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 3rd Edition, 2019.
2. Iqbal Hussain, "Electric and Hybrid Vehicles – Design Fundamentals", CRC Press, 2nd Edition, 2011.

Reference Books

1. K. T. Chau, "Electric vehicle machines and drives: Design, analysis and application", John Willey and Sons Singapore pte. ltd., 1st Edition, 2015.
2. M. Ehsani, Y. Gao and A. Emadi, "Modern electric, hybrid electric and fuel cell vehicles: Fundamentals, Theory and design", CRC press, 2nd Edition, 2011.
3. J. Larminie and J. Lowry, "Electric vehicle technology explained", John Willey & Son ltd., 2nd Edition, 2012.
4. I. Husain, "Electric and hybrid vehicles: Design fundamentals", CRC press, 2003.

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Web References

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2. https://www.evgo.com/why-evs/types-of-electric-vehicles/
3. https://www.electrichybridvehicletechnology.com/
4. http://www.ieahev.org/
5. https://www.sae.org/learn/content/acad06/
6. https://www.intechopen.com/books/electric-vehicles-modelling-and-simulations

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	-	3	-	-	-	-	1	1	2	3
2	2	3	3	3	-	-	3	-	-	-	-	1	1	1	3
3	3	3	2	2	-	-	3	-	-	-	-	1	2	2	1
4	3	3	3	2	-	-	3	-	-	-	-	1	3	1	3
5	2	3	3	2	-	-	3	-	-	-	-	1	1	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19EEO76	ELECTRICAL ENERGY CONSERVATION AND AUDITING (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know the necessity of conservation of energy.
- To understand the energy management schemes in motors.
- To understand the energy management methods in lighting schemes.
- To illustrate the metering schemes for energy management.
- To learn economic analysis and management techniques.

Course Outcomes

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

CO1 - Outline about the energy audit process and instruments. **(K2)**
CO2 - Apply the energy efficient methods for improving efficiency of electric motors. **(K2)**
CO3 - Develop good illumination systems and analyze the power factor. **(K3)**
CO4 - Acquire knowledge on various meters used for energy management. **(K2)**
CO5 - Analyze and evaluate cost effective model in electrical equipments. **(K5)**

UNIT I INTRODUCTION (9 Hrs)

Basics of energy – need for energy management – energy accounting – energy monitoring – targeting and reporting – energy audit – definitions – types of energy audit – audit instruments – audit of process industry – Case studies.

UNIT II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION (9 Hrs)

Energy management for electric motors: energy efficient controls and starting efficiency – motor efficiency and load analysis – selection of motors – energy efficient motors. Energy management by cogeneration: forms of cogeneration – electrical interconnection.

UNIT III LIGHTING SYSTEMS (9 Hrs)

Energy management in lighting systems: task and the working space – light sources – ballasts – lighting controls – optimizing lighting energy – reactive power management – capacitor sizing – degree of compensation – capacitor losses –effect of harmonics – lighting and energy standards.

UNIT IV METERING FOR ENERGY MANAGEMENT (9 Hrs)

Metering for energy management: units of measure – utility meters – demand meters – paralleling of current transformers – instrument transformer burdens – multi tasking solid state meters – metering location vs requirements – power analyzer – metering techniques and practical examples.

UNIT V ECONOMIC ANALYSIS AND MODELS (9 Hrs)

Power system tariffs – Economic analysis: cash flow model – Time value of money – pay-back method – utility rate structures – cost of electricity – loss evaluation – load management – demand control techniques – utility monitoring and control system – economic analysis of HVAC systems.

Text Books

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", The Fairmont Press, Inc., 5th Edition, 2006.
2. Frank Kreith, D. Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press, 2nd Edition, 2016.
3. Wayne C. Turner, "Energy Management Handbook", The Fairmont Press, 4th Edition, 2001.

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1. P. Venkataseshaiah K.V. Sharma, "Energy Management and Conservation", Dreamtech Press, 1st Edition, 2020.
2. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 1st Edition, 2003.
3. ICAI, "Electricity in buildings good practice guide", McGraw-Hill Education, 1st Edition, 2017.

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5. https://ieeexplore.ieee.org/document/993185
6. https://ieeexplore.ieee.org/document/6450335

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	-	-	-	-	-	-	-	-	1	1	1	3
2	3	2	3	-	-	-	-	-	-	-	-	1	2	2	2
3	3	2	3	-	-	-	-	-	-	-	-	1	3	1	2
4	3	2	2	-	-	-	-	-	-	-	-	1	1	2	2
5	2	2	3	-	-	-	-	-	-	-	-	1	1	1	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VELMURUGAN)

U19ECO75	IOT AND ITS APPLICATIONS (Common to EEE, ICE, CSE, MECH, IT, CIVIL)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart necessary and practical knowledge of components of Internet of Things.
- To attain the knowledge about different types of architecture and their elements of IoT.
- To understand the concepts of integration of devices and data's.
- To acquire the knowledge about remotely monitor data and control devices.
- To develop skills required to build real-time IoT based projects.

Course Outcomes

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

CO1 - Understand internet of Things and its hardware and software components. **(K2)**
CO2 - Demonstrate the Interfacing of I/O devices, sensors & communication modules. **(K3)**
CO3 - Understand the concepts of remotely monitor data and control devices. **(K2)**
CO4 - Build and deploy an various architecture with their elements. **(K3)**
CO5 - Can develop real time IoT based projects. **(K3)**

UNIT I INTRODUCTION TO INTERNET OF THINGS (9 Hrs)

The technology of the internet of things, making the internet of things, Elements of an IoT ecosystem, design principles for connected devices, Web thinking for connected devices.

UNIT II ARCHITECTURE OF IoT (9 Hrs)

Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

UNIT III ELEMENTS OF IoT (9 Hrs)

Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT IV IoT APPLICATION DEVELOPMENT (9 Hrs)

Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices

UNIT V IoT APPLICATIONS (9 Hrs)

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in Business to Master IoT, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Text Books

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things, A Hands on Approach", University Press, 3rd/e, Aug 2018.
2. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill ISBN: 9789352605224, 9789352605224, 2nd edition, May 2017
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2014

Reference Books

1. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2012
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2007
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013
4. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media, 2015

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5. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

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1. https://www.i-scoop.eu/internet-of-things-guide/
2. https://www.theinternetofthings.eu/
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	2	-	-	-	-	-	-	-	-	1	2	3
2	3	-	3	2	-	-	-	-	-	-	-	-	3	2	3
3	2	3	2	-	-	-	-	-	-	-	-	-	3	2	3
4	2	2	2	-	-	-	-	-	-	-	3	-	3	2	3
5	2	3	2	-	3	-	-	-	-	-	3	-	1	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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(R. VELMURUGAN)

U19ECO76	SENSORS FOR INDUSTRIAL APPLICATIONS (Common to EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study principles of sensor and calibration
- To understand different types of motion sensors
- To demonstrate force, magnetic and heading sensors with its application to the learners
- To enhance students to understand the concept of optical, pressure and temperature sensor
- To select suitable sensor for industrial application

Course Outcomes

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

CO1 - Explain principles of sensor and illustrate the calibration **(K2)**
CO2 - Demonstrate different types of range and sensors **(K3)**
CO3 - Determine the principles of Force, magnetic and heading sensors **(K3)**
CO4 - Describe different optical and thermal sensors **(K2)**
CO5 - Select suitable sensor for real time applications **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Principles of Physical and Chemical Sensors: Sensor classification, Sensing mechanism of Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological Sensors. Sensor Characterization and Calibration: Study of Static and Dynamic Characteristics, Sensor reliability, aging test, failure mechanisms and their evaluation and stability study.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS (9 Hrs)

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS (9 Hrs)

Strain Gage, Load Cell and Magnetic Sensors – types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS (9 Hrs)

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement. Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V APPLICATIONS OF SENSORS (9 Hrs)

Applications of Sensors for Industry Automation - Design of smart Industry using Temperature, Humidity and Pressure sensors - Applications of Flow sensors in Industries-Applications of Gyro sensor. Applications of Position sensors.

Text Books

1. Patranabis D.," Sensor and Actuators", Prentice Hall of India (Pvt) Ltd., second edition, 2005. (revised)
2. Renganathan S.," Transducer Engineering", Allied Publishers (P) Ltd., 2005. (revised)
3. Ernest O. Doebelin, "Measurement systems Application and Design", International Student Edition, VI Edition, Tata McGraw-Hill Book Company, 2012.

Reference Books

1. Kr.Iniewski, "Smart Sensors for Industrial Applications" ,CRC Press ,2017
2. Bolton W, "Mechatronics", Thomson Press, third edition, 2004.
3. Ian R Sinclair, Sensors and Transducers, Third Edition, Newnes publishers, 2001.
4. Robert B. Northrop, "Introduction to Instrumentation and Measurement", 3rd Edition", CRC – Press – Taylor and Francis Group, 2005
5. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall International Edition, 2015.

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2. https://www.finoit.com/blog/top-15-sensor-types-used-iot/
3. https://www.iaasiaonline.com/smart-sensors-for-industrial-applications-2/
4. https://www.plantautomation-technology.com/articles/types-of-sensors-used-in-industrial-automation
5. https://www.thomasnet.com/articles/instruments-controls/sensors/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	-	-	-	-	-	-	1	1	2	3
2	3	-	3	-	-	-	-	-	-	-	-	1	3	2	3
3	2	2	3	-	-	-	1	-	-	-	-	-	3	2	3
4	2	2	3	-	-	-	1	-	-	-	-	1	3	2	3
5	2	2	3	-	-	-	1	-	-	-	-	1	1	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19CSO76

ARTIFICIAL INTELLIGENCE

(Common to EEE, ICE, CIVIL, MECH,CCE, FT)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To cover fundamentals of Artificial Intelligence,
- To understand various knowledge representation techniques.
- To provide knowledge of AI systems and its variants
- To understand the planning and different learning.
- To understand the communication process of language translator.

Course Outcomes

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

CO1 - Understand the basics of Artificial Intelligence. (K1)

CO2 - Apply AI problem solving techniques, knowledge representation, and reasoning methods in Knowledge based systems (K3)

CO3 - Develop simple intelligent / expert system using available tools and techniques of AI to analyze and interpret domain knowledge. (K3)

CO4 - Become familiar with planning and different learning methods. **(K3)**

CO5 - Understanding the human language to Machine language and Robotics. **(K1)**

UNIT I INTRODUCTION (9 Hrs)

Introduction - Foundations of AI - History of AI - Structure of AI agents, Problem solving - Informed and uninformed search techniques.

UNIT II KNOWLEDGE REPRESENTATION AND REASONING (9 Hrs)

Logical Agents - Propositional logic - First-Order Logic - Forward and backward chaining - Knowledge Representation

UNIT III UNCERTAIN KNOWLEDGE AND REASONING (9 Hrs)

Basic probability notations - Bayes rule – Wumpus world revisited - Bayesian network.

UNIT IV PLANNING AND LEARNING (9 Hrs)

Introduction to planning, Planning in situational calculus - Representation for planning – Partial order planning algorithm- Learning from examples- Knowledge in Learning - Statistical Learning Methods - Reinforcement Learning

UNIT V COMMUNICATING, PERCEIVING AND ACTING (9 Hrs)

Natural Language Processing - Natural Language for communication - Perception - Robotics

Text Books

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill2008.
2. Stuart Russel, Peter Norvig "AI - A Modern Approach", 2nd Edition, Pearson Education 2007.
3. Patrick Henry Winston," Artificial Intelligence", Addison Wesley, Books Third edition, 2000.

Reference Books

1. George F Luger, Artificial Intelligence, Pearson Education, 6th edition, 2009.
2. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
3. EngeneCharniak and Drew Mc Dermott," Introduction to Artificial intelligence, Addison Wesley 2000.
4. Patrick Henry Winston," Artificial Intelligence", Addison Wesley, Books Third edition, 2000.
5. Nils J. Nilsson,"Principles of Artificial Intelligence", Narosa Publishing House, 2000.

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2. https://www.javatpoint.com/artificial-intelligence-tutorial
3. https://www.w3schools.com/ai/
4. https://www.mygreatlearning.com/blog/artificial-intelligence-tutorial/
5. https://nptel.ac.in/courses/112/103/112103280/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	3	3	3	3	3	3	-	-	3	-	3	3	3
2	2	2	2	2	-	2	-	2	-	2	-	2	2	2	-
3	3	3	3	3	3	3	3	3	-	-	3	-	3	3	3
4	2	2	2	2	-	2	-	2	-	2	-	2	2	2	-
5	2	2	2	2	-	2	-	2	-	2	-	2	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19CSO77	CLOUD TECHNOLOGY AND ITS APPLICATIONS (Common to EEE, ICE, MECH, CIVIL, BME, CCE, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To define the fundamental ideas behind Cloud Computing.
- To classify the basic ideas and principles in cloud information system.
- To relate cloud storage technologies and relevant distributed file systems.
- To explain the Cloud Applications.
- To define the Future of Cloud.

Course Outcomes

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

CO1 - Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing. **(K1)**

CO2 - Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacentres to build and deploy cloud applications that are resilient, elastic and cost-efficient. **(K3)**

CO3 - Illustrate the fundamental concepts of Cloud Applications. **(K4)**

CO4 - Explain the Applications of cloud. **(K3)**

CO5 - Advancing towards a Cloud. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Server Virtualization - Web Services Deliver from the Cloud – Communication-as-a-Service – Infrastructure-as-a-Service – Monitoring-as-a-Service – Platform-as-a-Service – Software-as-a-Service – Building Cloud Network.

UNIT II CLOUD INFORMATION SYSTEMS (9 Hrs)

Federation in the Cloud - Presence in the Cloud - Privacy and its Relation to Cloud-Based Information Systems – Security in the Cloud - Common Standards in the Cloud – End-User Access to the Cloud Computing.

UNIT III CLOUD INFRASTRUCTURE (9 Hrs)

Introduction – Evolving IT infrastructure – Evolving Software Applications –Service Oriented Architecture – Interoperability Standards for Data Center Management - Virtualization – Hyper Threading – Blade Servers - Automated Provisioning - Policy Based Automation – Application Management – Evaluating Utility Management Technology - Virtual Test and development Environment.

UNIT IV CLOUD APPLICATIONS (9 Hrs)

Software Utility Application Architecture - Characteristics of a SaaS - Software Utility Applications - Cost Versus Value - Software Application Services Framework - Common Enablers – Conceptual view to Reality – Business Profits - Implementing Database Systems for Multitenant Architecture - Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

UNIT V FUTURE OF CLOUD (9 Hrs)

Other Design Considerations - Design of a Web Services Metering Interface - Application Monitoring Implementation - A Design for an Update and Notification Policy - Transforming to Software as a Service - Application Transformation Program - Business Model Scenarios - Virtual Services for Organizations - The Future.

Text Books

1. Sandeep Bhowmik, & quot; Cloud Computing & quot; Cambridge University Press; First edition, 2017.
2. Erl ,'Cloud Computing: Concepts, Technology & Architecture', Pearson Education India, 1st edition, 1 January 2014.
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

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1. Sanjiva Shankar Dubey,' Cloud Computing and Beyond', Dreamtech Press 2nd edition, 2019.
2. John W. Rittinghouse and James F. Ransome, "Cloud Computing Implementation, Management and Security", CRC Press, Taylor & Francis Group, Boca Raton London New York, 2010.
3. George Reese, "Cloud Application Architectures", O'reilly Publications, 2009.
4. Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC, 2007.
5. Bunker and Darren Thomson, "Delivering Utility Computing", John Wiley & Sons Ltd.2006.

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3. https://www.cloudbakers.com/blog/what-is-a-cloud-application
4. https://www.cloudbakers.com/blog/what-is-a-cloud-application
5. https://blog.servermania.com/what-is-a-cloud-application/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	1	-	2	1	3	1	2	3	2
2	1	1	2	1	1	3	1	-	2	1	3	1	3	3	2
3	2	2	1	1	-	3	1	1	2	1	3	1	3	3	3
4	1	1	1	1	2	2	1	-	2	1	3	1	2	2	2
5	2	1	1	1	1	3	1	-	2	1	3	1	2	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ITO76	AUTOMATION TECHNIQUES & TOOLS - DEVOPS (Common to EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- The Background and mindset of Devops
- To enable students appreciate the agile led development environment.
- To give the students a perspective to grasp the need for Minimum viable product led development using Sprints.
- To enable students acquire fundamental knowledge of CI/CD and CAMS.
- To enable learners realize various aspects of DevOps Ecosystem.

Course Outcomes

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

CO1 - Explain traditional software development methodologies like waterfall. **(K2)**
CO2 - Apply the Agile Methodology and comparing various other software development models with agile. **(K3)**
CO3 - Explain implementing Continuous Integration and Continuous Delivery. **(K2)**
CO4 - Explain CAMS for DevOps (Culture, Automation, Measurement and Sharing). **(K2)**
CO5 - Create quick MVP prototypes for modules and functionalities. **(K3)**

UNIT I TRADITIONAL SOFTWARE DEVELOPMENT (9 Hrs)

The Advent of Software Engineering - Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation - Developers vs IT Operations conflict.

UNIT II RISE OF AGILE METHODOLOGIES (9 Hrs)

Agile movement in 2000 - Agile Vs Waterfall Method - Iterative Agile Software Development - Individual and team interactions over processes and tools - Working software over comprehensive documentation - Customer collaboration over contract negotiation - Responding to change over following a plan

UNIT III INTRODUCTION DEVOPS (9 Hrs)

Introduction to DevOps - Version control - Automated testing - Continuous integration - Continuous delivery - Deployment pipeline - Infrastructure management – Databases

UNIT IV PURPOSE OF DEVOPS (9 Hrs)

Minimum Viable Product- Application Deployment- Continuous Integration- Continuous Delivery

UNIT V CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING) (9 Hrs)

CAMS – Culture, CAMS – Automation, CAMS – Measurement, CAMS – Sharing, Test-Driven Development, Configuration Management-Infrastructure Automation- Root Cause Analysis- Blamelessness- Organizational Learning

Text Books

1. Dev Ops – Volume 1 , Pearson and Xebia Press
2. Grig Gheorghiu, Alfredo Deza, Kennedy Behrman, Noah Gift, Python for DevOps,2019

Reference Books

1. The DevOps Handbook - Book by Gene Kim, Jez Humble, Patrick Debois, and Willis Willis
2. What is DevOps? - by Mike Loukides
3. Joakim Verona, Practical DevOps, 2016.

Web References

1. https://www.pinkelephant.com/en-CA/Course/DevOps-Essentials
2. https://www.edureka.co/devops-certification-training
3. https://devopsinstitute.com/certifications/devops-foundation/
4. https://www.softed.com/course/foundation-of-devops

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
2	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
3	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ITO77	AUGMENTED AND VIRTUAL REALITY (Common to EEE, ICE, MECH, CIVIL, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn basics of VR and AR systems
- To know about basic Augment reality functions
- To know about basic Virtual reality functions
- To know about Virtual reality environment and steps to work on it
- To learn various application on AR and VR

Course Outcomes

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

CO1 - Understand the concepts of VR **(K2)**
CO2 - Summarize different VR modelling Process **(K2)**
CO3 - Identify applications of virtual reality environment **(K2)**
CO4 - Explore and work on Augmented Reality environment **(K2)**
CO5 - Illustrate applications related to VR and AR **(K3)**

UNIT I VIRTUAL REALITY AND 3D COMPUTER GRAPHICS (9 Hrs)

Introduction - Benefits of virtual reality - The Virtual world space – Positioning the virtual observer – Stereo perspective projection – 3D clipping – Color Theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms

UNIT II VR MODELLING PROCESS (9 Hrs)

Geometric modeling – kinematics modeling- physical modeling – behaviour modeling – model Management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR (9 Hrs)

Methodology and terminology - user performance studies - VR health and safety issues – Usability of virtual reality system - cyber sickness -side effects of exposures to virtual reality environment

UNIT IV AUGMENTED REALITY (AR) (9 Hrs)

Introduction – Benefits of AR – Key players of AR technology - Understanding Augmented reality - Working with AR and System structure

UNIT V APPLICATIONS ON VR (9 Hrs)

Medical applications- robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations

Text Books

1. Kelly S. Hale, Kay M. Stanney," Handbook of Virtual Environments: Design, Implementation, and Applications", Human Factors and Ergonomics, Second Edition, 2014.
2. C. Burdea and Philippe Coiffet, "Virtual Reality Technology", Gregory, John Wiley and Sons, Inc., Second Edition, 2008.
3. Jason Jerald,"The VR Book: Human-Centred Design for Virtual Reality". Association for Computing Machinery and Morgan and Claypool, New York, 2015.

Reference Books

1. Dieter Schmalstieg and Tobias Hollerer , "Augmented Reality: Principles and Practice (Usability)" , Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
2. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", Addison-Wesley Professional; 1 edition, 2016.
3. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", OReilly Media, 1st edition, 2015.
4. Tony Parisi,"Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages", OReilly Media, 1st edition, 2014.

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2. https://nptel.ac.in/courses/106/106/106106138/
3. http://www.vrmedia.it/en/xvr.html
4. http://www.hitl.washington.edu/artoolkit/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	2	-	2	1	2	3
2	2	1	-	-	2	-	-	-	-	2	-	2	1	2	3
3	2	1	-	-	2	-	-	-	-	2	-	2	1	2	3
4	2	1	-	-	2	-	-	-	-	2	-	2	1	2	3
5	2	1	-	-	2	-	-	-	-	2	-	2	2	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ICO75	INDUSTRIAL AUTOMATION	L	T	P	C	Hrs
	(Common to EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To know about the design of a system using PLC.
- To study about PLC Programming
- To study knowledge on application of PLC
- To have an exposure SCADA architecture
- To know about the fundamentals of DCS.

Course Outcomes

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

CO1 - Know the fundamentals of data networks and Understand working of PLC,I/O modules of PLC, automation and applications in industry. **(K1)**
CO2 - Know about the design of systems using PLC and PLC programming. **(K3)**
CO3 - Acquire knowledge on application of PLC **(K3)**
CO4 - Know about the SCADA architecture, communication in SCADA, develop any application based on SCADA along with GUI using SCADA software. **(K3)**
CO5 - Know the fundamentals of DCS. **(K1)**

UNIT I PLC ARCHITECTURE (9 Hrs)

Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic- Application of PLC.

UNIT II PLC PROGRAMMING (9 Hrs)

Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.

UNIT III APPLICATION OF PLC (9 Hrs)

Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

UNIT IV INTRODUCTION OF SCADA (9 Hrs)

Introduction to DCS and SCADA - Block diagram – function of each component – Security objective – Operation and engineering station interface – Communication requirements.

UNIT V DISTRIBUTED CONTROL SYSTEM (9 Hrs)

Development of different control block using DCS simulation software – Real time control of test rigs using DCS. Introduction to HART, Field bus and PROFIBUS – Application and case studies of large scale process control using DCS.

Text Books

1. John W. Webb and Ronald A Reis, Programmable Logic Controllers - Principles and Applications, Prentice Hall Inc., New Jersey, 5th Edition, 2002.
2. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.
3. Frank D. Petruzella, Programmable Logic Controllers, McGraw Hill, New York, 4th Edition, 2010.

Reference Books

1. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi, 8th Edition, 2005.
3. Krishna Kant, Computer-based Industrial Control, Prentice Hall, New Delhi, 2 nd Edition, 2011.

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1. https://nptel.ac.in/courses/108105063/
2. https://www.google.com/amp/s/controlstation.com/what-is-a-distributed-control-system/amp/
3. https://nptel.ac.in/courses/108/105/108105088/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	-	-	1	-	-	-	1	1	2	3	3	2
2	3	3	1	-	-	1	-	-	-	1	1	2	3	3	2
3	3	2	1	-	-	1	-	-	-	1	1	2	3	3	2
4	2	3	1	-	-	1	-	-	-	1	1	2	3	3	2
5	3	2	1	-	-	1	-	-	-	1	1	3	3	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19ICO76

ULTRASONIC INSTRUMENTATION

(Common to EEE, ECE, MECH, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To know about the ultrasonic waves characteristics
- To study about ultrasonic wave generation
- To study knowledge on ultrasonic test methods
- To have an exposure on ultrasonic measurements
- To explore the ultrasonic applications

Course Outcomes

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

CO1 - Know the fundamentals of ultrasonic characteristics **(K1)**

CO2 - Know about the generation of ultrasonic generation **(K1)**

CO3 - Acquire knowledge on ultrasonic test methods **(K1, K2)**

CO4 - Know about the ultrasonic density **(K1)**

CO5 - Explore knowledge on ultrasonic applications **(K3)**

UNIT I ULTRASONIC WAVES CHARACTERISTICS (9 Hrs)

Ultrasonic waves: principle and propagation of various waves, characterization of ultrasonic transmission, reflection and transmission coefficients, intensity and attenuation of sounds beam .power level, medium parameters.

UNIT II ULTRASONIC WAVE GENERATION (9 Hrs)

Generation of ultrasonic waves: magnetostrictive and piezoelectric effects, search unit types, construction and characteristics

UNIT III ULTRASONIC TEST METHODS (9 Hrs)

Ultrasonic test methods: pulse echo, transit time, resonance, direct contact and immersion type and ultrasonic methods of flaw detection.

UNIT IV ULTRASONIC MEASUREMENTS (9 Hrs)

Ultrasonic measurements: ultrasonic methods of measuring thickness, depth and flow, variables affecting ultrasonic testing in various applications.

UNIT V ULTRASONIC APPLICATIONS (9 Hrs)

Ultrasonic applications: ultrasonic applications in medical diagnosis and therapy, acoustical holography.

Text Books

1. J.David N. Cheeke, Fundamentals and Applications of Ultrasonic Waves, CRC Press, 2002.
2. Dale Ensminger, Ultrasonic: Fundamentals, Technology, Applications, CRC press, Second Edition, 1988.

Reference Books

1. Baldev Raj, Palanichamy P., Rajendran. V, Science And Technology Of Ultrasonic, Alpha Science, 2004
2. Emmanuel P. Papadakis, Ultrasonic Instruments and Devices, ASA, 1998

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2. https://nptel.ac.in/courses/108/105/108105064/
3. https://www.ti.com/lit/an/slaa907c/slaa907c.pdf?ts=1630072911996&ref_url=https%253A%252F%252F www.google.com%252F
4. https://pocketdentistry.com/6-ultrasonic-instrumentation-technique/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	1	1	-	-	-	-	1	-	2	2	1	-
2	3	1	-	1	1	-	-	-	-	1	-	2	2	1	-
3	3	1	-	1	1	-	-	-	-	1	-	2	2	1	-
4	2	1	-	1	1	-	-	-	-	1	-	2	2	1	-
5	3	1	-	2	1	-	2	-	-	1	-	3	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R. VELMURUGAN)

U19CEO75

ENERGY EFFICIENT BUILDINGS

(Common to EEE, ECE, MECH)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the concept of energy consumption of building
- Aware about the various energy efficiency implementation
- Understand the measurements available to indicate energy efficiency
- Understand the investment in energy efficiency
- Understand the audit and management of energy

Course Outcomes

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

CO1 - Assess the energy consumption of buildings. **(K2)**
CO2 - Choose suitable energy efficiency implementation **(K2)**
CO3 - Identify the measurements available to indicate energy efficiency **(K2)**
CO4 - Apply the investment in energy efficiency **(K3)**
CO5 - Select the audit and apply it for management of energy **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Energy consumption of building, Energy efficiency potential in buildings, Energy efficient building design (procedure), Energy efficient building technologies, energy efficient materials, certification of energy efficient building, cooling comfort in hot climates

UNIT II ENERGY EFFICIENCY IMPLEMENTION (9 Hrs)

Energy efficiency policies, Target setting and stakeholder engagement, Various building codes and standards, Energy efficient building operation, Passive solar, Natural ventilation, Day lighting of building

UNIT III ENERGY EFFICIENCY MEASUREMENT (9 Hrs)

Data and energy efficiency indicators, Evaluation of energy efficiency, The multiple benefits of energy efficiency. Electrical Energy Measurements, Thermal Energy Measurements, Mechanical & Utility System Measurements, Measurement & Verification. Case studies.

UNIT IV ENERGY EFFICIENCY INVESTMENT (9 Hrs)

Energy efficiency investment – through policy, through project standardization, through procurement, through funding, finance and fiscal instruments, through energy markets. Case studies with cutting edge of sustainable construction.

UNIT V ENERGY AUDIT AND MANAGEMENT (9 Hrs)

Definition, energy audit, need, types of energy audit, energy management (audit) approach - understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering, precautions, smart metering.

Text Books

1. Ana-Maria Dabija, "Energy Efficient Building Design", Springer Nature, 2020
2. Dean Hawkes and Wayne Forster, "Energy Efficient Buildings", W.W. Norton & Company, 2002
3. Amritanshu Shukla, Atul Sharma, "Sustainability Through Energy-Efficient Buildings", CRC Press, 2018.
4. Ursula Eicker, "Energy Efficient Buildings with Solar and Geothermal Resources", John Wiley & Sons, 2014.
5. Jacob J. Lamb and Bruno Georges Pollet, "Energy-Smart Buildings: Design, Construction and Monitoring of Buildings for Improved Energy Efficiency", Institute of Physics Publishing, 2020

Reference Books

1. Umberto Desideri, Francesco Asdrubali, "Handbook of Energy Efficiency in Buildings: A Life Cycle Approach", Butterworth-Heinemann, 2019.
2. Susan Roaf and Mary Hancock, "Energy Efficient Building: A Design Guide", Wiley, 1992

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3. Xiaoqiang Zhai and Ruzhu Wang, "Handbook of Energy Systems in Green Buildings", Springer Berlin Heidelberg, 2018
4. Roberto Gonzalo, "Energy-efficient architecture", Walter de Gruyter, 2012
5. José Manuel Andújar and Sergio Gómez Melgar, "Energy Efficiency in Buildings: Both New and Rehabilitated", MDPI, 2020

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1. https://nptel.ac.in/courses/105/102/105102175/
2. https://nptel.ac.in/courses/105/102/105102195/
3. https://alison.com/course/sustainable-architecture-energy-efficiency-and-quality

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	1	3	3	3	3	3	3	3	1	2	2
2	2	1	1	1	1	3	3	3	3	3	3	3	3	2	2
3	2	1	1	1	1	3	3	3	3	3	3	3	3	1	1
4	2	1	1	1	1	3	3	3	3	3	3	3	3	2	2
5	2	1	1	1	1	3	3	3	3	3	3	3	1	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19CEO76	GLOBAL WARMING AND CLIMATE CHANGE (Common to EEE, ECE, CSE, IT, ICE, MECH, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand the basics and importance of global warming.
- Gain adequate knowledge about the characteristic of atmosphere components.
- Gain knowledge about impart of climate change.
- Gain knowledge about the Changes in Climate and Environment
- Impart knowledge about the mitigation measures

Course Outcomes

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

CO 1 - Understand the concept and effects of global warming **(K2)**
CO 2 - Understand Climate system, earth's atmosphere and its components **(K2)**
CO 3 - Analyze the Impacts of Climate Change on various sectors **(K4)**
CO 4 - Assess the concept about carbon credit and clean development mechanism **(K3)**
CO 5 - Understand climate changes, its impact and mitigation activities **(K2)**

UNIT I EARTH'S CLIMATE SYSTEM (9 Hrs)

Ozone layer - Role of ozone in environment - ozone depleting - Green House gases - Effects of Greenhouse Gases - Global Warming - Hydrological Cycle - Radiative Effects and Carbon Cycle.

UNIT II ATMOSPHERE AND ITS COMPONENTS (9 Hrs)

Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere- Vertical structure of the atmosphere - Composition of the atmosphere - Atmospheric stability - Temperature profile of the atmosphere - Lapse rates - Temperature inversion - effects of inversion on pollution dispersion.

UNIT III IMPACTS OF CLIMATE CHANGE (9 Hrs)

Causes of Climate change: Change of Temperature in the environment-Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors - Agriculture, Forestry and Ecosystem - Water Resources – Human Health-Industry, Settlement and Society - Methods and Scenarios - Projected Impacts for Different Regions - Uncertainties in the Projected Impacts of Climate Change - Risk of Irreversible Changes.

UNIT IV OBSERVED CHANGES AND ITS CAUSES (9 Hrs)

Climate change and Carbon credits - Initiatives in India - Kyoto Protocol-Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks –The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India .

UNIT V CLIMATE CHANGE AND MITIGATION MEASURES (9 Hrs)

Clean Development Mechanism - Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco - Friendly Plastic - Alternate Energy - Hydrogen - Bio-fuels - Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices - Carbon sequestration - Carbon capture and storage (CCS) – International and Regional cooperation - Remedial measures.

Text Books

1. Joan Fitzgerald "Greenovation: Urban Leadership on Climate Change, Oxford University Press, 2020.
2. J. David Neelin" Climate change and climate modelling" Cambridge University press, 2011.
3. Robin Moilveen "Fundamentals of weather and climate" Oxford University Press, 2nd Edition, 2010.
4. Andrew Dessler and Edward A. Parson "The Science and Politics of Global Climate Change" 2009.
5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

Reference Books

1. Bill McKibben, The Global Warming Reader: A Century of Writing About Climate Change, Penguin, 2012.
2. JasonSmerdon, Climate Change: The Science of Global Warming and Our Energy Future, Columbia University, 2009.

(C.K.VELMURUGAN)

3. Adaptation and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge, 2006.
4. J.M. Wallace and P.V. Hobbs, Atmospheric Science, Elsevier / Academic Press, 2006.
5. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

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1. https://nptel.ac.in/courses/105102089/
2. https://www.warmheartworldwide
3. https://nptel.ac.in/content/storage

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	3	3	3	3	3	3	3	3	3	1	2	3
2	3	3	2	3	3	3	3	3	3	2	3	3	3	2	1
3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1
4	2	3	3	2	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	3	3	1	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(R.VELMURUGAN)

U19MCO71 **BUILDING AUTOMATION** (Common to MECH, CIVIL)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Gain knowledge on Building Management System (BMS) and Automation.
- Be familiarized with various transducers and sensors in BMS.
- Be exposed on Control panel and Communication.
- Learn Fire Alarm System (FAS) and security system such as CCTV.
- Gain knowledge on Energy Management in Building Automation.

Course Outcomes

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

CO1 - Remembering current philosophy, technology, terminology, and practices used in building automation **(K1)**
CO2 - Understand different fire standards, FAS Components, FAS loops, Architectures **(K2)**
CO3 - Apply hardware and software for HVAC system **(K3)**
CO4 - Evaluate energy management system **(K3)**
CO5 - Design the new concepts materials of building automation **(K3)**

UNIT I INTRODUCTION TO BMS AND AUTOMATION (9 Hrs)

Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT II FAS AND SECURITY SYSTEMS (9 Hrs)

Fire, Fire modes – Fire Alarm Systems components: Field components, panel components – FAS Architectures – Access Components, Access control system Design - CCTV camera types and operation –camera selection criteria – CCTV Applications.

Security Systems Fundamentals: Introduction to Security Systems, Concepts. Perimeter Intrusion: Concept, Components, Technology. Security Design: Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control – DAC, MAC, RBAC.

UNIT III HVAC SYSTEM (9 Hrs)

Fundamentals: HVAC Fundamentals, Basic Processes (Heating, Cooling etc) Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms. Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heatloss. Processes: Heating Processes (Boiler, Heater), Cooling Process (Chiller), Ventilation Process (Central Fan System, AHU, Exhaust Fans), Unitary Systems (VAV, FCU).Control Theory: Instrumentation Basics, Field components & use, DDC &applications. Control Panel: HVAC Control Panel, MCC Basics, Panel Components.

UNIT IV ENERGY MANAGEMENT SYSTEM (9 Hrs)

ASHRAE Symbols Energy Management: Energy Savings concept & methods, lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples

UNIT V BUILDING MANAGEMENT SYSTEM (9 Hrs)

IBMS (HVAC, Fire & Security) project cycle, Project steps BMS.Verticals: Advantages & Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation. Advantages of BMS

Text Books

1. Gerardus Blokdyk "Intelligent Building Automation Systems The Ultimate Step-By-Step Guide "5STARCooks, 2018.
2. Phil Zito "Building Automation Systems a to Z: How to Survive in a World Full of Bas "CreateSpace Independent Publishing Platform, 2016

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Reference Books

1. Jim Sinopoli "Smart Buildings", Butterworth-Heinemann imprint of Elsevier, 2nd ed., 2010.
2. Albert Ting-Pat So, WaiLok Chan, Kluwer "Intelligent Building Systems" Academicpublisher, 3rd ed., 2012.
3. James Sinopoli "Advanced Technology for Smart Buildings" Artech House, 2016.
4. Sibanjan Das, Umit Mert Cakmak "Hands-On Automated Machine Learning: A beginner's guide to building" Packt Publishing Ltd., 2018.
5. Gerard Blokdyk "Building Automation: Quickstart Administration" CreateSpace Independent Publishing Platform, 2017.

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2. https://nptel.ac.in/courses/108/105/108105063/
3. https://swayam.gov.in/nd1_noc20_me39/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	2	1	-	-	-	-	-	-	-	3	1	2	3
2	2	3	2	1	-	-	-	-	-	-	-	3	3	2	3
3	3	3	2	1	-	-	-	-	-	-	-	3	3	1	3
4	4	3	2	1	-	-	-	-	-	-	-	3	3	1	3
5	5	3	2	1	-	-	-	-	-	-	-	3	1	1	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

(K.VELMURUGAN)

U19MCO72 **AUTOMATION IN MANUFACTURING SYSTEMS**
(Common to MECH, CIVIL)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart knowledge in the field of Automated Manufacturing system.
- To illustrate the basic concepts of automation in production lines.
- To understand the fundamentals of automation in multi station assembly machines
- Describe the importance of automated material handling and storage systems.
- To understand automated inspection principles and strategies in manufacturing.

Course Outcomes

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

CO1 - Understand the basic types, levels, strategies of automation. **(K1)**
CO2 - Understand basic components and their functions of automated production line system.**(K2)**
CO3 - Apply the quantitative analysis and assembly systems.**(K2)**
CO4 - Examine various storage system and transportation requirements of automated systems.**(K2)**
CO5 - Evaluate the process control strategy to an automated system.**(K3)**

UNIT I INTRODUCTION (9 Hrs)

Facilities - Manual work systems, worker - machine systems and automated systems. Manufacturing support systems, Automation in Production systems - Automated Manufacturing systems, Computerized manufacturing support systems, Manual labour in Production systems, Automation principles and strategies.

UNIT II AUTOMATED PRODUCTION LINES (9 Hrs)

Fundamentals - System configurations, work part transfer mechanisms, Storage buffers, and Control of the production line. Applications - Machining systems and System Design Considerations. Analysis of Transfer lines - Transfer lines with No internal parts storage, Transfer lines with internal storage buffers.

UNIT III AUTOMATED ASSEMBLY SYSTEMS (9 Hrs)

System configurations, Parts delivery at workstations and applications, quantitative analysis of assembly systems - Parts Delivery System at Workstations, Multi - Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

UNIT IV AUTOMATED MATERIAL TRANSPORT & STORAGE SYSTEMS (9 Hrs)

Automated Material Transport & Storage systems: Automated Guided Vehicle (AGV) Systems, Types and applications, Vehicle Guidance Technology, Vehicle Management and Vehicle safety. Automated Storage and Retrieval Systems (ASRS) and Carousel Storage Systems.

UNIT V AUTOMATEDINSPECTIONSYSTEMS (9 Hrs)

Quality in Design and manufacturing, inspection principles and strategies, automated inspection, contact Vison-contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

Text Books

1. Beno Benhabib Manufacturing: Design, Production, Automation, and Integration, CRC Press, 2009.
2. R. Thomas Wright, Mich+ael Berkeihiser, 'Manufacturing and Automation Technology', 2011.
3. Mikell P. Groover, 'Automation, Production Systems and Computer-Integrated Manufacturing', Pearson Publisher, Fourth Edition, 2016.

Reference Books

1. P. Radhakrishnan, S. Subramanyan andV. Raju, 'CAD/CAM/CIM', New Age International (P) Ltd., New Delhi, 2009.
2. S.R.Deband Sankha Deb, 'Robotics Technology and Flexible Automation', TataMcGrawHill, Second Edition, NewDelhi, 2010.
3. Peter Corke, 'Robotics, Vision and Control: Fundamental Algorithms in MATLAB', Springer, 2011.

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4. Nicholas Odrey, Mikell P Groover, Roger Nagel, Ashish Dutta, 'Industrial Robotics (SIE): Technology, Programming and Applications', McGraw Hill, 2012.
5. Caustic Kumar (Editor), Divya Zindani (Editor), J. Paulo Davim,' Digital Manufacturing and Assembly Systems in Industry 4.0', CRC Press, 2021

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5. https://nptel.ac.in/courses/112/102/112102011/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3
2	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3
3	3	2	1	-	-	-	-	-	-	-	3	2	3	1	3
4	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3
5	3	2	1	-	-	-	-	-	-	-	3	2	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

Divya
(R.VELMURUGAN)

U19CCO75	DATA SCIENCE USING PYTHON (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concepts of Real world data science and Python.
- To learn the OOPs concepts with data science.
- To understand the NumPy operations with data science.
- To learn the data manipulation with Pandas.
- To clean, prepare and visualize with real data science.

Course Outcomes

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

CO1 - Infer the Real world data science and and solve basic problems using Python. **(K2)**
CO2 - Design an application with user-defined modules and packages using OOP concept. **(K2)**
CO3 - Employ efficient storage and data operations using NumPy arrays. **(K2)**
CO4 - Apply powerful data manipulations using Pandas. **(K3)**
CO5 - Do data preprocessing using Pandas. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE AND PYTHON **(9 Hrs)**

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators.
Decision Making- Looping- Loop Control statement - Math and Random number functions. User defined functions - function arguments & its types.

UNIT II FILE, EXCEPTION HANDLING AND OOP **(9 Hrs)**

User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods- Python Exception Handling. OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

UNIT III INTRODUCTION TO NUMPY **(9 Hrs)**

NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays - Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods- Sorting Unique and Other Set Logic.

UNIT IV DATA MANIPULATION WITH PANDAS **(9 Hrs)**

Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking.

UNIT V DATA CLEANING AND PREPARATION **(9 Hrs)**

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers - String.
Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Text Books

1. Y. Daniel Liang, "Introduction to Programming using Python", Pearson, 2012.
2. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly, 2nd Edition, 2018.
3. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.

Reference Books

1. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2006.
2. Mark Lutz, "Learning Python", O'Reilly, 4th Edition, 2009.
3. Steven S. Skiena, "Data Science Design Manual", Spring International Publication, 2017.

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4. RajendraAkerkar, PritiSrinivasSajja, "Intelligence Techniques for Data Science", Spring International Publication, 2016.
5. Longbing Cao "Data Science Thinking: The Next Scientific, Technological and Economic Revolution", Spring International Publication, 2018.

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2. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3. http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf
4. https://www.edx.org/course/python-basics-for-data-science
5. https://www.edx.org/course/analyzing-data-with-python

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	1	-	-	-	-	-	-	3	1	2	3
2	2	2	2	2	2	-	-	-	-	-	-	3	3	2	3
3	2	2	2	2		-	-	-	-	-	-	3	3	2	3
4	3	3	3	3	3	-	-	-	-	-	-	3	3	2	3
5	3	2	2	2	2	-	-	-	-	-	-	3	1	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CCO76	MOBILE APPLICATIONS DEVELOPMENT USING ANDROID (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

Course Outcomes

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

CO1- Describe the requirements for mobile applications **(K2)**
CO2- Explain the challenges in mobile application design and development **(K3)**
CO3- Develop design for mobile applications for specific requirements **(K3)**
CO4- Implement the design using Android SDK. **(K2)**
CO5- Implement the design using Objective C and iOS. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications

UNIT II BASIC DESIGN (9 Hrs)

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – user interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN (9 Hrs)

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV ANDROID (9 Hrs)

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V IOS (9 Hrs)

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

Text Books

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd edition 2011.
2. Charlie Collins, Michael D. Galpin, Matthias Käppler, "Android in Practise", Manning Publications Co., 1st edition, 2012.
3. Jeff McWherter, Scott Gowell, "Professional Mobile Application Development", John Wiley & Sons, Inc., 2012.

Reference Books

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
2. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012
3. James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012
4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the

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iOS SDK", Apress, 2013.
5. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd.

Web Reference

1. http://developer.android.com/develop/index.html
2. http://developer.android.com/reference/
3. https://www.udacity.com/course/developing-android-appsfundamentals--ud853-nd

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	2	3	-	-	-	3	2	2	1	2	3
2	3	2	3	2	2	3	-	-	-	3	2	2	3	2	3
3	3	2	3	2	2	3	-	-	-	3	2	2	3	2	3
4	3	2	3	2	2	3	-	-	-	3	2	2	3	2	3
5	3	2	3	2	2	3	-	-	-	3	2	2	1	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19AD073	DATA SCIENCE APPLICATION OF NLP (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts and techniques of Natural language Processing(NLP)
- To analyzing words based on Text processing.
- To analyzing words based on Morphology.
- To examine the syntax and language modeling
- To get acquainted with syntax and semantics

Course Outcomes

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

CO1 - Understand the principles and process the Human Languages such as English using computers. **(K2)**
CO2 - Creating CORPUS linguistics based on digestive approach (Text Corpus method). **(K3)**
CO3 - Demonstrate the techniques for text-based Processing of NLP with respect to morphology. **(K3)**
CO4 - Perform POS tagging for a given natural language **(K2)**
CO5 - Check the syntactic and semantic correctness of sentences using grammars and labelling. **(K2)**

UNIT I INTRODUCTION TO NLP (9 Hrs)

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, and machine translation

UNIT II TEXT PROCESSING (9 Hrs)

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.

UNIT III MORPHOLOGY (9 Hrs)

Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers.

UNIT IV LEXICAL SYNTAX AND LANGUAGE MODELING (9 Hrs)

Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions - The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

UNIT V SYNTAX AND SEMANTICS (9 Hrs)

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense. Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Applications of NLP.

Text Books

1. Dan Jurafsky, James H. Martin, "Speech and Language Processing", Third Edition, Prentice Hall, 2018.
2. Emily Bender, "Linguistics Fundamentals for NLP", Morgan Claypool Publishers, 2013.
3. Jacob Eisenstein, "Introduction to Natural Language Processing", MIT Press, 2019.

Reference Books

1. Chris Manning, Hinrich Schuetze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
2. Cole Howard, Hobson Lane, Hannes Hapke, "Natural Language Processing in Action" Manning Publication 2019.
3. Li Deng, Yang Liu "Deep Learning in Natural Language Processing" Springer, 2018.
4. Tom Hoobyar, Tom Dotz, Susan Sanders, "NLP The Essential Guide to Neuro-Linguistic Programming", William Morrow Paperbacks, 2013.
5. Kate Burton, "Coaching With NLP For Dummies", Wiley, 2011.

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Web References

1. https://machinelearningmastery.com/natural-language-processing/
2. https://towardsdatascience.com/your-guide-to-natural-language-processing-nlp-48ea2511f6e1
3. https://www.nlp.com/what-is-nlp/

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	–	1	-	-	-	-	-	-	-	2	1	-
2	2	2	1	–	–	-	-	-	-	-	-	-	1	1	1
3	2	2	1	2	–	-	-	-	-	-	-	-	-	1	1
4	1	2	2	2	1	-	-	-	-	-	-	-	1	-	2
5	2	1	2	2	1	-	-	-	-	-	-	-	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19ADO74 **ARTIFICIAL INTELLIGENCE APPLICATIONS** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study the basic design concept of AI.
- To understand the Machine learning concepts.
- To learn the concept of Deep learning and its applications
- To learn the concept of RPA.
- To acquire the skill to design a chatbot using NLP.

Course Outcomes

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

CO1 - Apply the concept of data science. **(K3)**
CO2 - Understand the concept of Machine learning. **(K2)**
CO3 - Understand the concept of Deep Learning. **(K2)**
CO4 - Apply the design ideas in RPA. **(K3)**
CO5 - Make use of NLP concepts to create chatbot. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introduction – Alan Turing and Turing test - The rise and fall of expert system - technological drivers of modern AI - Structure of AI - Data: types of Data - Big Data - Database and other tools - Data Process - Ethics and Governance - Data terms.

UNIT II MACHINE LEARNING (9 Hrs)

Machine learning - Standard deviation - the normal distribution - Naive Bayes Classifier - K-Nearest Neighbor - Linear regression - K-Means Clustering.

UNIT III DEEP LEARNING (9 Hrs)

Deep Learning - Difference between Deep Learning and Machine learning – ANN – Backpropagation – RNN – CNN – GAN - Deep Learning Applications - Use Case: detecting Alzheimer's Disease - Deep Learning Hardware - When to use Deep Leaning? - Drawbacks of deep learning.

UNIT IV ROBOTIC PROCESS AUTOMATION (9 Hrs)

RPA - pros and cons of RPA - Determine the right function to automate - assess the processes - RAP and AI - RPA in the real world.

UNIT V NATURAL LANGUAGE PROCESSING (9 Hrs)

Challenges of NLP - Understanding How AI translated Language - NLP in real World - Voice Commerce - Virtual assistants – Chatbot - Future of NLP - The Future of AI.

Text Books

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing" Third Edition. 2000.
2. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, "Artificial Intelligence (AI) Recent Trends and Applications" CRC Press, 2021.
3. Navin Sabharwal; Amit Agrawal, "Cognitive Virtual Assistants Using Google Dialogflow" Apress, 2020.

Reference Books

1. Durkin, J., "Expert systems Design and Development", Macmillan, 1994.
2. Peter Jackson, "Introduction to Expert Systems", Addison Wesley Longman, 1999.
3. Amir Shevat," Designing Bots: Creating Conversational Experiences" O'Reilly, 2017.
4. Anik Das and Rashid Khan,"Build Better Chatbots: A Complete Guide to Getting Started with Chatbots" Apress,2017.
5. Akhil Mittal "Getting Started with Chatbots: Learn and create your own chatbot with deep understanding of Artificial Intelligence and Machine Learning" BPB Publications, 2019

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1. https://www.javatpoint.com/application-of-ai
2. https://pytorch.org/tutorials/beginner/chatbot_tutorial.html
3. https://www.mygreatlearning.com/blog/basics-of-building-an-artificial-intelligence-chatbot/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/lecture-3-reasoning-goal-trees-and-rule-based-expert-systems/
5. http://www.umsl.edu/~joshik/msis480/chapt11.htm

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

Correlation Level: 1- Low, 2 - Medium, 3 - High

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