SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.

MECHANICAL ENGINEERING

ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM AND SYLLABI

Volume - V

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

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.

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Science (HS)	7
2	Basic Sciences(BS)	22
3	Engineering Sciences (ES)	25
4	Professional Core (PC)	71
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
Total		**164**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	-	1	1	-	3	1	1	07
2	Basic Sciences(BS)	9	3	3	3	4	-	-	-	22
3	Engineering Sciences (ES)	9	5	7	4	-	-	-	-	25
4	Professional Core (PC)	-	13	11	8	12	15	9	3	71
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	09
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	02
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**18**	**21**	**22**	**22**	**22**	**21**	**20**	**18**	**164**

**** 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	U20BST101	Engineering Mathematics – I (Calculus and Linear Algebra)	BS	2	2	0	3	25	75	100
2	U20BST106	Physics For Mechanical Engineering	BS	3	0	0	3	25	75	100
3	U20BST107	Material Science and Engineering	BS	3	0	0	3	25	75	100
4	U20EST117	Basic Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
5	U20EST119	Engineering Mechanics	ES	2	2	0	3	25	75	100
Practical										
6	U20ESP118	Basic Electrical and Electronics Engineering Lab	ES	0	0	2	1	50	50	100
7	U20ESP120	Engineering Mechanics Lab	ES	0	0	2	1	50	50	100
8	U20ESP121	Engineering Practice Lab	ES	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20MEC1XX	Certification Course - I **	EEC	0	0	4	-	100	-	100
10	U20MES101	Skill Development Course 1*	EEC	0	0	2	-	100	-	100
Mandatory Course										
11	U20MEM101	Induction Program	MC	3 Weeks			-	-	-	-
							18	475	525	1000

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST215	Engineering Mathematics - II (Multiple Integrals and Transforms)	BS	2	2	0	3	25	75	100
2	U20EST201	Programming in C	ES	3	0	0	3	25	75	100
3	U20MET201	Manufacturing Processes	PC	3	0	0	3	25	75	100
4	U20MET202	Engineering Metallurgy	PC	3	0	0	3	25	75	100
5	U20MET203	Concepts of Engineering Design	PC	3	0	0	3	25	75	100
6	U20MET204	Engineering Thermodynamics	PC	2	2	0	3	25	75	100
Practical										
7	U20ESP202	Programming in C Lab	ES	0	0	2	1	50	50	100
8	U20ESP212	Engineering Graphics using Auto CAD	ES	0	0	2	1	50	50	100
9	U20MEP201	Manufacturing Processes Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MEC2XX	Certification Course – II **	EEC	0	0	4	-	100	-	100
Mandatory Course										
11	U20MEM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	500	600	1100

 # 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 – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST320	Complex Analysis and Applications of Partial Differential Equations	BS	2	2	0	3	25	75	100
2	U20EST356	Data Structures	ES	3	0	0	3	25	75	100
3	U20EST358	Electronic Devices and Circuits	ES	3	0	0	3	25	75	100
4	U20MET305	Mechanics of Solids	PC	2	2	0	3	25	75	100
5	U20MET306	Computer Aided Design	PC	3	0	0	3	25	75	100
6	U20MET307	Fluid Mechanics and Machinery	PC	2	2	0	3	25	75	100
Practical										
7	U20HSP301	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U20ESP357	Data Structures Lab	ES	0	0	2	1	50	50	100
9	U20MEP302	Material Testing and Metallurgy Lab	PC	0	0	2	1	50	50	100
10	U20MEP303	Fluid Mechanics and Machinery Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20MEC3XX	Certification Course – III **	EEC	0	0	4	-	100	-	100
12	U20MES302	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20MEM303	Physical Education	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST433	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in JAVA	ES	3	0	0	3	25	75	100
3	U20MET408	Kinematics of Machinery	PC	2	2	0	3	25	75	100
4	U20MET409	Heat and Mass Transfer	PC	2	2	0	3	25	75	100
5	U20MEE4XX	Professional Elective - I #	PE	3	0	0	3	25	75	100
6	U20XXO4XX	Open Elective – I $	OE	3	0	0	3	25	75	100
Practical										
7	U20HSP402	General Proficiency - II	HS	0	0	2	1	50	50	100
8	U20ESP468	Programming in JAVA Lab	ES	0	0	2	1	50	50	100
9	U20MEP404	Computer Aided Machine Drawing Lab	PC	0	0	2	1	50	50	100
10	U20MEP405	Heat Transfer Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MEC4XX	Certification Course – IV**	EEC	0	0	4	-	100	-	100
12	U20MES403	Skill Development Course 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20MEM404	NSS	MC	0	0	2	-	100	-	100
							22	650	650	1300

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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	U20BST548	Numerical Methods and Statistics	BS	2	2	0	3	25	75	100
2	U20MET510	Design of Machine Elements	PC	2	2	0	3	25	75	100
3	U20MET511	Dynamics of Machinery	PC	2	2	0	3	25	75	100
4	U20MET512	Metrology and Measurement	PC	3	0	0	3	25	75	100
5	U20MEE5XX	Professional Elective – II #	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective - II $	OE	3	0	0	3	25	75	100
Practical										
7	U20BSP549	Numerical Methods Lab	BS	0	0	2	1	50	50	100
8	U20MEP506	Metrology and Measurements Lab	PC	0	0	2	1	50	50	100
9	U20MEP507	Dynamics Lab	PC	0	0	2	1	50	50	100
10	U20MEP508	CAD/CAM Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20MEC5XX	Certification Course – V **	EEC	0	0	4	-	100	-	100
12	U20MES504	Skill Development Course 4: Foreign Language/ IELTS-I	EEC	0	0	2	-	100	-	100
13	U20MES505	Skill Development Course 5: Hands-on Training in 3D Printing	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20MEM505	Indian Constitution	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	U20MET613	Thermal Engineering	PC	2	2	0	3	25	75	100
2	U20MET614	Design of Transmission Systems	PC	2	2	0	3	25	75	100
3	U20MET615	Finite Element Analysis	PC	3	0	0	3	25	75	100
4	U20MET616	Advanced Manufacturing Technology	PC	3	0	0	3	25	75	100
5	U20MEE6XX	Professional Elective – III #	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective - III $	HS	3	0	0	3	25	75	100
Practical										
7	U20MEP609	Thermal Engineering lab	PC	0	0	2	1	50	50	100
8	U20MEP610	Computational Fluid Dynamics Lab	PC	0	0	2	1	50	50	100
9	U20MEP611	Manufacturing Technology Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20MEC6XX	Certification Course – VI **	EEC	0	0	4	-	100	-	100
11	U20MES606	Skill Development Course 6: Foreign Language/ IELTS-II	EEC	0	0	2	-	100	-	100
12	U20MES607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20MES608	Skill Development Course 8: NPTEL/MOOC -I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20MEM606	Essence of Indian Traditional Knowledge	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	U20MET717	Production Planning and Cost Estimation	PC	2	2	0	3	25	75	100
2	U20MET718	Industrial Automation and Robotics	PC	3	0	0	3	25	75	100
3	U20MEE7XX	Professional Elective - IV #	PE	3	0	0	3	25	75	100
4	U20XXO7XX	Open Elective - IV $	OE	3	0	0	3	25	75	100
Practical										
5	U20HSP703	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U20MEP712	Automation and Robotics lab	PC	0	0	2	1	50	50	100
7	U20MEP713	Product Development Lab	PC	0	0	2	1	50	50	100
8	U20MEP714	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20MEW701	Project Phase - I	PW	0	0	4	2	50	50	100
10	U20MEW702	Internship / Inplant Training	PW	-	-	-	2	100	-	100
Mandatory Course										
11	U20MEM707	Professional Ethics	MC	2	0	0	-	100	-	100
							20	600	500	1100

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20MET819	Power Plant Engineering	PC	2	2	0	3	25	75	100
2	U20MEE8XX	Professional Elective – V #	PE	3	0	0	3	25	75	100
3	U20MEE8XX	Professional Elective – VI #	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP804	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U20MEW803	Project Phase - II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U20MES809	Skill Development Course 9: 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	U20MEE401	Gas Dynamics and Jet propulsion
2	U20MEE402	Geometric Tolerance and Dimensioning
3	U20MEE403	Product design and Development
4	U20MEE404	Industrial Casting Technology
5	U20MEE405	Non-Conventional Energy Sources
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE506	Turbo Machinery
2	U20MEE507	Powder Metallurgy and Surface Coating
3	U20MEE508	Green Manufacturing
4	U20MEE509	Fluid Power Automation
5	U20MEE510	IoT and Smart Manufacturing
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE611	Automobile Engineering
2	U20MEE612	Computational Fluid Dynamics
3	U20MEE613	Fuzzy Logic And Neural Networks
4	U20MEE614	Additive Manufacturing
5	U20MEE615	Energy And Climate Change
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE716	Industrial Tribology
2	U20MEE717	Advanced Welding Technology
3	U20MEE718	Artificial Intelligence and Machine Learning
4	U20MEE719	Nano Technology
5	U20MEE720	Modelling and Simulation of Manufacturing Systems
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE821	Lean Manufacturing
2	U20MEE822	Cryogenic Engineering
3	U20MEE823	Autotronics
4	U20MEE824	Optimization Techniques in Engineering Design
5	U20MEE825	Total Quality Management
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20MEE826	Composites Material
2	U20MEE827	Alternative Fuels
3	U20MEE828	Electric and Hybrid Vehicles
4	U20MEE829	Maintenance and Safety Engineering
5	U20MEE830	Non-Destructive Evaluation and Testing

ANNEXURE - II

OPEN ELECTIVE COURSES

S. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U20EEO401	Solar Photovoltaic Fundamental and applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE
2	U20EEO402	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT
3	U20ECO401	Engineering Computation with MATLAB	ECE	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics
4	U20ECO402	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT
5	U20CSO401	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U20CSO402	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U20ITO401	Database System: Design & Development	IT	EEE, ECE, ICE, CCE, BME
8	U20ITO402	R programming	IT	EEE, ECE, ICE, CCE, BME, MECH, Mechatronics
9	U20ICO401	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL, CCE, AI&DS, FT
10	U20ICO402	Industrial Safety Management	ICE	CSE, IT, MECH, CCE, AI&DS
11	U20MEO401	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
12	U20MEO402	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
13	U20MEO403	Industrial Engineering for Textile	MECH	FT
14	U20CEO401	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics, FT
15	U20CEO402	Building Science and Engineering	CIVIL	EEE, MECH, BME
16	U20BMO401	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS
17	U20BMO402	Telemedicine	BME	EEE, ECE, CSE, IT, ICE, CCE, AI&DS
18	U20CCO401	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20CCO402	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
20	U20ADO401	Knowledge Representation and Reasoning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20ADO402	Introduction to Data Science	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics

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Open Elective – II / Open Elective – III				
1	U20HSO501/ U20HSO601	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics, AI&DS**)
2	U20HSO502/ U20HSO602	Intellectual Property and Rights	MBA	
3	U20HSO503/ U20HSO603	Marketing Management and Research	MBA	
4	U20HSO504/ U20HSO604	Project Management for Engineers	MBA	
5	U20HSO505/ U20HSO605	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**)				
1	U20EEO503/ U20EEO603	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT
2	U20EEO504/ U20EEO604	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics, AI&DS
3	U20ECO503/ U20ECO603	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics
4	U20ECO504/ U20ECO604	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U20CSO503/ U20CSO603	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS
6	U20CSO504/ U20CSO604	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, FT
7	U20ITO503/ U20ITO603	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U20ITO504/ U20ITO604	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS
9	U20ICO503/ U20ICO603	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME, AI&DS
10	U20ICO504/ U20ICO604	Measurement and Instrumentation	ICE	ECE, Mechatronics
11	U20MEO504/ U20MEO604	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO505/ U20MEO605	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
13	U20CEO503/ U20CEO603	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
14	U20CEO504/ U20CEO604	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20BMO503/ U20BMO603	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics
16	U20BMO504/ U20BMO604	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , Mechatronics

17	U20CCO503/ U20CCO603	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
18	U20CCO504/ U20CCO604	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20ADO503/ U20ADO603	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE
20	U20ADO504/ U20ADO604	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20MCO501/ U20MCO601	Industrial Automation for Textile	Mechatronics	FT
Open Elective – IV (Offered in Semester VII)				
1	U20EEO705	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U20EEO706	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS
3	U20ECO705	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT
4	U20ECO706	Sensors for Industrial Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
5	U20CSO705	Artificial Intelligence	CSE	EEE, ICE, CIVIL, CCE, MECH, FT
6	U20CSO706	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, CCE, BME, Mechatronics
7	U20ITO705	Automation Techniques & Tools-DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS
9	U20ICO705	Industrial Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Ultrasonic Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U20MEO706	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO707	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U20CEO705	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U20CEO706	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20MCO702	Building Automation	Mechatronics	MECH, CIVIL
16	U20MCO703	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL

17	U20BMO705	Internet of Things for Healthcare	BME	EEE, ECE, ICE, CCE
18	U20BMO706	Telehealth Technology	BME	EEE, ECE, ICE, CCE
19	U20CCO705	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U20CCO706	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
21	U20ADO705	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics.
22	U20ADO706	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME
23	U20HSO706	Industrial Safety and Human Resource Management	MBA	FT
24	U20HSO707	Operation Research in Textile Industry	MBA	FT
25	U20HSO708	Global marketing and Sourcing Strategies	MBA	FT
26	U20HSO709	Fashion Advertising and sales promotions	MBA	FT
27	U20HSO710	Luxury Brand management	MBA	FT
28	U20HSO711	Fashion Retail Store Operations	MBA	FT

ANNEXURE-III

EMPLOYABILITY ENHANCEMENT COURSES - (A) CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20MECX01	3ds Max
2	U20MECX02	Advance Structural Analysis of Building using ETABS
3	U20MECX03	Advanced Java Programming
4	U20MECX04	Advanced Python Programming
5	U20MECX05	Analog System Lab Kit
6	U20MECX06	Android Medical App Development
7	U20MECX07	Android Programming
8	U20MECX08	ANSYS -Multiphysics
9	U20MECX09	Artificial Intelligence
10	U20MECX10	Artificial Intelligence and Edge Computing
11	U20MECX11	Artificial Intelligence in Medicines
12	U20MECX12	AutoCAD for Architecture
13	U20MECX13	AutoCAD for Civil
14	U20MECX14	AutoCAD for Electrical
15	U20MECX15	AutoCAD for Mechanical
16	U20MECX16	Azure DevOps

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17	U20MECX17	Basic Course on ePLAN
18	U20MECX18	Basic Electro Pneumatics
19	U20MECX19	Basic Hydraulics
20	U20MECX20	Bio Signal and Image Processing Development System
21	U20MECX21	Blockchain
22	U20MECX22	Bridge Analysis
23	U20MECX23	Building Analysis and Construction Management
24	U20MECX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20MECX25	CATIA
26	U20MECX26	CCNA (Routing and Switching)
27	U20MECX27	CCNA (Wireless)
28	U20MECX28	Cloud Computing
29	U20MECX29	Computer Programming for Medical Equipments
30	U20MECX30	Corel Draw
31	U20MECX31	Creo (Modeling and Simulation)
32	U20MECX32	Cyber Security
33	U20MECX33	Data Science and Data Analytics
34	U20MECX34	Data Science using Python
35	U20MECX35	Data Science using R
36	U20MECX36	Deep Learning
37	U20MECX37	Design and Documentation using ePLAN Electric P8
38	U20MECX38	Design of Biomedical Devices and Systems
39	U20MECX39	Digital Marketing
40	U20MECX40	Digital Signal Processing Development System
41	U20MECX41	DigSILENT Power Factory
42	U20MECX42	Electro Hydraulic Automation with PLC
43	U20MECX43	Embedded System using Arduino
44	U20MECX44	Embedded System using C
45	U20MECX45	Embedded System with IoT
46	U20MECX46	ePLAN Data Portal
47	U20MECX47	ePLAN Electric P8
48	U20MECX48	ePLAN Fluid
49	U20MECX49	ePLAN PPE
50	U20MECX50	Fusion 360
51	U20MECX51	Fuzzy Logic and Neural Networks
52	U20MECX52	Google Analytics
53	U20MECX53	Hydraulic Automation
54	U20MECX54	Industrial Automation
55	U20MECX55	Industry 4.0
56	U20MECX56	Internet of Things
57	U20MECX57	Introduction to C Programming

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58	U20MECX58	Introduction to C++ Programming
59	U20MECX59	IoT using Python
60	U20MECX60	Java Programming
61	U20MECX61	Machine Learning
62	U20MECX62	Machine Learning and Deep Learning
63	U20MECX63	Machine Learning for Medical Diagnosis
64	U20MECX64	Mechatronics
65	U20MECX65	Medical Robotics
66	U20MECX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20MECX67	Mobile Edge Computing
68	U20MECX68	Modeling and Visualization using Micro station
69	U20MECX69	MX Road
70	U20MECX70	Photoshop
71	U20MECX71	PLC
72	U20MECX72	Pneumatics Automation
73	U20MECX73	Project Management
74	U20MECX74	Python Programming
75	U20MECX75	Revit Architecture
76	U20MECX76	Revit Inventor
77	U20MECX77	Revit MEP
78	U20MECX78	Robotics
79	U20MECX79	Search Engine Optimization
80	U20MECX80	Software Testing
81	U20MECX81	Solar and Smart Energy System with IoT
82	U20MECX82	Solid Works
83	U20MECX83	Solid Works with Electrical Schematics
84	U20MECX84	Speech Processing
85	U20MECX85	STAAD PRO V8i
86	U20MECX86	Structural Design and Analysis using Bentley
87	U20MECX87	Total Station
88	U20MECX88	Video and Image Processing Development System
89	U20MECX89	VLSI Design
90	U20MECX90	Web Programming - I
91	U20MECX91	Web Programming - II

ANNEXURE - IV

EMPLOYABILITY ENHANCEMENT COURSES - (B) SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1	U20MES101	Skill Development Course 1: Demonstration in Civil Engineering
2	U20MES302	Skill Development Course 2 *
		1) Two wheeler Troubleshooting
		2) Troubleshooting of CNC Milling machine
		3) Troubleshooting of CNC lathe machine
3	U20MES403	Skill Development Course 3 *
		1) Four wheeler Troubleshooting
		2) Electronic Troubleshooting for Mechanical Engineers
		3) Hardware Networking
4	U20MES504	Skill Development Course 4: Foreign Language/ IELTS-I
5	U20MES505	Skill Development Course 5: Hands-on Training in 3D Printing
6	U20MES606	Skill Development Course 6: Foreign Language/ IELTS-II
7	U20MES607	Skill Development Course 7: Technical Seminar
8	U20MES608	Skill Development Course 8: NPTEL/MOOC-I
9	U20MES809	Skill Development Course 9: NPTEL/MOOC-II

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

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SEMESTER - I

U20BST101

ENGINEERING MATHEMATICS - I
CALCULUS AND LINEAR ALGEBRA

(Common to all branches except CSBS)

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To familiarize the concept of matrices.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.
- To understand the concept of partial differentiation.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus.

Course Outcomes

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

CO1 - Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix. **(K2)**
CO2 - Solve differential equations**. (K3)**
CO3 - Solve higher order differential equations. **(K3)**
CO4 - Solve different types of partial differential equation. **(K3)**
CO5 - Understand the use of vector calculus. **(K2)**

UNIT I MATRICES (12 Hrs)

Rank of a Matrix – Consistency of system of equations. Eigen values and Eigen vectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigen vectors. Cayley – Hamilton Theorem – Diagonalization of matrices.

UNIT II DIFFERENTIAL EQUATIONS (12 Hrs)

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

UNIT III 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, Solution by variation of parameter method.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Partial derivatives, Total derivatives, Differentiation of implicit functions, Maxima and Minima of two variables. Partial differential equations of higher order with constant coefficients.

UNIT V VECTOR CALCULUS (12 Hrs)

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Gauss Divergence Theorem and Stokes Theorem.

Text Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 10th Edition, 2019.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
3. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9th Edition, 2018.

Reference Books

1. C W. Evans, Engineering Mathematics: A Programmed Approach, 3rd Edition, 2019.
2. A. Singaravelu. , "Engineering Mathematics for first year", Meenakshi publications, Tamil Nadu, 2019.
3. M.K. Venkataraman, "Engineering Mathematics" The National Publishing Company, Madras, 2016.
4. S. Narayanan and Manicavachagom T.K. Pillay " Differential Equations and Its Applications", Viswanathan, S., Printers & Publishers Pvt Ltd, 2009.
5. Dr.G Balaji., " Engineering Mathematics-I", G.Balaji publishers, 2017.

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Web References

1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra–slides-systemsofquation-handout.pdf
2. http://www.math.cum.edu/~wn0g/2ch6a.pdf
3. https://nptel.ac.in/courses/122/104/122104017/
4. https://nptel.ac.in/courses/111/106/111106051/
5. https://nptel.ac.in/courses/111/108/111108081/

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

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

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U20BST106 PHYSICS FOR MECHANICAL ENGINEERING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- The purpose of this course is to provide an understanding of physical concepts and underlying various engineering and technological applications.
- In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.
- This course gives good broad baseline knowledge of laser safety and fiber optics
- To acquire knowledge of the Quantum Mechanics in Classical Mechanics and electromagnetic radiation
- To understand the basis of solar energy and solar radiation measurement

Course Outcomes

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

CO1 - To understand the basic concept of semiconductor in physics. **(K2)**
CO2 - To apply the Physics concepts in acoustics. **(K3)**
CO3 - To understand scientifically the new developments in lasers and fiber optics. **(K3)**
CO4 - To understand about quantum mechanics and it applications. **(K2)**
CO5 - To emphasize the significance of Green technology through Physics principles. **(K1)**

UNIT I SEMICONDUCTOR PHYSICS (9 Hrs)

Semiconductor Physics: Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport - Einstein's relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions – tunnel diode - Schottky diode.

UNIT II ACOUSTICS (9 Hrs)

Acoustics: Intensity – Loudness – Absorption coefficient and its determination – Reverberation – Reverberation time – Factors affecting acoustics of buildings and their remedies – Sources and impacts of noise – Sound level meter – Strategies on controlling noise pollution – Ultrasonic waves and properties – Methods of Ultrasonic production (Magnetostriction and Piezoelectric) – Applications of Ultrasonic in Engineering and medicine.

UNIT III LASERS AND FIBER OPTICS (9 Hrs)

Lasers: Characteristics of Lasers – Einstein's coefficients and their relations – Lasing action – Working principle and components of CO2 Laser, Nd-YAG Laser, Semiconductor diode Laser, Excimer Laser and Free electron Laser – Applications in Remote sensing, holography and optical switching – Mechanism of Laser cooling and trapping.

Fiber Optics: Principle of Optical fiber – Acceptance angle and acceptance cone – Numerical aperture – V-number – Types of optical fibers (Material, Refractive index and mode) – Photonic crystal fibers – Fiber optic communication – Fiber optic sensors.

UNIT IV QUANTUM MECHANICS (9 Hrs)

Quantum mechanics: Inadequacies of Classical Mechanics – Duality nature of electromagnetic radiation – De Broglie hypothesis for matter waves –Heisenberg's uncertainty principle –Schrödinger's wave equation – Particle confinement in 1D box (Infinite Square well potential).

UNIT V GREEN ENERGY PHYSICS (9 Hrs)

Introduction to Green energy – Solar energy: Energy conversion by photovoltaic principle – Solar cells – Wind energy: Basic components and principle of wind energy conversion systems – Ocean energy: Wave energy – Wave energy conversion devices – Tidal energy – single and double basin tidal power plants – Ocean Thermal Electric Conversion (OTEC) – Geothermal energy: Geothermal sources (hydrothermal, geo-pressurized hot dry rocks, magma) – Biomass: Biomass and bio-fuels – bio-energies from wastages – Fuel cells: H2O2 – Futuristic Energy: Hydrogen – Methane Hydrates – Carbon capture and storage (CCS).

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Text Books

1. J.D.Thiruvadigal, S.Ponnusamy, D.Sudha and M.Krishnamohan, “Physics for Technologists”, Vibrant Publication, Chennai, 2013
2. Dattu R.Joshi, “Engineering Physics”, Tata McGraw- Hill, New Delhi, 2010.
3. R.K Gaur. & Gupta,S.L, Engineering Physicsǁ. Dhanpat Rai Publishers, 2012.

Reference Books

1. Frank Fahy, “Foundations of Engineering Acoustics”, Elsevier Academic Press, 2005.
2. Alberto Sona, “Lasers and their applications”, Gordon and Breach Science Publishers Ltd., 1976.
3. Leonard. I. Schiff, “Quantum Mechanics”, Third Edition, Tata McGraw Hill, 2010.
4. Charles Kittel, "Introduction to Solid State Physics", Wiley India Pvt. Ltd, 7th ed., 2007.
5. Godfrey Boyle, “Renewable Energy: Power sustainable future”, 2nd edition, Oxford University Press, UK, 2004.

Web References

1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/preview
3. https://www.newport.com/t/fiber-optic-basics
4. http://www.greenenergytech.in/
5. https://nptel.ac.in/courses/112/104/112104026/

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

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

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U20BST107 MATERIAL SCIENCE AND ENGINEERING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the fundamental concepts of engineering materials, applications and selection of materials.
- To discuss the crystal structure and crystal imperfections
- To compare the difference between ferrous and non-ferrous metals
- To explain the basic fundamentals of polymers and composites
- To illustrate the working of testing machines of materials and its material properties

Course Outcomes

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

CO1 - Understand the basic fundamentals of engineering materials, structure- properties relations. **(K2)**

CO2 - Recognize the basic crystal structure, metallography, structure identification. **(K1)**

CO3 - Select suitable ferrous and non-ferrous materials for Engineering application. **(K3)**

CO4 - Understand the polymers, composite properties and its applications. **(K2)**

CO5 - Understand the relationship between Microstructure – Properties of materials and evaluate properties of engineering materials. **(K4)**

UNIT I INTRODUCTION TO MATERIAL SCIENCE (9 Hrs)

Basics of Engineering Materials, Classifications and Application, Basics of Advance Engineering Materials, Engineering requirements of materials, Structure- Property relationships in Materials- Selection of materials for engineering Applications

UNIT II CRYSTAL STRUCTURE AND DEFECTS (9 Hrs)

Crystal Systems – Bravais Lattices – Coordination Number, Atomic Radius, and Packing Factor for FCC & HCP structures – Miller Indices for a cubic crystal– Metallography – Metallurgical microscopes – specimen preparation- Cooling curves

UNIT III FERROUS AND NON FERROUS METALS (9 Hrs)

Ferrous – steel, cast iron, stainless steel - types- properties & application, Non Ferrous - classification of alloy metals , Copper and its alloy, Aluminum and its alloy, Nickel and its alloy and Lead based alloys, Titanium and its applications

UNIT IV POLYMERS AND COMPOSITE MATERIALS (9 Hrs)

Introduction – Preparation – types - PMMA, PET, PVC- Processing of polymers, Extrusion, Injection molding, Blow molding, Transfer molding, Transfer Molding – Properties of polymers and Applications Composites: Introduction – classification – Polymer Composites - Metal Matrix Composites - Ceramic Matrix Composites – Properties-Applications- Nano Materials- applications

UNIT V PROPERTIES MATERIALS AND TESTING (9 Hrs)

Mechanical properties of materials - Deformation – types - Testing of materials - Destructive: Tensile, compression, torsion, hardness (micro & macro) and impact testing - Non-destructive: Visual inspection, Magnetic Particle Inspection (MPI), Liquid penetrate Inspection (LPI), Eddy current inspection (ECI), Ultra sonic inspection, Radiographic inspection.

Text Books

1. V. Raghavan, Materials Science And Engineering: A First Course, Prentice Hall India Pvt. Ltd., New Delhi, 6th edition, 2016
2. R. K. Rajput, Engineering Materials & Metallurgy, S. Chand Limited, 2010
3. O.P.Khanna , - Material Science & Metallurgy 2nd Edition, DhanpatRai& Co, 2nd Edition, 2014

Reference Books

1. George E.Dieter -Mechanical Metallurgy, McGraw hill 3rd Edition, 2017
2. Sidney H Avner, “Introduction to Physical Metallurgy, Tata McGraw Hill Publishing Company Limited, 2009.

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3. Donald R. Askeland, Wendelin J. Wright - The Science and Engineering of Materials, Global Engineering publication, seventh edition, 2017
4. Sidney Avner, Introduction to Physical Metallurgy, Tata McGraw Hill, Second Edition, 2017
5. William D. Callister, David G. Rethwisch - Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Edition, 2016

Web References

1. https://nptel.ac.in/courses/113102080/
2. https://nptel.ac.in/courses/113105021/
3. https://nptel.ac.in/courses/113/104/113104081/
4. https://nptel.ac.in/courses/112/108/112108150/
5. https://www.youtube.com/watch?v=NXmv_8FLFsI

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

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

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U20EST117

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to MECH,CIVIL,FT, AI&DS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To introduce fundamental concepts, various laws and principles associated with electrical circuits and its analysis.
- To provide knowledge about the various factors in AC circuits and resonance condition.
- To introduce the concept of electrical safety, power system and working of transformers and motors.
- To understand the characteristics and applications of semiconductor devices
- To provide the basic knowledge in analog 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 system, importance of electrical safety measures and application of transformers and motors in real time. **(K2)**

CO 4 - Understand the operator of semiconductor diode and its applications. **(K2)**

CO 5 - Distinguish the characteristics and operation of BJT and FET. **(K2)**

CO 6 - Introduce about different Communication Systems. **(K2)**

PART A - ELECTRICAL ENGINEERING

UNIT I D.C CIRCUITS AND NETWORK THEOREMS (8 Hrs)

Concept of Potential difference, voltage, current, work, Power, Energy, Electric networks, voltage source and current sources, linear passive and active elements, current-voltage relation, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Simplifications of networks using series-parallel, Star/Delta transformation. Network Theorem – Superposition, Thevenin's, Norton's and Maximum Power Transfer.

UNIT II AC CIRCUITS (8 Hrs)

AC waveform- definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in Polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, Resonance in series and parallel circuits, bandwidth and quality factors,3 phase Balanced AC Circuits (Y-Δ and Y-Y)-power Measurement –two Wattmeter method

UNIT III ELECTRICAL SAFETY AND ELECTRICAL MACHINES (7 Hrs)

Layout of electrical power system and its functions, Safety devices and systems, Types of domestic wiring, Wiring Accessories, Necessity of earthing, insulators, cables, fuse and circuit breakers - Sensors and its types.

Law of Electromagnetic induction, Auto transformer, Single phase transformer- load test – Open Circuit and Short Circuit test, Fleming's Right and Left hand rule – construction, principle, load test and performance characteristics of rotating machines – DC Motor and DC Generator - single phase/three phase induction motor, Alternator and synchronous motor (Qualitative approach only)

PART B - ELECTRONICS ENGINEERING

UNIT IV SEMICONDUCTOR DIODES AND APPLICATIONS (7 Hrs)

Introduction semiconductor materials-Doping-Intrinsic and Extrinsic Semiconductor –PN junction diode, structure, characteristics-diffusion and depletion capacitance-Rectifier, Half wave and Full wave rectifier-zener diode characteristics-zener diode as regulator –Light Emitting Diode(LED)-Solar Panel.

UNIT V TRANSISTORS (7 Hrs)

Bipolar Junction Transistor-construction-operation-Common Base, Common Emitter, Common collector Configuration-characteristics - Biasing- numerical application- Junction Field Effect Transistor(JFET), Metal oxide semiconductor Field Effect Transistor, EMOSFET-DMOSFET operation characteristics-Numerical applications.

UNIT VI COMMUNICATION SYSTEMS (8 Hrs)

Need for Modulation – Block diagram of analog communication System - AM, FM, PM Definitions and Waveforms – Comparison of digital and analog communication system- Block diagram of digital communication system – Electromagnetic Spectrum. Wired and wireless Channel – Block diagram of communication systems – satellite communication – Cellular Mobile Communication – Fibre Optical Communication System.

Text Books

1. Sudhakar.A and Shyam Mohan.S.P, “Circuits and Networks Analysis and Synthesis”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2010.
2. D.P.Kothari and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill, New Delhi, 5th Edition, 2017.
3. Theraja B. L and Theraja A. K., “A Textbook of Electrical Technology”, Vol. II, S Chand & Co. Ltd., New Delhi, 2009
4. R.L. Boylestad and L. Nashelsky, “Electronic Devices and Circuit Theory”, PHI Learning Private Limited, Ninth Edition, 2008
5. Wayne Tomasi, “Electronic Communication Systems- Fundamentals Theory Advanced”, Fourth Edition, Pearson Education, 2001

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1. V. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education India, New Delhi, 2nd Edition, 2015.
2. A.E.Fitzgerald, Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, Tata Mcgraw Hill, New Delhi, 7th Edition, 2013.
3. William H Hayt, J. E. Kemmerly and Steven M Durbin, “Engineering Circuit Analysis”, McGraw Hill, 8th Edition, 2012.
4. David. A. Bell, “Electronic Devices and Circuits”, PHI Learning Private Ltd, India, Fourth Edition, 2008
5. George Kennedy, Bernard Davis and S. R. M Prasanna, “Electronic Communication Systems”, 6th Edition, McGraw Hill Education, 2017

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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://www.electronics-tutorials.ws
5. https://nptel.ac.in/courses/117/1 02/117102059/

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	2	3	2	1	2	-	-	-	-	-	-	-	1	2	-
2	2	3	2	1	2	-	-	-	-	-	-	-	1	2	-
3	2	3	2	1	2	-	-	-	-	-	-	-	1	2	-
4	3	1	2	1	-	-	-	-	-	-	-	-	1	2	-
5	3	2	2	1	-	-	-	-	-	-	-	-	1	2	-
6	2	-	2	-	2	-	-	-	-	-	-	-	1	2	-

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

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U20EST119	ENGINEERING MECHANICS (Common to ECE, EEE, MECH, Mechatronics)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the basics of force and moment, static equilibrium of particles in two and three dimensions.
- To examine the equilibrium of rigid bodies and components of a moment.
- To discuss the properties of surfaces and solids.
- To integrate the relationship between the motion of bodies
- To associate the various structural analysis and load on system of rigid bodies.

Course Outcomes

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

CO1 - Recognize the basics of equilibrium of particles in 2D and 3D. **(K1,K2)**
CO2 - Review the requirements of equilibrium of rigid bodies in 2D and 3D. **(K2)**
CO3 - Compute the center of mass and moment of inertia of surfaces and solids. **(K2,K3)**
CO4 - Predict displacement, velocity and acceleration of dynamic particles. **(K2,K3)**
CO5 - Solve for friction force and rigid body dynamics. **(K2,K3)**

UNIT I BASICS AND STATICS OF PARTICLES (12 Hrs)

Introduction - Units and Dimensions - Vectorial representation of forces and moments –Coplanar Forces - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces -Resolution and Composition of forces -Equilibrium of a particle - Principle of transmissibility -Single equivalent force - Free body diagram

UNIT II EQUILIBRIUM OF RIGID BODIES (12 Hrs)

Types of supports and their reactions -requirements of stable equilibrium -Moments and Couples -Moment of a force about a point and about an axis -Vectorial representation of moments and couples - Scalar components of a moment -Varignon's theorem -Equilibrium of Rigid bodies in two dimensions –Forces in space -Equilibrium of a particle in space - Equivalent systems of forces - Equilibrium of Rigid bodies in three dimensions –Examples.

UNIT III PROPERTIES OF SURFACES AND SOLIDS (12 Hrs)

Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas- Parallel axis theorem and perpendicular axis theorem, radius of gyration of area- product of inertia- mass moment of inertia.

UNIT IV DYNAMICS OF PARTICLES AND FRICTION (12 Hrs)

Displacements, Velocity and acceleration, their relationship - Relative motion -Curvilinear motion - Newton's law -Work Energy Equation of particles -Impulse and Momentum -Impact of elastic bodies.
Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction -wedge friction- Rolling resistance

UNIT V STRUCTURAL ANALYSIS OF TRUSSES AND RIGID BODY DYNAMICS (12 Hrs)

Trusses: - Definition of a truss - Simple Trusses - Analysis of Trusses - Method of joints- Method of sections. - Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

Text Books

1. F.P.Beer, and Johnston Jr. E.R. "Vector Mechanics for Engineers", McGraw-Hill Education India Pvt Ltd., 11th Edition, 2016.
2. J.L. Meriam & L.G. Karidge, Engineering Volume I and Engineering Mechanics: Dynamics, 8th edition, Wiley student edition, 2016.
3. R.C, Hibbeller, "Engineering Mechanics", Prentice hall, 14th edition, 2016.

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Reference Books

1. Arthur P. Boresi and Richard J. Schmidt, “Engineering Mechanics: Statics and Dynamics”, Thomson Asia Private Limited, Singapore, 2010.
2. D.P.Sharma “Engineering Mechanics”, Dorling Kindersley India Pvt. Ltd, New Delhi, 2010
3. S.Rajasekaran, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2012.
4. S.S.Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics, New Age International(P) Ltd, New Delhi, 7th Edition, 2019.
5. Dr.I.SGujral, “Engineering Mechanical” second edition, Lakshmi Publication (P), Ltd., 2011.

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

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

(K.VELMURUGAN)

U20ESP118	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce practical knowledge for the analysis of laws and theorems.
- To provide the methods to evaluate and test the devices and machines.
- To Study about Electronic components and CRO.
- To study VI characteristics of Diodes the applications of Diode as Half wave rectifier
- To understand Input and output characteristics of Transistors and FETs

Course Outcomes

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

CO1 - Inspect the network theorems and validate the results through simulation. **(K4)**
CO2 - Build the various wiring systems for house, Godown, etc. **(K3)**
CO3 - Estimate the performance of DC and induction motor by conducting load and no load tests**.(K5)**
CO4 - Describe characteristics of semiconductor diode and utilize it for different applications **(K3)**
CO5 - Relate the characteristics of various transistor **(K3)**

List of Experiments

PART – A ELECTRICAL EXPERIMENTS

Demonstration on Sources, Ammeters, Voltmeters, Wattmeters, Energy meters and Transducers are Pre Requisite for conducting this electrical engineering Lab.

1. Domestic Wiring Practice
   - Staircase wiring
   - Doctor's room wiring
   - Godown wiring
   - Ceiling fan and fluorescent lamp wiring
2. Verification of Network Theorems (simulation and experimental)
3. Determination of resistance temperature coefficient
4. Simulation of R-L-C Series Circuit for XL>XC, XC>XL
5. Load test on single phase transformer.
6. Measurement of 3-phase power using two wattmeter methods.
7. Load test on DC shunt motor.
8. Load test on single phase induction motor.

PART – B ELECTRONICS EXPERIMENTS

1. Study of Electronic components and equipments: Resistor, Capacitor
2. Measurement of AC signal parameter (Peak-Peak, rms period, frequency) using CRO.
3. VI Characteristics of PN junction diode, Zener diode
4. Input and output characteristics of Common Emitter configuration of BJT
5. Characteristics of JFET
6. Measurement of Ripple factor of HWR

Reference Books

1. A.Sudhakar and Shyam Mohan.S.P, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2010.
2. D.P.Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill, New Delhi, 5th Edition, 2017.
3. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, Electrical and Electronics Technology, Pearson Education Limited, New Delhi, 10 th edition 2010.
4. S.K. Sahdev, "Fundamentals of Electrical Engineering and Electronics", DhanpatRai and Co, 2013.
5. David Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.

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Web References

1. https://www.electronics-tutorials.ws/accircuits/series-circuit.html
2. https://www.allaboutcircuits.com/textbook/experiments/
3. https://www.electrical4u.com/
4. https://www.electronicshub.org/measurements-of-ac-current/
5. http://www.electronics-tutorials.ws

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

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

U20ESP120 **ENGINEERING MECHANICS LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn the law of forces, principle of moments and equilibrium of forces
- To interpret the axial forces acting in the truss members and compute centroid of a lamina
- To compute the coefficient of friction and verify Newton's law of motion
- To study the concept of moment of inertia of a flywheel
- To understand the concept of conservation of energy

Course Outcomes

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

CO1 - Applies the concept of law of forces, principle of moments and equilibrium of forces. **(K2)**
CO2 - Computes the axial forces acting in the truss members and centroid of a lamina. **(K3)**
CO3 - Applies the coefficient of friction and Newton's law of motion. **(K2)**
CO4 - Infers about the concept of moment of inertia of a flywheel. **(K2)**
CO5 - Demonstrates the concept of conservation of energy. **(K2)**

List of Experiments

1. Verification of triangle law & parallelogram law of forces
2. Verification of polygon law of forces
3. Verification of the Principle of Moments using the Bell Crank Lever apparatus
4. Verification of support reactions of a simply supported beam
5. Verification of condition of equilibrium of a system of forces
6. Verification of equilibrium of three dimensional forces.
7. Verification of axial forces in the members of a truss
8. Verification of centroid of different lamina
9. Determination of coefficient of friction between two surfaces
10. Verification of newton's laws of motion
11. Determination of moment of inertia of a flywheel
12. Verification of motion parameters using conservation of energy.

Reference Books

1. A.K.Gupta, Mohit Bhoot, Engineering Mechanics laboratory manual, Scientific Publishers, 2015.
2. A.K.Sharma, Engineering mechanics practicals, University Science Press, 2009.
3. U.C.Jindal, Basics of Engineering Mechanics, Galgotia Publications, 2002.
4. S.Rajasekaran, G.Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2012.
5. S.S.Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics, New Age International(p) Ltd, New Delhi, 7th Edition, 2019.

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

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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

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U20ESP121 **ENGINEERING PRACTICE LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To familiarize with the basic manufacturing processes.
- To impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
- To practice on manufacturing of components and assembly of centrifugal pump, air conditioner using various workshop trades.
- To educate students of safe handling of machine and tools.
- To exercise individual as well as group activity with hands on training in different workshop trades.

Course Outcomes

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

CO1 - Be conversant with the basic manufacturing processes. **(K3)**
CO2 - Identify and apply suitable tools and instruments for machining, assembly and fitting. **(K3)**
CO3 - Manufacture and assembly of different components using various workshop trades. **(K3)**
CO4 - Take safety and precautionary measures of self and machines during operations. **(K3)**
CO5 - Develop skills to work as an individual or in a team during practice. **(K3)**

List of Experiments

BASIC MACHINING

(a) Plain Turning and Facing
(b) Step Turning
(c) Taper turning
(d) Thread cutting
(e) Eccentric turning
(f) Drilling and boring
(g) Tapping

MACHINE ASSEMBLY PRACTICE

(a) Study of centrifugal pump
(b) Study of air conditioner

DEMONSTRATION ON

(a) Fitting – Exercises – Preparation of square fitting and V – fitting models.

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

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

U20MEC1XX	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.

U20MES101	SKILL DEVELOPMENT COURSE 1 DEMONSTRATION IN CIVIL ENGINEERING	L	T	P	C	Hrs
		0	0	2	-	30

Course Objectives

- To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering.
- To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.
- To identify the civil engineering materials properties.
- To understand important of civil engineering in day today life.

Course Outcomes

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

CO1 - Acquire knowledge of material selection in civil engineering. (**K1)**

CO2 - Analyze the fundamental concepts of civil engineering. **(K2)**

CO3 - Design and development of current national planning for civil engineering/ infrastructure projects. **(K3)**

CO4 - Discus the various Construction materials, Hydrology and Water, Resources Engineering. **(K4)**

CO5 - Creativity & Innovativeness in Civil Engineering. **(K6)**

List of Experiments

1. Understanding Civil Engineering/ Infrastructure.
2. History of Civil Engineering
3. Overview of National Planning for Construction and Infrastructure Development.
4. Fundamentals of Architecture and Town Planning
5. Fundamentals of Building Materials
6. Basics of Construction Management and Contracts Management
7. Environmental Engineering and Sustainability
8. Geotechnical Engineering
9. Hydraulics, Hydrology and Water Resources Engineering
10. Structural Engineering

References Books

1. Narasimha Vavilala, “Basic Knowledge in Civil Engineering” Independently Published, 2019.
2. SS Bhavikatti, “Building Materials” Vikas publishing House Pvt Ltd. 2014.
3. Richard H McCuen, Edna Z Ezzell, Melanie K Wong, “Fundamentals of Civil Engineering” CRS Press Taylor & Francis Group.2011.
4. Satheesh Gopi “Basic Civil Engineering” Pearson Publications, 2009.
5. Andrew Braham “Fundamentals of Sustainability in Civil Engineering” CRS Press Taylor & Francis Group, 2017.

Web References

1. https://www.youtube.com/results?search_query=civil+engineering+basic+knowledge+nptel
2. https://www.youtube.com/watch?v=EIDXE28_8eQ.
3. https://www.youtube.com/watch?v=NSamrfRhoKY.
4. https://www.youtube.com/watch?v=2eKR8b7q8K4&list=PLkEhI-YDhJ6xN7lsr6rc7d5awH5WTmpxG.
5. https://www.youtube.com/watch?v=aTVDiRtRook&list=PLDF5162B475DD915F

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

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

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U20MEM101 **INDUCTION PROGRAM**

Induction program for students to be offered right at the start of the first year

Duration of the Program	3 Weeks
Induction program	• Physical Activity • Creative Arts and Culture • Mentoring and Universal Human Values • Familiarization with College, Dept./Branch • Literary Activity • Proficiency Modules • Lectures and Workshops by Eminent People • Visits in Local Area • Extra-Curricular Activities in College

1. Physical Activity

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health. Each student could pick one game and learn it for the duration of the induction program and hopefully, continue with it later.

2. Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, music, dance, pottery, sculpture etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

3. Mentoring and Universal Human Values

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

4. Other Activity

Activities that are not there on a daily basis, but are conducted for 3-4 days (typically in the afternoons) and change thereafter.

4.1 Familiarization with College, Department/Branch

The incoming students should be told about the credit and grading system, and about the examinations. They should be informed about how study in college differs from study in school. They should also be taken on a tour of the college and shown important points such as library, canteen, and other facilities. They should be shown their department, and told what it means to get into the branch or department. Describe what role the technology related to their department plays in society and after graduation what role the student would play in society as an engineer in that branch.

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A lecture by an alumnus of the Dept. would be very helpful in this regard. They should also be shown the laboratories, workshops and other facilities. The above should be done right in the first two days, and then over the afternoons thereafter, as appropriate.

4.2 Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

4.3 Proficiency Modules

The induction program period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

4.4 Lectures and Workshops by Eminent People

Lectures by eminent people should be organized, say, once a week. It would give the students exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni could be invited as well. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, Vivekanand Kendras, S-VYASA, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops (3 sessions, 9 hours).

4.5 Visits in Local Area

A couple of visits to the local landmarks including historical monuments should be organized. This would familiarize the students with the area together with bonding with each other, like in a picnic. Visits should also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

4.6 Extra-Curricular Activities in College

The new students should be introduced to the extra-curricular activities at the college/university. They should be shown the facilities and informed about activities related to different clubs etc. This is when selected senior students involved in or leading these activities can give presentations, under faculty supervision.

SEMESTER - II

U20BST215	ENGINEERING MATHEMATICS II MULTIPLE INTEGRALS AND TRANSFORMS (Common to all branches except CSBS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To equip themselves familiar with Laplace, transform and solve the differential equations using Laplace transform techniques.
- To enable the students to expand functions into Fourier series using change of intervals.
- To gain good knowledge in application of Fourier transform.
- To inculcate the computational knowledge in Z-transforms.

Course Outcomes

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

CO1 - Understand the concept of double and triple integrals. **(K2)**
CO2 - Apply Laplace transform and inverse Laplace transform of simple functions**. (K3)**
CO3 - Convert a periodic function into series form. **(K3)**
CO4 - Compute Fourier transforms of various functions. **(K3)**
CO5 - Solve difference equations using Z – transforms. **(K3)**

UNIT I MULTIPLE INTEGRALS (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 II LAPLACE TRANSFORMS AND INVERSE LAPLACE TRANSFORMS (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, Methods for determining inverse Laplace Transforms, Convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT III FOURIER SERIES (12 Hrs

Dirichlet's conditions – General Fourier series – Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems.

UNIT IV FOURIER TRANSFORMS (12 Hrs)

Fourier Integral theorem Fourier transform and its inverse, properties. Fourier sine and cosine transforms their properties, Convolution and Parseval's identity.

UNIT V Z - TRANSFORMS (12 Hrs)

Difference equations, basic definition, z – transform - definition, Standard z – transforms, Damping rule, Shifting rule, Initial value and final value theorems and problems, Inverse z – transform. Applications of z – transforms to solve difference equations.

Text Books

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, 1st Edition, New Delhi, 2016.
2. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearsons, New Delhi, 2017.
3. M.D.Petale, "A text book on Z- Transforms (Engineering Mathematics)", Bames and Noble, New Edition, 2020.

Reference Books

1. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co. New Delhi, 2019.
2. N.P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019.
4. C. B. Gupta, Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2016.

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5. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill, New Delhi 2018.

Web References

1. https://nptel.ac.in/courses/111105121/
2. https://nptel.ac.in/courses/111105035/
3. https://nptel.ac.in/courses/111107119/
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. https://nptel.ac.in/courses/111/103/111103021/

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

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

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U20EST201 **PROGRAMMING IN C**
(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME,MECHTRONICS, CCE)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the Fundamentals of Computers and introduction to C language.
- To study about the programs using Control structures.
- To understand the programs using looping and arrays.
- To understand the concepts of Functions and Pointers.
- To study about Structure, Union and File Management Operations in C.

Course Outcomes

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

CO1 - Comprehend the basic constructs of C programming. **(K2)**
CO2 - Illustrate the concepts of sequential, selection and repetition control structures in C program. **(K2)**
CO3 - Implement simple programs using looping structure and arrays. **(K3)**
CO4 - Demonstrate programs using Functions and Pointers. **(K3)**
CO5 - Build programs using Structure, Union and understand the concept of File management Operations. **(K3)**

UNIT I INTRODUCTION TO C (9 Hrs)

C programming: Overview of C - Visual Studio code-Constants- Compiling a C Program -Variables and Data Types- Technical Difference between Keywords and Identifiers- - Types of C Qualifiers and format specifies - Operators and Expressions-Operators Precedence-Type conversion-Input-Output Statements.

UNIT II DECISION MAKING (9 Hrs)

Decision making and branching- Relational operators – Logical operators- if – if else-if else if –nested if. Switch-case.

UNIT III LOOPING AND ARRAYS (9 Hrs)

Looping: while - do while – for – break – continue - nested loop Arrays: One Dimensional Arrays-Two-Dimensional Arrays-Multi-Dimensional Array-Dynamic arrays-Character Arrays and String-Sorting - Searching.

UNIT IV FUNCTIONS, POINTERS (9 Hrs)

Functions: Introduction - Definition – Declaration – Categories of Functions - Nesting of Functions, Recursive functions - Passing Arrays to Functions - Strings – String library function. Pointers: Introduction - Declaring Pointer Variables - Initialization of Pointer Variables - Accessing the address of a variable - Accessing a variable thorough Pointer - Chain of Pointers - Pointer Expressions - Pointers and arrays – Pointers and functions – Call by Reference - Pointers and character strings - Array of Pointers - Pointers and Structures.

UNIT V STRUCTURES AND UNIONS, FILE MANAGEMENT (9 Hrs)

User defined data types: Introduction – Structure: definition - declaration - Arrays of Structures – Nested structures – Passing structures to functions — Union - Enumeration and Typedef. Introduction to File Handling in C, Input and Output operations on a file – Error Handling - Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books

1. E.Balagurusamy, “Programming in ANSI C”, Tata McGraw Hill, 8th Edition, 2019.
2. Herbert Schildt,” C: The Complete Reference”, McGraw Hill, Fourth Edition, 2014.
3. Yashvant Kanetkar, “Let us C”, BPB Publications, 16th Edition, 2017.

Reference Books

1. Ashok N Kamthane, “Computer Programming”, Pearson education, Second Impression, 2012.
2. Vikas Verma, “A Workbook on C “, Cengage Learning, Second Edition, 2012.
3. Dr.P. Rizwan Ahmed, “Office Automation”, Margham Publications, 2016.
4. P.Visu, R.Srinivasan and S.Koteeswaran, “Fundamentals of Computing and Programming”, Fourth Edition, Sri Krishna Publications, 2012.
5. Pradip Dev, Manas Ghoush, “Programming in C”, Second Edition, Oxford University Press, 2011.

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Web References

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-language-set-1-introduction/
3. https://www.tutorialspoint.com/cprogramming
4. https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c
5. https://nptel.ac.in/courses/106/104/106104128/

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)

U20MET201 **MANUFACTURING PROCESSES**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart knowledge in casting technology and foundry shop
- To familiarize various metal joining processes
- To specify the bulk deformation processes
- To impart knowledge on various surface finishing processes
- To learn about the various plastics manufacturing techniques

Course Outcomes

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

CO1 - Acquire complete knowledge about casting. **(K2)**
CO2 - Manipulate the principles of metal joining processes. **(K3)**
CO3 - Identify the process of bulk deformation. **(K2)**
CO4 - Understand the various surface finishing processes. **(K2)**
CO5 - Classify the manufacturing methods of plastics. **(K2)**

UNIT I CASTING PROCESSES (9 Hrs)

Introduction to Molding and Casting. Molding sand: types, properties, preparation of dry and green sand molding. Pattern making: Pattern materials, types and allowances. Core making: types of core, core materials, making of cores. Casting methods: Die casting, Centrifugal Castings, Investment Casting and Shell mold Casting. Defects in casting.

UNIT II JOINING PROCESSES (9 Hrs)

Fusion welding processes-Types of Gas Welding-, Oxy-Acetylene Welding Equipment-Flame characteristics - Electric-Arc Welding, Electrodes, manual metal arc welding, Carbon Arc Welding, Inert-Gas Shielded Arc Welding, Tungsten Inert-Gas Welding (TIG), Gas Metal-Arc Welding (GMAW), Submerged Arc-Welding (SAW), Resistance Welding and its types and applications-Welding Defects. Soldering and Brazing- welding of non-metals.

UNIT III BULK DEFORMATION PROCESSES (9 Hrs)

Hot working and cold working of metals-Forging processes-Open, impression and closed die forging-types of Forging machines-Typical forging operations-Swaging-Rolling of metals-Types of rolling mills- Defects in rolled parts-principle of rod and wire drawing-Tube drawing-Principles of extrusion-Types of Extrusion-hot and cold extrusion-Equipment's used. Sheet metal work– Shearing- Bending – Drawing.

UNIT IV SURFACE FINISHING PROCESSES (9 Hrs)

Surface finishing processes- surface finish and Roughness-Honing-Lapping- Abrasive belt finishing. Polishing-Buffing-Grinding-Types-size and specification of grinding - Grinding fluids- grinding speed, feed and Depth of cut.

UNIT V PLASTIC MANUFACTURING (9 Hrs)

Plastics and polymers – structure of polymers – additives in plastics – thermoplastics and thermosetting plastics – manufacturing of plastic products – different moulding methods – forming or shaping methods – laminating methods – machining of plastics – joining plastics – industrial applications of plastics.

Text Books

1. P.N.Rao, "Manufacturing Technology, Volume I & II", Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition, 2018.
2. B.S.Nagendra Parashar and R.K.Mittal – Elements of Manufacturing Processes, Prentice Hall India Pvt. Ltd., 2003.
3. P.C Sharma, "A Text Book of Manufacturing – I " S Chand Company Pvt Ltd, 2008.

Reference Books

1. J.P Kaushish, "Manufacturing Processes", Second Edition, PHI Learning Pvt. Ltd., 2013.

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2. S.Kalpakjian and R.Schmid, “Manufacturing Engineering and Technology”, Seventh Edition, Pearson Education India Edition, 2013.
3. M.Adithan and A.B Gupta “Manufacturing Technology”, New Age, Fifth Edition, 2012.
4. H.M.T. Production Technology – Handbook”, Tata McGraw-Hill, First Edition, 2001.
5. R.K.Jain and S.C. Gupta, “Production Technology”, Khanna Publishers, Sixteenth Edition, 2001.

Web References

1. https://nptel.ac.in/courses/112/107/112107219/#
2. https://www.sciencedirect.com/topics/engineering/manufacturing-process
3. https://www.coursera.org/courses?query=manufacturing%20process
4. https://www.edx.org/course/fundamentals-of-manufacturing-processes
5. https://onlinecourses.nptel.ac.in/noc19_me20/

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

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

U20MET202 **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. **(K3)**
CO5 - Understand and analysis the behavior of engineering materials and prevention the failures. **(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 steel making processes; production of primary and secondary steel- Manufacturing methods of Cast Iron , Alloy cast iron.

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, Engineering Materials and Metallurgy, 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.
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

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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

(K. VELMURUGAN)

U20MET203 CONCEPTS OF ENGINEERING DESIGN

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide a board overview of generic concept of design, weld symbols and standards.
- To enable students to attain knowledge on design principles.
- To define various engineering materials and properties.
- To expand in depth knowledge on stress, strain and various loading conditions.
- To know about the applications of green design in industry.

Course Outcomes

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

CO1 - Understand the concepts of work, energy, torque, power and free body diagrams. **(K2)**
CO2 - Understand various design principles. **(K2)**
CO3 - Explain different classes of material and their properties. **(K2)**
CO4 - Illustrate the various loading and failures theory methods. **(K2)**
CO5 - Exposed to light engineering product and green design process. **(K3)**

UNIT I DESIGN CONSIDERATION (9 Hrs)

Review of basics of work, energy, torque, power, load analysis, equilibrium equations, free-body diagrams, internal loads, force flow concept, locating critical sections, practical considerations, Fits and tolerances, surface roughness, weld symbols, process capability.

UNIT II DESIGN PRINCIPLES (9 Hrs)

Occam's Razor, Saint-Venant's Principle, Golden Rectangle, Abbe's Principle, Maxwell's Reciprocity Theorem, Self-Principles, Stability, Symmetry, Parallel Axis theorem, Accuracy, Repeatability, Resolution, Sensitivity direction, Fool Proofing, mind maps

UNIT III MATERIALS AND THEIR PROPERTIES (9 Hrs)

Engineering materials and their classification: Metals, Ceramics and polymers, Stress-strain diagrams of metallic, Ceramics and polymers materials, Moduli of elasticity, Poisson's ratio, shear modulus – material strength, resilience and toughness, thermal conductivity, linear thermal expansion coefficient, specific heat capacity.

UNIT IV TYPES OF LOADING AND FRACTURE MECHANICS (9 Hrs)

Normal stress and strain, torsion, power transfer, bending stress and strain, curved member, transverse shear stress and strain, stress concentration. Modes of crack displacement, fracture toughness, failure prediction – maximum shear-stress theory, distortion – energy theory, maximum normal stress theory, modified Mohr theory.

UNIT V GREEN DESIGN PROCESS (9 Hrs)

Comparison of materials, material saving by form design, possible weight and cost reduction, design concepts for light engineering products, Material life cycle, embodied energy, 80-20 rule, carbon footprint, green design in industry, sustainability, biomimetics.

Text Books

1. Dieter, George E., Engineering Design - "A Materials and Processing Approach", McGraw Hill International Editions, Singapore, 3rd Edition, 2000.
2. Karl T. Ulrich and Steven D.Eppinger "Product Design and Development" McGraw Hill Edition 4th edition 2009.
3. Atif Aziz. ''Concepts in Engineering Design'' 1st Edition, New Age International, 2017.

Reference Books

1. Michael Ashby, Hugh Shercliff and David Cebon, "Materials Engineering, Science, Processing and Design", Butterworth Heinemann, 2009.
2. Robert C Juvinall, "Fundamentals of Machine Component Design", Wiley, 2011.

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3. George Dieter,Linda Schmidt, ‘‘Engineering Design’ ‘ Fifth Edition McGraw 2012.
4. Yousef Haik, Tamer M. Shahin, ‘‘Engineering Design Process’’ Second Edition .Cengage learning, 2016.
5. Aarron Walter,’’ Principles of product design’ Design better, 2019.

Web References

1. https://nptel.ac.in/courses/107/108/107108010/
2. https://nptel.ac.in/courses/113/104/113104096/
3. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-842
4. https://www.ifeu.de/en/methods/life-cycle-assessment-and-material-flow-analyses/
5. https://www.webdesignerdepot.com/2011/02/the-8020-rule-applied-to-web-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	1	1	-	2	1	1	1	-	-	-	2	2	1	1
2	3	-	1	1	1	1	-	2	-	-	-	2	2	2	2
3	3	-	1	-	2	2	1	2	1	1	-	2	2	2	3
4	3	1	2	2	1	1	-	2	1	1	-	2	2	2	2
5	3	1	2	1	2	2	2	1	1	2	2	3	3	3	3

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

(K.VELMURUGAN)

U20MET204 **ENGINEERING THERMODYNAMICS**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the basic concepts and the laws of thermodynamics.
- To know the second law of thermodynamics and energy concepts in the energy systems.
- To know the properties of pure substances and vapour power cycles.
- To gain the basic knowledge of ideal gas, real gas and thermodynamic relations.
- To learn basic concepts of the psychometric and refrigeration cycles.

Course Outcomes

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

CO1 - Explain the basic concepts and laws of thermodynamics. **(K2)**
CO2 - Illustrate the second law and energy concepts in the thermodynamic devices. **(K3)**
CO3 - Apply the concepts of pure substances in vapour power cycles. **(K3)**
CO4 - Categorize ideal gas, real gas and thermodynamic relations. **(K4)**
CO5 - Evaluate problems in the psychometric and refrigeration cycles. **(K4)**

UNIT I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS (12 Hrs)

Systems and control volume – Properties, processes and cycles – Thermodynamic equilibrium – Path function and point function – Quasi-static process – Zeroth law of thermodynamics – Work transfer – pdV work or displacement work – Heat transfer – Heat transfer, a path function – Specific heats – First law for a closed system undergoing a cycle and a change of state – Energy-a property of the system – Enthalpy – Energy of an isolated system – Perpetual Motion Machine of the First kind – First law applied to non-flow and flow processes.

UNIT II SECOND LAW OF THERMODYNAMICS AND EXERGY (12 Hrs)

Energy reservoirs – Heat engines – Kelvin-Planck and Clausius statements of the Second law – Refrigerator and Heat pump – Equivalence of Kelvin-Planck and Clausius statements – Reversibility and Irreversibility – Carnot cycle – Reversed Heat engine – Carnot's Theorem – Entropy – the Inequality of Clausius – Entropy generation in closed and open systems – Entropy and disorder – Concept of absolute entropy – Exergy – Exergy of closed and Steady flow systems – Irreversibility – Exergy balance – Second law efficiency.

UNIT III PROPERTIES OF PURE SUBSTANCE AND VAPOUR POWER CYCLES (12 Hrs)

Phase change processes – Property diagrams – p-v-T surface – Quality or Dryness fraction – Steam tables – Charts of thermodynamic properties – Measurement of Steam Quality – Simple steam power cycles – Actual vapour cycle processes – Comparison of Rankine and Carnot cycles – Mean temperature of Heat addition – Reheat cycle – Regenerative – Ideal regenerative cycle – Reheat-Regenerative cycle – Feed water heaters – Binary vapour cycles – Efficiencies of steam power plant.

UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS (12 Hrs)

Equation of state for a perfect – p-v-T surface of an Ideal gas – Internal energy and Enthalpy of a perfect gas – Real gases – Van der Waals' equation – Virial equation of state – Beattie-Bridgeman of equation – Reduced properties – Law of Corresponding states – Compressibility Chart – Maxwell's equations – Tds Equations – Difference and ratio of heat capacities – Energy equation – Joule-Kelvin effect – Clausius Clapeyron equation – Gibbs phase rule – Types of equilibrium.

UNIT V PSYCHROMETRY AND REFRIGERATION CYCLES (12 Hrs)

Properties of Atmospheric air – Psychrometric chart – Psychrometric process: Sensible heating or cooling, Cooling and dehumidification, Heating and humidification, Adiabatic mixing of two steams, Chemical dehumidification, Adiabatic evaporative cooling – Refrigeration by non-cyclic processes – Reversed heat engine cycle – Vapour Compression cycle – Refrigerants – Absorption Refrigeration cycle – Heat pump system – Gas cycle refrigeration – Liquefaction of gases – Production of solid ice.

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Text Books

1. P.K Nag, “Engineering Thermodynamics”, 6th Edition, McGraw-Hill, New Delhi, 2017.
2. Y.Cengel and M.Boles, "Thermodynamics - An Engineering Approach", 9th Edition, McGraw Hill, 2019.
3. C.P.Arora, “Thermodynamics”, 25th Reprint, McGraw-Hill, New Delhi, 2013.

Reference Books

1. C.Borgnakke, R.E. Sonntag, “Fundamentals of Thermodynamics, 10th Edition, John Wiley & Sons, Inc., 2019.
2. M.J.Moran, H.N.Shapiro, D.D.Boettner and M.B. Bailey., “Fundamentals of Engineering Thermodynamics, 9th Edition, John Wiley & Sons, Inc., 2018.
3. S.K.Gupta, “Engineering Thermodynamics”, Chand and Company Pvt. Ltd., New Delhi, 2013.
4. R.K.Rajput, “Thermal Engineering, Laxmi Publications (P) Ltd, 9th Edition, 2013.
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://byjus.com/physics/thermodynamics/
5. https://byjus.com/physics/various-processes-in-a-thermodynamic-system/

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

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

(K.VELMURUGAN)

U20ESP202

PROGRAMMING IN C LAB

(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME,MECHTRONICS, CCE)

L	T	P	C	Hrs
0	0	2	1	30

Course objectives

- To practice the fundamental programming methodologies in the C programming language.
- To apply logical skills for problem solving using control structures and arrays.
- To design, implement, test and debug programs that use different data types, variables, strings, arrays, pointers and structures.
- To design modular programming and provide recursive solution to problems.
- To understand the miscellaneous aspects of C and comprehension of file operations.

Course Outcomes

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

CO1 - Implement logical formulations to solve simple problems leading to specific applications. **(K3)**

CO2 - Execute C programs for simple applications making use of basic constructs, arrays and strings. **(K3)**

CO3 - Experiment C programs involving functions, recursion, pointers, and structures. **(K3)**

CO4 - Demonstrate applications using sequential and random access file processing. **(K3)**

CO5 - Build solutions for online coding challenges. **(K3)**

List of Experiments

1. Simple programming exercises to familiarize the basic C language constructs.
2. Develop programs using identifiers and operators.
3. Develop programs using decision-making and looping constructs.
4. Develop programs using functions as mathematical functions.
5. Develop programs with user defined functions – includes parameter passing.
6. Develop program for one dimensional and two dimensional arrays.
7. Develop program for sorting and searching elements.
8. Develop program to illustrate pointers.
9. Develop program with arrays and pointers.
10. Develop program for dynamic memory allocation.
11. Develop programs for file operations.

Reference Books

1. Zed A Shaw," Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)", Addison Wesley, 2016.
2. Anita Goel and Ajay Mittal, "Computer Fundamentals and programming in C", Pearson Education, First edition, 2011.
3. Maureen Sprankle, Jim Hubbard," Problem Solving and Programming Concepts," 9th Edition, Pearson,2011
4. Yashwanth Kanethkar, "Let us C", BPB Publications, 13th Edition, 2008.
5. B.W. Kernighan and D.M. Ritchie, "The C Programming language", 2nd Edition, Pearson Education, 2006.

Web References

1. https://alison.com/course/introduction-to-c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. https://www.tenouk.com/clabworksheet/clabworksheet.html
5. https://fresh2refresh.com/c-programming/

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)

U20ESP212	ENGINEERING GRAPHICS USING AUTO CAD (Common to ECE, IT, CSE, ICE, MECH, BME,CSBS, Mechatronics)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To develop graphic skills for communication of concepts, ideas and design of engineering products
- To expose them to standardized technical drawings
- To extend the skill to use software for creating 2D and 3D models
- To draw a simple steel truss.
- To develop the isometric projection of simple objects.

Course Outcomes

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

CO1 - Familiarize with the fundamentals and standards of engineering graphics. **(K2)**

CO2 - Perform freehand sketching of basic geometrical constructions and multiple views of objects. **(K3)**

CO3 - Visualize the project isometric and perspective sections of simple solids and to be familiar on software packages for drafting and modelling. **(K3)**

CO4 - Connect side view associate on front view.**(K4)**

CO5 - Correlate sectional views of prism, pyramid, cylinder and cone. **(K4)**

List of Experiments

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and Dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3D models of simple objects and obtaining 2D multi-view drawings from 3Dmodel.

    Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.

Reference Books

1. James D. Bethune, Engineering Graphics with AutoCAD A Spectrum book 1st Edition, Macromedia Press, Pearson, 2020.
2. NS Parthasarathy and Vela Murali, Engineering Drawing, Oxford university press, 2015.
3. M.B Shah, Engineering Graphics, ITL Education Solutions Limited, Pearson Education Publication, 2011.
4. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2017.
5. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd., 7th Edition, New Delhi, 2016.
6. C M Agrawal, Basant Agrawal, Engineering Graphics, McGraw Hill, 2012.
7. Dhananjay A. Jolhe, Engineering Drawing: With An Introduction To CAD McGraw Hill, 2016.
8. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.

Web References

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php
2. http://www.nptelvideos.in/2012/12/computer-aided-design.html
3. https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/
4. https://autocadtutorials.com
5. https://dwgmodels.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	1	-	-	3	-	-	-	3	-	-	2	3	3	3
2	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3
3	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3
4	3	1	-	-	3	-	-	-	3	-	-	2	3	3	3
5	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3

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

(K.VELMURUGAN)

U20MEP201	MANUFACTURING PROCESSES LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study and practice the various operations that can be performed in shaper machine and grinding machine
- To study about foundry tools and preparation of sand mold
- To practice various welding joints in metal arc welding and sheet metal operations
- To know the safety precautions exercised in the mechanical workshop
- To equip with the practical knowledge required in the core industry.

Course Outcomes

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

CO1 - Acquire knowledge about manufacturing process. **(K2)**
CO2 - Conduct experiments to understand the mechanism of chip formation **(K2)**
CO3 - Review various cutting parameters for different materials in machining operations. **(K3)**
CO4 - Acquire knowledge on selection of suitable manufacturing process for the typical components. **(K2)**
CO5 - Use different moulding tools, patterns and prepare sand moulds. **(K3)**

List of Experiments

MACHINES

1. Study of shaping machine
2. Square Head Shaping
3. Hexagonal Head Shaping
4. Study of grinding machine
5. Plain Surface grinding
6. Cylindrical grinding

FOUNDRY

7. Preparation of a sand mold using split pattern
8. Preparation of a sand mold using solid pattern

WELDING AND SHEET METAL

9. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding
10. Gas welding practice - Demonstration
11. Forming & Bending by sheet metal
12. Model making – Trays and funnels and different type of joints in sheet metal

Reference Books

1. P.N. Rao, “Manufacturing Technology – Metal Cutting and Machine Tools”, Tata Mc Graw Hill Publishing Company Ltd, NewDelhi,2008
2. Raghavan.V, “Physical Metallurgy–Principles and Practice”, Prentice Hall India Pvt. Ltd., New Delhi, 2006.
3. Kalpakjain S, Schimd S, “Manufacturing Engineering and Technology”, Pearson Education, 7th edition, New Delhi, 2018.
4. Kaushish J.P., “Manufacturing Processes”, Second Edition, PHI Learning Pvt. Ltd., 2013.
5. Jain. R.K. and Gupta S.C, “Production Technology”, Khanna Publishers, Sixteenth Edition, 2001.

Web References

1. http://gssl.iitk.ac.in/pssl/
2. https://ec.europa.eu/growth/tools-databases/dem/monitor/tags/industry-40
3. https://www.lynda.com/Manufacturing-training-tutorials/1702-0.html
4. https://openoregon.pressbooks.pub/manufacturingprocesses45/
5. https://make.3dexperience.3ds.com/processes/introduction-to-molding-processes

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

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

(K. VELMURUGAN)

U20MEC2XX	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.

U20MEM202 **ENVIRONMENTAL SCIENCE**

L	T	P	C	Hrs
2	0	0	-	30

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

i. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii. Slogan making event
iii. Poster making event
iv. Cycle rally
v. Lectures from experts

(b) Actual Activities:

i. Plantation
ii. Gifting a tree to see its full growth
iii. Cleanliness drive
iv. Drive for segregation of waste
v. To live some big environmentalist for a week or so to understand his work
vi. To work in kitchen garden for mess
vii. To know about the different varieties of plants
viii. Shutting down the fans and ACs of the campus for an hour or so

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SEMESTER - III

U20BST320 **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, 4th 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.
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.

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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/CnrAivf9l6o

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)

	DATA STRUCTURES	L	T	P	C	Hrs
U20EST356	(Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS, CCE)	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 – 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 and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque.

UNIT III LINKED LIST OPERATIONS (9 Hrs)

Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. 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.

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Reference Books

1. Balagurusamy, “Data Structures”, Tata McGraw-Hill Education, 2019.
2. D.Samanta, “Classic Data Structures, Prentice-Hall of India, Second Edition, 2012.
3. Robert Kruse, C.L. Tondo and Bruce Leung, “Data Structures and Program Design in c”, Prentice-Hall of India, Second Edition, 2007.
4. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education, Second Edition, 2006.
5. Mark Allen Weiss, ”Algorithms, Data Structures and Problem Solving with C++”, Addison-Wesley Publishing Company, Illustrated Edition, 1995.

Web References

1. https://www.geeksforgeeks.org/data-structures/
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	1	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-

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

U20EST358 ELECTRONIC DEVICES AND CIRCUITS

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

Course Outcomes

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

CO1 - Explain the structure and working operation of basic electronic devices. **(K1)**
CO2 - Describe the working principle of BJT, FET, UJT and Thyristors. **(K2)**
CO3 - Analyze the behavior of Bipolar Junction Transistors and Field Effect Transistors at different frequency Conditions. **(K3)**
CO4 - Design multistage amplifiers using Bipolar Junction Transistors. **(K4)**
CO5 - Employ the acquired knowledge in design and analysis of oscillators. **(K3)**

UNIT I PN JUNCTION DEVICES (9 Hrs)

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode characteristics- Zener Reverse characteristics – Zener as a Voltage regulator

UNIT II TRANSISTORS AND THYRISTORS (9 Hrs)

BJT, JFET, MOSFET- structure, operation, Biasing and characteristics. UJT - Characteristics and equivalent circuit – intrinsic standoff ratio –UJT relaxation oscillator, Thyristors- SCR - Two transistor model, DIAC and TRIAC - Operation, Characteristics and their applications.

UNIT III AMPLIFIERS (9 Hrs)

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response. Small signal model of JFET and MOSFET – Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS (9 Hrs)

RC-coupled amplifier, Operation and Frequency response, Power amplifier – Series fed and transformer coupled Class A amplifiers, Class B amplifier, Circuit and Operation, conversion efficiency, amplifier distortion, Class C and D amplifiers.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS (9 Hrs)

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

Text Books

1. A.David, Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press
3. S.Salivahanan, N. Suresh Kumar, A.Vallavaraj, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2012

Reference Books

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation" CRC Press, 2004.

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3. https://nptel.ac.in/courses/117/103/117103063/
4. https://www.electrical4u.com/diode-working-principle-and-types-of-diode/
5. https://www.allaboutcircuits.com/video-tutorials/transistors/

COs/POs/PSOs Mapping

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

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

U20MET305 **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 the 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.
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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Web References

1. https://nptel.ac.in/courses/112107146/#
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

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U20MET306 **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

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2. James A. Rehg, Henry W. Kraebber, “Computer Integrated Manufacturing”, Pearson Education. 2007
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.

Web References

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

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

U20MET307 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 solve the rate of flow and energy losses in flow through pipes. **(K3)**
CO4 - To evaluate the operating characteristics of hydraulic turbines. **(K3)**
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 AND 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 AND 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.

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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.
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

1. https://nptel.ac.in/courses/112/104/112104117/
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	-	-	-	-	-	1	-	1	2	2	2
4	3	3	3	3	-	-	-	-	-	1	-	1	3	3	3
5	3	2	2	3	-	-	-	-	-	1	-	1	2	2	2

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

(K.VELMURUGAN)

U20HSP301 **GENERAL PROFICIENCY – I** (Common to all branches except CSBS)

L	T	P	C	Hrs
0	0	2	1	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

(K. VELMURUGAN)

U20ESP357	DATA STRUCTURES LAB (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME, MECHATRONICS,CCE)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the basic concepts of Data Structures.
- To learn about the concepts of Searching Techniques.
- To explore about the concepts of Sorting Techniques.
- To know about the linear Data Structures.
- To study about non-linear Data Structures.

Course Outcomes

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

CO1 - Analyze the algorithm's / program's efficiency in terms of time and space complexity. **(K3)**
CO2 - Solve the given problem by identifying the appropriate Data Structure. **(K3)**
CO3 - Solve the problems of searching and sorting techniques. **(K3)**
CO4 - Solve problems in linear Data Structures. **(K4)**
CO5 - Solve problems in non-linear Data Structures. **(K4)**

List of Experiments

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list. b) Delete an element from list c) Search for a key element in list d) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder b) Inorder and c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.

Reference Books

1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd edition, 2019.
2. Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st edition, 2013.
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st edition, 2017.
4. Reema Thareja, "Data structures using C", 2nd edition, Oxford University, 2014.
5. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st edition, 2019.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. https://nptel.ac.in/courses/106103069/

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

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

(K. VELMURUGAN)

U20MEP302 MATERIAL TESTING AND METALLURGY LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To make student familiar with modern 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 learn 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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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)

U20MEP303 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. **(K3)**

CO2 - Interpret the flow structures through various models. **(K3)**

CO3 - Analyse the performance characteristic of various types of pumps. **(K3)**

CO4 - Correlate the characteristics curves of gear and turbine pump. **(K3)**

CO5 - Evaluate the performance characteristic of various types of turbine. **(K4)**

List of Experiments

1. Evaluate the coefficient of discharge of given Orifice meter.
2. Evaluate 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 mechanics/
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	-	-	-	1	-	-	-	2	1	1
2	3	3	2	2	3	-	-	-	1	-	-	-	2	1	1
3	3	3	3	3	3	-	-	-	1	1	1	1	2	1	1
4	3	3	3	3	3	-	-	-	1	1	1	1	2	1	1
5	3	3	3	3	3	-	-	-	1	1	1	1	2	1	1

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

(K.VELMURUGAN)

U20MEC3XX **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.

U20MES302	SKILL DEVELOPMENT COURSE 2 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		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.

U20MEM303 **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.

SEMESTER - IV

U20BST433 **PROBABILITY AND QUEUING THEORY** (Common to MECH & BME)

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To know the 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 and 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. Gupta, B.Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2015
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi,10th Edition, 2019
3. John F. Shortle, James M. Thomson, Donald Gross, "Fundamental of Queuing theory", Wiley series, 5th Edition, 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 & Co. Pvt. Ltd, 2015.

(K. VELMURUGAN)

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

PROGRAMMING IN JAVA

U20EST467 (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS, CCE)

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, packages, interfaces
- To get familiarized to generic programming, multithreading concepts.
- To gain and explore the advanced concepts in Java.
- To explore database connectivity

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, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, thread and generic programming. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams. **(K3)**
CO5 - Exemplify simple graphical user interfaces using GUI components and database programs. **(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. Concepts of classes and objects: Basic Concepts of OOPs – constructors – static keyword – Final with data – Access control – This key word – Garbage collection – Nested classes and inner classes – String class

.

UNIT II INHERITANCE, PACKAGES AND INTERFACES (9 Hrs)

Inheritance: Basic concepts – Forms of inheritance – Super key word – method overriding – Abstract classes – Dynamic method dispatch – The Object class. Packages: Defining – Creating and Accessing – importing packages. Interfaces: Defining – Implementing – Applying – Variables and extending interfaces

UNIT III EXCEPTION HANDLING, MULTITHREADING (9 Hrs)

Concepts of Exception handling – Types of exceptions – Creating own exception – Concepts of Multithreading – creating multiple threads – Synchronization – Inter thread communication. Enumeration: Autoboxing – Generics.

UNIT IV COLLECTIONS, I/O STREAMS (9 Hrs)

Collections: List – Vector – Stack – Queue – Dequeue – Set – Sorted Set. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT V EVENT DRIVEN PROGRAMMING AND JDBC (9 Hrs)

Events – Delegation event model – Event handling – Adapter classes. AWT: Concepts of components – Font class – Color class and Graphics. Introduction to Swing: Layout management - Swing Components. Java Database Connectivity. Develop real time applications.

Text Books

1. Herbert Schildt, Java: The Complete Reference 11th Edition, TMH Publishing Company Ltd, 2018.
2. Sagayaraj, Denis, Karthik, Gajalakshmi , “JAVA Programming for core and advanced learners” , Universities Press Private Limited, 2018
3. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.

Reference Books

1. H.M.Dietel and P.J.Dietel, “Java How to Program”, 11th Edition, Pearson Education/PHI, 2017.
2. Nageshvar rao, “Core Java and Integrated Approach”, 1st Edition, Dreamtech, 2016.
3. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, Prentice Hall, 9th Edition, 2013.
4. P.J. Dietel and H.M Dietel, “Java for Programmers”, Pearson Education, 9th Edition, 2011.
5. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Pearson Education, 8th Edition, 2008.

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Web References

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

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

(K.VELMURUGAN)

U20MET408 **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 & 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 & 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 & 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.

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Reference Books

1. Brian W. Kernighan & 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 & 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	3	-	-	-	-	-	-	-	2	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3
4	3	2	3	3	-	-	-	-	-	-	-	2	2	2	3
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	3

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

(K.VELMURUGAN)

U20MET409 **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.

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3. P. K. Nag, Heat and Mass Transfer, McGraw Hill Education India Pvt. Ltd. 2011.

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

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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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	2	2	2	3
2	3	2	2	1	1	-	-	-	-	-	-	2	2	2	3
3	3	2	2	1	1	-	-	-	-	-	-	2	2	2	3
4	3	3	3	2	2	-	-	-	-	-	-	2	3	3	3
5	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2

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

U20HSP402	GENERAL PROFICIENCY – II (Common to all branches except CSBS)	L	T	P	C	Hrs
		0	0	2	1	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 & 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 &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 & 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 & 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.

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Web References

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

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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)

U20ESP468 **PROGRAMMING IN JAVA LAB**

(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS, CCE)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To acquire programming skill in core java.
- To learn how to design java program and applications.
- To acquire object oriented skills in java.
- To develop the skill of designing applications.
- To explore database connectivity.

Course Outcomes

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

CO1 - Apply and practice logical formulations to solve simple problems leading to specific applications. **(K3)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, multithread. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams. **(K3)**
CO5 - Develop simple database programs. **(K3)**

List of Exercises

1. Develop simple programs using java technologies and testing tools.
2. Develop a java program that implements class and object.
3. Write a java program to demonstrate inheritance.
4. Develop a simple real life application program to illustrate the use of Multi Threads.
5. Implement simple applications using Collections.
6. Develop a simple application and use JDBC to connect to a back-end database.
7. Create a student application with Add, Edit, Delete, Show functions using JDBC.
8. Create a Bill Application to store sales details using JDBC.
9. Create java applications using Exception Handling for error handling.
10. Develop a java program that implements the Packages.

Reference Books

1. E. Balagurusamy, “Programming with java”, TMH Publication, 2nd Edition, 2005.
2. JAVA How to programming by DIETEL and DIETEL.
3. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.
4. Cay .S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education, Seventh Edition, 2010.
5. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018.

Web References

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. ttps://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	-	-	-	-	-	-	-	-	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
3	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
4	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1
5	3	2	1	1	3	-	-	-	-	-	-	-	-	1	1

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

(K.VELMURUGAN)

U20MEP404 **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 read and interpret the diagrams drawn by draughtsman by familiarizing on 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 1 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 & Datums, Twelve Degrees of Freedoms & Datum Planes, Surface Symbols – Roughness- Applying Feature Control Frame usage in drawings - minimum 5 exercises

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 & Sons, 2009.

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

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

(K.VELMURUGAN)

U20MEP405 **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 set-up**. (K4)**

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

CO3 - Analyse and Interpret heat transfer parameters by conducting experiments on Heat exchanger experimental set-up**. (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. Experiment to evaluate Stefan Boltzmann constant.
7. Experiment to evaluate the 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)

U20MEC4XX **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.

U20MES403	SKILL DEVELOPMENT COURSE 3 (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.

U20MEM404	NSS	L	T	P	C	Hrs
		0	0	2	-	30

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. Pass in this course is mandatory for the award of degree

SEMESTER - V

U20BST548	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

(K.VELMURUGAN)

U20MET510 **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)

Design of power screws - Design of bolts with pre-stresses- design of joints under eccentric loading - bolts of uniform strength - Design of fillet welds- axial loads-circular fillet welds-bending and torsion.

UNIT III DESIGN OF SHAFTS AND KNUCKLE JOINTS (12 Hrs)

Design of solid and hollow shafts for strength and rigidity – Design of shafts for complex loads– Shaft sizes. Design of Knuckle joints.

UNIT IV DESIGN OF KEYS AND COUPLINGS (12 Hrs)

Design of Keys - Stresses in keys. 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. Wei Jiang, ‘‘Analysis and Design of Machine Elements’’, Wiley, 2019.

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Web References

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2. https://nptel.ac.in/courses/112/105/112105124/
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)

U20MET511 **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, 3rdEdition, 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.
2. P.L.Ballaney, Theory of Machines and Mechanisms, 25th Edition, Khanna Publishers, 2016.

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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

(K.VELMURUGAN)

U20MET512 **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 ADVANCES IN METROLOGY (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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Web References

1. https://nptel.ac.in/courses/112106179/
2. https://nptel.ac.in/courses/112106138/
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

(K.VELMURUGAN)

U20BSP549

NUMERICAL METHODS LAB

(Common to ICE & MECH)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn the solution of algebraic and transcendental equations.
- To study the Eigen values and Eigen vectors of a matrix.
- To know the techniques of solving simultaneous equations.
- To introduce the numerical techniques of integration.
- To know the applications of Simpsons rule.

Course Outcomes

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

CO 1 - Find out the root of the Algebraic and Transcendental equations. **(K3)**
CO 2 - Find the Eigen values and Eigen vectors of a matrix **(K3)**
CO 3 - Solve the simultaneous equations. **(K3)**
CO 4 - Know the iterative Interpolation formula of integration. **(K3)**
CO 5 - Implement Simpsons Rule formula. **(K3)**

List of Experiments

1. Roots of non – linear equation using bisection method.
2. Roots of non – linear equation using Newton's method.
3. Find the largest Eigen value of a matrix by power - method.
4. Solve the system of linear equations using Gauss - Elimination method.
5. Solve the system of linear equations using Gauss – Jacobi method.
6. Solve the system of linear equations using Gauss - Jordan method.
7. Solve the system of linear equations using Gauss - Seidal iteration method.
8. Find the area by using trapezoidal rule.
9. Find the area by using Simpson's 1/3 rule.
10. Find the area by using Simpson's 3/8 rule

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)

U20MEP506 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. Study of Vernier Caliper, Micrometer.
2. Study of Vibration Measurement using Accelerometer.
3. Study of Profile projector.
4. Study of Coordinate Measuring Machine (CMM) for various elements.
5. Calibration of Vernier caliper, Micrometer and Height gauge.
6. Measurement of Wedge angle using Sine Bar.
7. Measurement of Thread Parameter Using Tool Maker's Microscope.
8. Measurement of Strain using Strain Gauges.
9. Measurement of Pressure using Strain Gauges.
10. Characteristics of Thermocouple.
11. Characteristics of Load cell.
12. Characteristics of LVDT.
13. Measurement of speed using stroboscope.
14. Inspection of gear tooth 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

Web References

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/metrologylabktrsrm/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)

U20MEP507 **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

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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	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)

U20MEP508 **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

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)

U20MEC5XX	CERTIFICATION COURSE - V	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.

U20MES504	SKILL DEVELOPMENT COURSE 4 (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

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U20MES505	SKILL DEVELOPMENT COURSE 5 HANDS-ON TRAINING IN 3D PRINTING	L	T	P	C	Hrs
		0	0	2	-	30

The official said that the theory classes have been designed in a simple manner to ensure that the students are able to grasp the topics in a short period of time. The training began with an explanation about the importance of CAD modelling, and the difference between model, prototype and products, Additive manufacturing (AM), broadly known as 3D printing, is transforming how products are designed, produced, and serviced. AM enables on-demand production without dedicated equipment or tooling, The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence. The skill training to improve the employability of the students and also impart industry relevant training for up-skilling the faculty and Industrial persons

U20MEM505 **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.

SEMESTER - VI

U20MET613 **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”, Dhanpat Rai and sons, 2004.
3. V.Ganesan, “Internal Combustion Engines”, Tata McGraw-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)

U20MET614 **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 BEARINGS (12 Hrs)

Theory of hydrodynamic bearing –design of journal bearing – heat dissipation – elementary ideas of hydrostatic bearings – bearing materials and lubricants. Rolling contact bearings – load capacity and life – selection of rolling contact bearings for radial and axial loads

UNIT II 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 III 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 IV 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 V GEAR BOX (12 Hrs)

Geometric Progression – standard step Ratio- Structural and ray diagrams - Design of sliding mesh gear boxes for machine tools – Design of bearings.

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)

U20MET615 **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, weighted residual methods, concept of potential energy.

UNIT II ONE DIMENSIONAL (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- one dimensional problems.

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, 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.
3. S.Siddu, Anup Goel, Parmeshwar Patil, N. I. Jamader, “Finite Element Analysis”, Technical publications, 2019.

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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

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U20MET616 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

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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)

U20MEP609 **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

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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)

U20MEP610 **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)

U20MEP611 **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 Koc, Tugrul Ozel, ‘‘Modern Manufacturing Processes’’, Wiley, 2019.

Web References

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

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U20MEC6XX	CERTIFICATION COURSE - VI	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.

U20MES606	SKILL DEVELOPMENT COURSE 6 (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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U20MES607	SKILL DEVELOPMENT COURSE 7 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.

U20MES608	SKILL DEVELOPMENT COURSE 8 (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

U20MEM606 **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 – VII

U20MET717 PRODUCTION PLANNING AND COST ESTIMATION

L	T	P	C	Hrs
2	2	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 production cost estimation.

Course Outcomes

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

CO1 - Differentiate standard/ non-standard working methodologies to enhance productivity. **(K2)**
CO2 - Develop operational procedures to perform process planning in industrial set up. **(K2)**
CO3 - Identify the costing methods and estimation procedures. (**K3)**
CO4 - Evaluate the cost ladder and various elements of cost to arrive the selling cost. **(K3)**
CO5 - Demonstrate the machining costs in an industry and calculate the production cost. **(K3)**

UNIT I WORK STUDY AND ERGONOMICS (9 Hrs)

Method study – Definition – Objectives-Motion economy- Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics – principles – applications.

UNIT II PROCESS PLANNING (9 Hrs)

Definition – Objective– approaches to process planning- Process planning activities – Finished part requirements - operating sequences - machine selection – material selection parameters- Set of documents for process planning - Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes.

UNIT III INTRODUCTION TO COST ESTIMATION (9 Hrs)

Importance and aims of cost estimation – functions of estimation – costing – importance and aims of costing – difference between costing and estimation – importance of realistic estimates – estimation procedure. Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation.

UNIT IV ELEMENTS OF COST (9 Hrs)

Introduction – Material Cost – determination of material cost, Labour cost – Analysis of Overhead Expenses – Factory Expenses – Depreciation – Methods – Administrative Expenses – Marketing Expenses - Ladder of Cost.

UNIT V PRODUCTION COST ESTIMATION (9 Hrs)

Estimation for forging - estimation for welding and gas cutting – estimation in foundry shop – estimation for machining – estimation for drilling and other metal removal operations - Illustrative Examples.

Text Books

1. Sinha.B.P., “Mechanical Estimating and Costing”, Tata McGraw-Hill, Publishing Co., 1995
2. Banga.T.R. Sharma.S.C., Mechanical Estimating and Costing, Khanna Publishers, 2006.
3. Panneerselvam, R. , Sivasankaran, P.Process Planning and Cost Estimation, Prentice-Hall of India, 2016.

Reference Books

1. Phillip.F Ostwalal and Jairo Munez, “Manufacturing Processes and systems”, John Wiley, 9th Edition, 1998
2. Russell.R.S and Tailor, B.W, “Operations Management”, PHI, 4th Edition, 2003.
3. Chitale.A.V. and Gupta.R.C. “Product Design and Manufacturing”, PHI, 2nd Edition, 2002.
4. M.Adithan,”Process planning and cost Estimation”, New Age International Publishers,2015
5. R. Kesavan, E.Elanchezhian, B.Vijaya Ramnath, Process planning and cost estimation, New Age International Publications, 2019

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Web References

1. https://nptel.ac.in/courses/112107238/
2. https://www.youtube.com/watch?v=yYIVumq6sVM
3. https://onlinecourses.nptel.ac.in/noc20_mg06/preview
4. https://www.youtube.com/watch?v=9qBZyzjoqAo
5. https://www.youtube.com/watch?v=UUZ3EV2Qn70

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

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

(K.VELMURUGAN)

U20MET718 **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.

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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	2	-	1	-	1	-	3	2	2	2

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

(K.VELMURUGAN)

U20HSP703 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**. (K2)**

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. **(K2)**

CO5 - Evaluate the effectiveness of different entrepreneurial strategies. **(K3)**

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 Entrepreneurial 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. Michael Laverty, Chris Little. Entrepreneurship, OpenStax publication,2020
2. Lasher, Perfect Business Plan Made Simple: The best guide to writing a plan that will secure financial backing for your business. Broadway Books, 2010.
3. Arjun Kakkar. Small Business Management: Concepts and Techniques for improving Decisions. Global India Publications, 2009.

Reference Books

1. Prajakt Raut, Starting up and Fund Raising, Notion Press, 2020.
2. Rhett Power, Entrepreneurs Book of Actions: Essential Daily Exercises and Habits for Becoming Wealthier, Smarter, and More Successful, McGraw-Hill Education, 2017.
3. Robert D. Hisrich, Veland Ramadani, Effective Entrepreneurial Management, Springer International Publishing, 2017
4. Eric W. Liguori, Mark, Entrepreneurship in Action- The Power of Student-Run Ventures, Edward Elgar Publishing, 2021.

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5. N. V. R. Naidu, Management and Entrepreneurship, I.K. International Publishing House Pvt. Limited,2013

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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)

U20MEP712 **AUTOMATION AND ROBOTICS LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To provide the student with basic of robots and its components.
- To familiarize with part program for the required robot motion
- To impart knowledge on Robot forward and reverse kinematics
- To impart knowledge on robot kinematics and programming for a given application.
- To provide the robotic applications, by interfacing it with real environment.

Course Outcomes

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

CO1 - Understand the type of robot and various motions. **(K2)**
CO2 - Generate part program for Robots to performing various tasks. **(K3)**
CO3 - Understand the robot forward and reverse kinematics. **(K3)**
CO4 - Solve direct and inverse kinematics and choose appropriate Robot for given application. **(K3)**
CO5 - Perform robot programming for a given application. **(K3)**

List of Experiments

1. Study of robot and its major components.
2. To impart simulation and programming software of robotics.
3. Demonstration of forward and reverse kinematics programming.
4. Programming a robot for performing Point-to-point motion of the manipulator arm.
5. Programming a robot for performing continuous path motion of the manipulator arm.
6. Combining an industrial robot with a conveyor.
7. Programming a robot to perform pick and place operation.
8. Programming a robot for material handling application
9. Programming a robot for processing application
10. Programming a robot for a sorting operation using a sensing system.

Reference Books

1. Rex Miller, Mark R. Miller “Robots and Robotics: Principles, Systems, and Industrial Applications “McGraw Hill Professional, 2017
2. Bruno Siciliano, OussamaKhatib “Springer Handbook of Robotics“Springer. – 2016
3. Kevin M. Lynch, Frank C. Park “Modern Robotics” Cambridge University Press - 2017
4. Thomas R. Kurfess “Robotics and Automation Handbook” CRC Press. – 2018
5. Mark W. Spong, Seth Hutchinson, M. Vidyasagar “Robot Modeling and Control” John Wiley & Sons. 2020

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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

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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	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)

U20MEP713 **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.

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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

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)

U20MEP714	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.

U20MEW701 **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 learn 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. **(K2)**
CO2 – Work independently to lead the project along with team members. **(K3)**
CO3 - Interpret the results and document the report. **(K3)**
CO4 - Communicate effectively through presentation. **(K3)**
CO5 - Design and Develop the working model. **(K4)**

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.

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	3	3	3	3
2	3	2	2	2	1	2	2	2	3	2	3	3	3	3	3
3	3	2	2	2	1	2	2	2	3	2	3	3	3	3	3
4	3	2	3	3	1	3	3	3	3	3	3	3	3	3	3
5	3	2	3	3	1	3	3	3	3	3	3	3	3	3	3

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

(K. VELMURUGAN)

U20MEW702	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 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.

U20MEM707 **PROFESSIONAL ETHICS**

L	T	P	C	Hrs
2	0	0	-	30

Course Objectives

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Course Outcomes

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

CO1 - Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

UNIT I HUMAN VALUES (6 Hrs)

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence andstress management.

UNIT II ENGINEERING ETHICS (6 Hrs)

Senses of „Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION (6 Hrs)

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS SAFETY (6 Hrs)

and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights –Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES (6 Hrs)

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development– Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility

Reference Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi,2004.
3. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics –Concepts and Cases", Cengage Learning, 2009
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
6. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", OxfordUniversity Press, Oxford, 2001
7. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and SocialResponsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi2013.
8. World Community Service Centre, " Value Education", Vethathiri publications, Erode,2011

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1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

SEMESTER – VIII

U20MET819 **POWER PLANT ENGINEERING**

L	T	P	C	Hrs
2	2	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

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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)

U20HSP804 **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)

U20MEW803 **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 design and fabrication of the products.
- To apply engineering disciplines and analysis the fabrication of the product.
- To compare the result analysis with follow standards norms develop the components.
- To conclude the developed product.

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. **(K2)**

CO2 - Enhance the financial management skills to achieve project goal in a stipulated time by working as a Team. **(K3)**

CO3 - Familiarize in technical writing skills and create a project proposal and report on completion. **(K3)**

CO4 - Develop a model comprising of real time application in the industry. **(K6)**

CO5 - Challenge and Achieve the real time solutions for industry and society oriented problems. **(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.

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	2	2	3	2	3	3	3	3	3
2	3	2	2	2	3	2	2	2	3	2	3	3	3	3	3
3	3	2	2	2	3	2	2	2	3	2	3	3	3	3	3
4	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3
5	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3

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

(K. VELMURUGAN)

U20MES809	SKILL DEVELOPMENT COURSE 9 (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

PROFESSIONAL ELECTIVES - I

		L	T	P	C	Hrs
U20MEE401	**GAS DYNAMICS AND JET PROPULSION**	**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.

(K.VELMURUGAN)

3. E. Rathakrishnan, “Gas Dynamics”, Prentice Hall of India, New Delhi, 2014.
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.

Web References

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

(K.VELMURUGAN)

U20MEE402 GEOMETRIC TOLERANCE AND DIMENSIONING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand Geometric Dimensioning and Tolerance standards to communicate design Intent.
- To Learn how the dimensioning and tolerance can affect part design and documentation
- To Learn Symbols, Geometric Characteristic of dimension
- To understand how dimensional variation can affect a design.
- To Gain added insight on working in a team design environment.

Course Outcomes

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

CO1 - Explain the geometrical requirements on engineering drawings. **(K1)**
CO2 - Interpret and specify dimensions and tolerance in professional manner. **(K3)**
CO3 - Explain geometric symbols and rules. **(K1)**
CO4 - Specify straightness, circularity and cylindricity tolerance. **(K3)**
CO5 - Define the orientation and profile of plane surfaces. **(K1)**

UNIT I INTRODUCTION TO GEOMETRIC DIMENSIONING AND TOLERANCE (9 Hrs)

Geometric product definitions principles , Geometric characteristics symbols, Chart symbols, Rules sheet, introduction to Geometric Tolerance, Coordinate tolerance, Geometric dimensioning, , Allowance and Clearance, GT & D Terms, GT & D rules, Concepts, Value of Tolerance, flat tolerance, straight tolerance, circularity and cylindricity tolerance.

UNIT II DIMENSIONING AND TOLERANCE FUNDAMENTALS (9 Hrs)

Fundamental Drawing Rules, Units of Linear Measurement, Specifying Linear Dimensions, Specifying Linear Tolerances, Interpreting Dimensional Limits, Specifying Angular Dimensions, Specifying Angular Tolerances, Dimensioning and Tolerancing for CAD/CAM Database Models.

UNIT III SYMBOLS, TERMS AND RULES (9 Hrs)

Symbols, Geometric Characteristic Symbols, Datum Feature Symbol, Feature Control Frame, Reading the Feature Control Frame, Other Symbols Used with Geometric Tolerancing, Terms, Rules, Limits of Size Prescribe Variations of Form, Applicability of Modifiers in Feature Control Frames, Pitch Diameter Rule.

UNIT IV FLATNESS AND STRAIGHTNESS (9 Hrs)

Definition, Specifying Straightness of Surface Tolerance, Specifying Straightness of Median Line, Circularity: Definition, Specifying Circularity Tolerance, Cylindricity: Definition, Specifying Cylindricity Tolerance, Free-State Variation- Problems.

UNIT V ORIENTATION, POSITION, LOCATION AND PROFILE (9 Hrs)

Definition, Specifying Perpendicularity of a Flat Surface, Tangent Plane, Specifying the Perpendicularity of an Axis to a Plane Surface, Parallelism, Angularity, Floating Fasteners, Fixed Fasteners, Projected Tolerance Zones, Multiple Patterns of Features, Specifying Profile Tolerance, Application of Datum Features, A Radius Refinement with Profile, Combining Profile Tolerances with other Geometric Controls.

Text Books

1. P.S.Gill, Geometric Dimensioning & Tolerancing,S. K. Kataria and Sons, 2009.
2. Alex Krulikowski, Fundamentals of Geometric Dimensioning and Tolerance, Cengage Learning, 2012.
3. Gene Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design 2/E, McGraw-Hill Professional, 2011.

Reference Books

1. Gene R. Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design, 3E, McGraw Hill Professional, 2020
2. David A. Madsen, Geometric Dimensioning and Tolerancing, Goodheart-Willcox Company, 2010
3. G.Henzold, Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, 1995.

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4. Paul J. Drake, Dimensioning and Tolerancing Handbook, McGraw-Hill Professional, 1999.
5. James D. Meadows, Geometric Dimensioning and Tolerance, Routledge, 2017.

Web References

1. https://www.fictiv.com/articles/gdt-101-an-introduction-to-geometric-dimensioning-and-tolerancing
2. https://formlabs.com/blog/gdt-geometric-dimensioning-and-tolerancing/
3. https://www.gdandtbasics.com/
4. https://www.youtube.com/watch?v=aS9OgYadjpY
5. https://www.youtube.com/watch?v=fXoWTHwElvo

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

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

(K.VELMURUGAN)

U20MEE403 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)

U20MEE404 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/

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4. https://cursa.app/en/course/mechanical-metal-casting-by-nptelhrd/9R19vNE1w2c
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)

U20MEE405 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

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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.

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3. MM.Wakil, Power Plant Technology, McGraw Hill Book Co, New Delhi, 2004.
4. Magal, "Solar Power Engineering", Tata McGraw Hill, 2005.
5. Non – Conventional Energy Sources. G.D. Rai, Khanna Publishers, 4th edition, 2009.

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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

		L	T	P	C	Hrs
U20MEE506	**TURBOMACHINERY**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To study about the classification of turbo machinery and the thermodynamics of fluid flow in turbo machines
- To adopt the knowledge of energy transfer mechanism in turbo machines.
- To gain the knowledge about steam turbines and its characterization.
- To teach about the various hydraulic turbines.
- To learn about the characterization of pumps and compressor.

Course Outcomes

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

CO1 - Explain the principle working of turbo machines and analysis of thermodynamic fluid flow in turbo machines. **(K2)**

CO2 - Analyse the energy exchange mechanism in all turbo machines. **(K3)**

CO3 - Illustrate the operation and principle of steam turbines. **(K2)**

CO4 - Explain the principle of hydraulic turbines and able to analyse the design of turbine blades. **(K4)**

CO5 - Interpret the working of pumps and compressors and its characteristics (**K3)**

UNIT I INTRODUCTION (9 Hrs)

Definition - parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynolds number, Unit and specific quantities. 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 and polytrophic efficiency for both compression and expansion processes.

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.

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, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

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.

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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.

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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

(K. VELMURUGAN)

U20MEE507 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

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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)

U20MEE508 **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

UNIT II (9 Hrs)

Metrics for Green Manufacturing" Introduction, Overview of Currently Used Metrics, Overview of LCA Methodologies, Metrics Development Methodologies. Green Supply Chain: Motivation and Introduction, Definition, Issues in Green Supply Chains (GSC), Techniques/Methods of Green Supply Chain. Principles of Green Manufacturing: Introduction, Background, and Technology Wedges, Principles.

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, Remanufacturing, Reuse, Approaches for Sustainable Factory Design.

Semiconductor Manufacturing: Overview of Semiconductor Fabrication and Green Manufacturing in the Semiconductor Industry

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.

UNIT V (9 Hrs)

Packaging and the Supply Chain: A Look at Transportation Introduction, Enabling Technologies for Assuring Green Manufacturing: Motivation, Process Monitoring System.

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

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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

1. https://nptel.ac.in/courses/112/104/112104225/
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=NSzvttpHdWY

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

U20MEE509 **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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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)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

(K.VELMURUGAN)

U20MEE510 IOT AND SMART MANUFACTURING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To learn about the depth knowledge of IoT.
- 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 Internet of things **(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 INTRODUCTION TO INTERNET OF THINGS (9 Hrs)

Introduction – Overview of Internet of Things (IoT), Characteristics of devices and applications in IoT, building blocks of IoT, IoT levels, IoT design methodology, The Physical Design and Logical Design of IoT, Functional blocks of IoT and Communication Models. M2M to IoT - Introduction, From M2M to IoT, M2M towards IoT.

UNIT II AUTOMATIC STORAGE MANAGEMENT AND SECURITY (9 Hrs)

Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, ASM in the Cloud. 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, 1stedition, 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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1. https://nptel.ac.in/courses/106/105/106105195/
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

U20MEE611 **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=lkuln7TWAl0
5. https://www.youtube.com/watch?v=owjMb76AIvE

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

(K.VELMURUGAN)

U20MEE612 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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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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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)

U20MEE613 **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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1. https://nptel.ac.in/courses/127/105/127105006/
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=phMLnHZgrnQ
5. https://www.youtube.com/watch?v=xwUKQcT1bKc

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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

(K.VELMURUGAN)

U20MEE614 **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. **(K4)**

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
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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4. https://www.journals.elsevier.com/additive-manufacturing
5. https://www.springer.com/journal/40964

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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)

U20MEE615 **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/

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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

(K.VELMURUGAN)

PROFESSIONAL ELECTIVE - IV

U20MEE716 **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 **(K1)**
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 **(K2)**
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

6. Ian Hutchings, Philip Shipway, Tribology: Friction and Wear of Engineering Materials, Elsevier, 2017
7. Theo Mang, Kirsten Bobzin, Thorsten Bartels, Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering**,** Wiley -VCH Verlag publication, 2011
8. A W Batchelor, G W Stachowiak Gwidon Stachowiak, Andrew W Batchelor, Engineering Tribology 2005 Edition.
9. Kirsten Bobzin, Theo Mang, and Thorsten Bartels, Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering, Lubrication, Wiley-vch Verlag Gmbh, 2010.
10. Harish Hirani, Fundamentals of Engineering Tribology with Applications, 2017

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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.
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

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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

(K.VELMURUGAN)

U20MEE717 **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 metallurgy
- 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 (9 Hrs)

Introduction, Classification of welding processes, types of fusion welds, welding symbols, Selection of electrodes, Various weld joint designs, position of welds, applications of welding. Brief review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding, Resistance welding. Electroslag welding, Friction welding, Soldering & Brazing.

UNIT II WELDING METALLURGY (9 Hrs)

Fundamentals of physical metallurgy: Need, phase diagrams: Fe-C, Al-Cu, Cu-Zn system, Effect of heat in various zones, HAZ, effect of welding parameters on weld structure, grain refinement principle of weld metal, Principle of solidification of weld metal, modes of solidification.

UNIT III MODERN WELDING TECHNIQUES AND ITS APPLICATIONS (9 Hrs)

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.
Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Under Water welding, Welding automation in aerospace, robotic welding, nuclear and surface transport vehicles.

UNIT ARC AND RESISTANCE WELDING, WELDING OF PLASTICS (9 Hrs)

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 WELD QUALITY TESTING AND INSPECTION (9 Hrs)

Weld quality parameters, weldability, weld faults, Destructive testing: Aggressive environment, Corrosion, hardness, hydrogen, residual stress measurement, fatigue, software, fracture and mechanical testing. Non destructive testing: Visual (VT), Ultrasonic (UT), Radiography (RT), Eddy Current (ET), Magnetic Particle (MT), Acoustic Emission (AE) , Dye Penetrant (PT), Leak Testing (LT).

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.
5. Srinivasan. N. K, Welding Technology, Khanna Publishers, 4th Edition, 2001.

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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	1	1	1	-	-	-	-	-	-	-	1	1	2	2
2	3	1	1	1	-	-	-	-	-	-	-	1	1	2	2
3	3	1	1	1	-	-	-	-	-	-	-	1	1	2	2
4	3	2	2	2	-	-	-	-	-	-	-	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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U20MEE718	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.

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2. Vinod Chandra S.S. and Anand Hareendran, Artificial Intelligence and Machine Learning, First Edition, PHI Learning Private Limited, 2014.
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

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	2	2	1	-	-	2	2	1	1	2	2	2
2	3	1	1	2	2	2	-	-	2	2	2	1	2	2	2
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

U20MEE719 **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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3. https://nptel.ac.in/courses/118/107/118107015/
4. https://nptel.ac.in/courses/118/102/118102003/
5. https://nptel.ac.in/courses/118/106/118106021/

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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U20MEE720	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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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)		
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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

U20MEE821 **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 **(K3)**
CO5 - Apply the knowledge of systematic planning methodology **(K3)**

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.
4. David T. Rowlands, John Maxey, and Michael L. George, The Lean Six Sigma Pocket Toolbook: A Quick Reference Guide to Nearly 100 Tools for Improving Quality and Speed, 2004.
5. Lonnie Wilson, How To Implement Lean Manufacturing, 2009.

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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.
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

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	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

U20MEE822 **CRYOGENIC ENGINEERING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To introduce the subject cryogenic engineering to the students.
- To provide the basics required from thermodynamics, heat transfer as well as refrigeration
- To make the students understand the various methods to create cryogenic temperatures and to maintain it.
- To make the students aware of the wide technological applications of cryogenics in various fields.
- To recognize the engineering problems solvable by applying cryogenic techniques.

Course Outcomes

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

CO1 - Demonstrate the concept of Cryogenics technology and its working cycles operations. **(K1)**
CO2 - Describe various properties of cryogenics fluids and its production processes. (**K2)**
CO3 - Acquire knowledge in various cryogenic liquefaction storage and handling systems. **(K2)**
CO4 - Identify the various measuring techniques involved to quantify the cryogenic fluids. **(K2)**
CO5 - Apply the knowledge of cryogenics techniques in various applications. **(K3)**

UNIT I INTRODUCTION TO CRYOGENICS AND ITS CYCLES (9 Hrs)

Definition and history of cryogenics, Gas-Liquefaction and refrigeration systems, thermodynamics of gas liquefaction, liquefaction cycles, cryogenic refrigeration systems down to milli Kelvin range, Dilution Refrigerator and adiabatic demagnetization.

UNIT II CRYOGENIC FLUIDS: PROPERTIES, SEPERATION AND PRODUCTION (9 Hrs)

Properties of cryogenic liquids, super fluidity, properties of solids at cryogenic temperatures, mechanical, thermal, electrical and magnetic properties, superconductivity Principle of air separation, production of gases like oxygen, nitrogen and argon.

UNIT III CRYOGENIC FLUIDS : STORAGE, INSULATION AND TRANSFER (9 Hrs)

Cryogenic insulations, storage and transfer of cryogenic liquids, cryostats, introduction to vacuum technology, cool down of cryogenic transfer lines, frost phenomena

UNIT IV INSTRUMENTATION IN CRYOGENICS (9 Hrs)

Instrumentation in Cryogenics: measurement temperature, thermocouples, platinum resistance and semiconductor thermometry- liquid level, flow rate, quality

UNIT V CRYOGENICS AND ITS APPLICATIONS (9 Hrs)

Cryogenics and its applications: applications of cryogenics in engineering, space technology, liquid fuel rockets, space simulation chambers, cryogenic heat pipes, nuclear research, bubble chambers, spectroscopy, cryo pumping, food processing, biology, medicine and LNG technology, cryocooler and its applications.

Text Books

1. S.S. Thipse, Cryogenics: A Textbook, Narosa, 2013.
2. A.R. Jha, Cryogenic Technology and Applications, Academic Press Inc.(London) Ltd, 2011.
3. Guglielmo Ventura and Lara Risegari, The Art of Cryogenics Low-Temperature Experimental Techniques, science Direct, 2008.
4. Mukhopadhyay Mamata, Fundamentals of Cryogenic Engineering , PHI Learning,
5. Zhao Z, Cryogenic Engineering and Technologies Principles and Applications of Cryogen Free Systems, Taylor and Francis, 2020.

Reference Books

1. Haselden C.J. (Ed) Cryogenic Fundamentals, Academic Press 1975.
2. Baily C.A. Advanced cryogenics. Plenum Press 1971.
3. Bahman Zohuri, Physics of Cryogenics An Ultralow Temperature Phenomenon, Elseivier, 2017.

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4. Valery V. Kostionk, A Text Book Of Cryogenics, Discovery Publishing House, 2003
5. G. Perinić, G. Vandoni, T. Niinikoski,Introduction to Cryogenic Engineering, CERN, 2005.

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2. https://trc.nist.gov/cryogenics/aboutCryogenics.html
3. https://home.cern/science/engineering/cryogenics-low-temperatures-high-performance
4. https://www.thoughtco.com/cryogenics-definition-4142815
5. https://www.academia.edu/38257014/_1_1_1_NPTEL_Introduction_to_Cryogenic_Engineering

COs/POs/PSOs Mapping

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3	3	2	2	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	2	2	2

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

(K. VELMURUGAN)

U20MEE823 **AUTOTRONICS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To explain the working of engine management System
- To understand the working of ignition and injection systems
- To teach the students regarding the working of sensors and actuators.
- To educate the students about electrical systems in automobiles.
- To make the students understand and to enhance the students knowledge regarding chassis and safety systems

Course Outcomes

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

CO1 - Understand the basic knowledge about engine management System. **(K2)**
CO2 - Acquire knowledge about ignition and injection systems. **(K2)**
CO3 - Summarize the working of sensors and actuators. **(K2)**
CO4 - Acquire knowledge about electrical systems in automobiles**. (K3)**
CO5 - Infer the details of chassis and safety systems in automobiles. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Fundamentals of Automotive Electronics: Microprocessor and micro Computer applications in automobiles; components for engine management System; electronic management of chassis system; vehicle motion control; electronic panel meters.

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 AUTOMOTIVE ELECTRICAL (9 Hrs)

Batteries; starter motor & drive mechanism; D.C. generator and alternator; regulation for charging; lighting design; dashboard instruments; horn, warning system and safety devices

UNIT V CHASSIS AND SAFETY SYSTEMS (9 Hrs)

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars

Text Books

1. N. R. Khatawale, Automotive Electrical auxiliary systems, 2017.
2. P.L.Kohli, Automotive electrical equipments, Tata McGraw hill publications,2016
3. William B.Ribbens, Understanding Automotive Electronics, 2014.
4. Tom Denton, Arnold, London, Automobile Electrical and Electronics Systems,2013
5. Robert Bosch – Automotive Hand Book, 5th Edition, SAE, 200

Reference Books

1. Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers, 2017.
2. Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint, 2015
3. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 2013.
4. Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication, 2000.
5. Barry Hollembeak, “Automotive Electricity, Electronics & Computer Controls”, Delmar Publishers, 2011.

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1. https://www.youtube.com/watch?v=c0zl7449pwE
2. https://www.youtube.com/watch?v=M1klF1_RQqE
3. https://www.youtube.com/watch?v=z4xkPyQn_ZU&list=PLO7bO9QDjtAYV5UcQAQsZPNEiO9FjScVj
4. https://youtu.be/c0zl7449pwE
5. https://youtu.be/z94jk49JzCk

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

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

(K.VELMURUGAN)

U20MEE824 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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1. https://nptel.ac.in/courses/112/101/112101298/
2. https://nptel.ac.in/courses/112/106/112106064/
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

(K.VELMURUGAN)

U20MEE825 **TOTAL QUALITY MANAGEMENT**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study the various methods of Quality Management
- To be appropriate the tools to implement six sigma in various organization.
- To acquire knowledge of tools used in Total quality management.
- To understand the service based management and Cost of Quality.
- To instruct students about Intellectual property system.

Course Outcomes

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

CO1 - Highlighting the lean Quality Management. **(K1)**
CO2 - Commenting fundamentals of total Quality Management **(K2)**
CO3 - Examining the concept of Total quality management. **(K3)**
CO4 - Distinguishing service based management and Cast of Quality **(K3)**
CO5 - Apply the knowledge of Intellectual properties system **(K3)**

UNIT I QUALITY AND QUALITY SYSTEMS (9 Hrs)

Quality: Objective, Concept and Dimensions of Quality, Quality Management System & Benefits, Understanding Voice of Customer (VOC) and Challenges in VOC Top Management Commitment, Quality Councils: Definition, Principles and Roles of Quality Councils for Implementation of TQM. Quality Statements, Eight building blocks of TQM.

UNIT II LEAN AND SIX SIGMA (9 Hrs)

Define Lean & Six Sigma, Features, Goals, ISO Standard, Six Sigma implementation, Operational Excellence, Belts & Roles of Belts, Principals of Determinism Pareto, DMAIC and DMADV, Critical Success factors for Six Sigma Project.

UNIT III TQM TOOLS (9 Hrs)

Quality Policy Deployment (QPD), Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Techniques , Total Productive Maintenance (TPM) – Concept and need, Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA- Failure Modes and Effective Analysis

UNIT IV SERVICE QUALITY MANAGEMENT AND COST OF QUALITY (9 Hrs)

Products and services, Classification of services, Service Quality, Measuring Service Quality, Prevention costs, Appraisal Costs, Internal and External failure costs, Cost of quality models, India's Quality Journey so far, Quality management in India, Quality related priorities of Indian companies, Case studies

UNIT V INTELLECTUAL PROPERTY RIGHTS (9 Hrs)

Definition of intellectual property, importance of IPR; TRIPS and its implications, patent, copyright, industrial design and trademark.

Text Books

1. J. Luis Guasch "Quality Systems and Standards for a competitive Edge"
2. Stephen George,Arnold Weimerskirch "Total Quality Management: Strategies & Techniques" by D.H.Stamatis Failure Mode & Effect Analysis: FMEA from theory to execution
3. Trivedi, Probability and Reliability with Statistics, PHI, 2012.
4. D.R Kiran, Total Quality Management: Key Concepts and Case Studies, BSP, 2016.
5. Arora, Total Quality Management, Kataria, 2011.

Reference Books

1. Douglas C. Montgomery, Introduction of Statistical Quality Control:, John Wiley & Sons, 2009.
2. Total Quality Management: Dale H. Besterfield , Hemant Urdhwareshe , Mary Besterfield-Sacre , Carol Besterfield-Michna , Rashmi Urdhwareshe , Glen H. Besterfield, Pearson, ISBN: 978-81-7758-412-7

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3. Douglas C. Montgomery , Design of Experiment:, John Wiley & Sons, 2015.
4. M. Mahajan, Statistical Quality Control, 2016
5. R.P.Mohanty and R.R.Lakhe , TQM in Service Sector, 2013.

Web References

1. https://hello.iitk.ac.in/course/mba663a21
2. https://onlinecourses.nptel.ac.in/noc20_mg34/preview
3. https://onlinecourses.nptel.ac.in/noc21_mg72/preview
4. https://www.careers360.com/university/indian-institute-of-technology-kanpur/total-quality-management-i-certification-course
5. https://edusparkz.com/course_details?course_id=11205

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

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

(K.VELMURUGAN)

PROFESSIONAL ELECTIVE - VI

U20MEE826 **COMPOSITES MATERIAL**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the need and types of composites available.
- To identify about polymer matrix composites and their properties, manufacturing methods and applications.
- To recognize about metal matrix composites and their properties, manufacturing methods and applications.
- To know about ceramic matrix composites and their properties, manufacturing methods and applications.
- To propose the advancements in composite materials.

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 - Understand different techniques to process polymer-matrix composites and its limitations. **(K2)**
CO3 - Gather 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. **(K4)**

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, Aspect Ratio. 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.

Web References

1. https://nptel.ac.in/content/storage2/courses/101106038/mod01lec01
2. https://www.classcentral.com/course/edx-composite-materials-overview-for-10
3. https://www.digimat.in/nptel/courses/video/112104229/L01.html
4. https://www.youtube.com/watch?v=VMH6qbED7pg
5. https://www.youtube.com/watch?v=PzdCymgyZ6c

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

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

(K. VELMURUGAN)

U20MEE827 **ALTERNATIVE FUELS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart the necessity of finding alternative energy sources for automobiles
- To acquire the general knowledge to deliver consistently high qualities of alcohols fuel an environment.
- To understand the methods and properties of vegetable oil using engine.
- To teach students about strategic issues associated with hydrogen as a fuel.
- To compare the emission characteristics of Biogas,NG and LPG

Course Outcomes

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

CO1 - Student will possess a comprehensive understanding of available alternative fuels for IC engines. **(K1)**

CO2 - Familiarize with knowledge on producing different biofuels, modifying them and using them in IC engines.
(K2)

CO3 - Acquire the skills in developing new technologies for alternative fuels efficiently in engine. **(K2)**

CO4 - Relate and learn the performance of alternate fuels in IC engines. **(K2)**

CO5 - Demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels, Scenario of conventional auto fuels, fuel quality aspects related to emissions. Technological up gradation required, business driving factors for alternative fuels. Implementation barriers for alternative fuels.

UNIT II ALCOHOLS AS FUELS (9 Hrs)

Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT III VEGETABLE OILS AS FUELS (9 Hrs)

Base materials used for production of Bio Diesel, Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

UNIT IV HYDROGEN AS ENGINE FUEL (9 Hrs)

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen.

UNIT V BIOGAS, NATURAL GAS AND LPG AS FUELS (9 Hrs)

Introduction of biogas system, Production methods of Biogas, Natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines.

Text Books

1. M. K. Gajendra Babu and K. A. Subramanian, “Alternative Transportation Fuels-Utilisation in Combustion Engines”, CRC Press, 2013.
2. Avinash Kumar Agarwal, Rashmi Avinash Agarwal, Tarun Gupta, Bhola Ram Gurjar,”Boifuels: Technology, Challenges and Prospects” springer, 2017.
3. David M. Mousdale, “Introduction to Biofuels”, CRC Press, 2015.

Reference Books

1. Ayhan Demirbas, ‘Biodiesel A Realistic Fuel Alternative for Diesel Engines’, Springer-Verlag London Limited 2008.

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2. Ayhan Demirbas and M. Fatih Demirbas, “Algae Energy-Algae as a New Source of Biodiesel”, Springer-Verlag London Limited 2010.
3. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997.
4. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
5. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.

Web References

1. https://www.iitk.ac.in/me/alternate-fuels-and-internal-combustion-engines
2. https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture39.pdf
3. https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture35.pdf

COs/POs/PSOs Mapping

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

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

(K.VELMURUGAN)

U20MEE828 **ELECTRICAL AND HYBRID VEHICLES**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To Understand electric vehicle technology and electric vehicles
- To acquire the knowledge on hybrid and electric drive trains
- To perform design calculations of hybrid system under study.
- To impart knowledge on various storage system used in electric and hybrid vehicle technology
- To teach students about energy strategic issues associated with hybrid and electric vehicle.

Course Outcomes

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

CO1 - Select appropriate source of energy for the electric vehicle based on driving cycle. **(K2)**

CO2 - Analyse the power and energy need of the various hybrid electric vehicles. **(K2)**

CO3 - Measure and Estimate the energy consumption of the Hybrid Vehicles. **(K3)**

CO4 - Evaluate energy efficiency of the vehicle for its drive trains. **(K3)**

CO5 - Demonstrate the importance of energy management strategies used in hybrid and electric vehicles. **(K4)**

UNIT I INTRODUCTION TO ELECTRIC VEHICLE (9 Hrs)

History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions

UNIT II INTRODUCTION TO HYBRID ELECTRIC VEHICLE (9 Hrs)

Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis

UNIT III ELECTRIC DRIVE TRAINS (9 Hrs)

Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. 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 IV TYPES OF STORAGE SYSTEMS (9 Hrs)

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. selecting the energy storage technology, Calculation for the rating

UNIT V ENERGY MANAGEMENT STRATEGIES (9 Hrs)

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. Introduction to various charging techniques and schematic of charging stations.

Text Books

1. Iqbal Husain, "Electic and Hybrid vehicles Design Fundamentals", CRC Press, second enition 2013.
2. James Larminie, John Lowry, "Electric vehicle technology Explained" second Edition, Wiley 2012.
3. M. Abul Masrur& Chris Ml, "Hybrid Electric Vehicle," Wiley Publishers, 2011

Reference Books

1. Ronald k.Gergon, "Electric and hybrid-electric vehicles : fuel cell hybrid EVS", SAE, 2011.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
3. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

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4. Babu.A.K, “Electric and Hybrid Vehicles”, Khanna publishing house, 2018.
5. Ali Emadi, "Hand book of Automotive Power Electronics and Motor Drives" ,CRC Press 2005

Web References

1. https://nptel.ac.in/course.html
2. Ocw.mit.edu/courses
3. https://www.eng.mcmaster.ca/mech/content/electric-and-hybrid-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	2	2	1	-	-	-	2	-	-	1	-	1	2	1	1
2	2	2	1	-	-	-	2	-	-	1	-	1	2	1	1
3	2	2	1	-	-	-	2	-	-	1	-	1	2	1	1
4	2	2	1	-	-	-	2	-	-	1	-	1	2	1	1
5	2	2	1	-	-	-	3	-	-	1	-	1	2	1	1

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

(K.VELMURUGAN)

U20MEE829 MAINTENANCE AND SAFETY ENGINEERING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To learn about the fundamentals of industrial safety and maintenance
- To understand the fault finding and Tracing techniques
- To learn the Periodic and Preventive Maintenance
- To identify the principles of Industrial safety and prevention of accidents
- To comprehend the various safety acts

Course Outcomes

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

CO1 - Identify various types of Maintenance policies used in industries. **(K2)**
CO2 - Identify and apply the various faults finding in machines. **(K2)**
CO3 - Implement Trouble shooting of machines. **(K3)**
CO4 - Demonstrate different safety methods and protective equipment's. **(K3)**
CO5 - Discuss safety acts and legal provisions. **(K3)**

UNIT I INTRODUCTIONOFMAINTENANCE ENGINEERING (9 Hrs)

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT II FAULT TRACING (9 Hrs)

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, Draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's for various machine components.

UNIT III PERIODIC AND PREVENTIVE MAINTENANCE (9 Hrs)

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, Preventive maintenance - Definition, need, steps and advantages. Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

UNIT IV INDUSTRIALSAFETY AND PREVENTION OF ACCIDENTS (9 Hrs)

Introduction to the development of industrial safety and management, Implementation of factories act, Formation of various councils, Safety and productivity, Safety organizations. Safety committees, Roll of management and roll of Govt. in industrial safety, Safety analysis, Accident preventions, protective equipment's and the Acts, First aid, Firefighting equipment. Accident reporting, Investigations, Industrial psychology in accident prevention.

UNIT V SAFETY ACTS (9 Hrs)

Introduction of Explosive Act, Boiler Act, ESI Act, Workman's compensation Act.Features of Factory Act. Industrial hygiene, Occupational safety, Diseases prevention, Ergonomics, Occupational diseases. Stress, fatigue, health, safety and the physical environment, safety and the physical environment. Control of industrial noise and protection against it, Code and regulations for worker safety and health.

Text Books

1. M.P. Poonia, S.C. SharmaIndustrial Safety and Maintenance Management, Khanna Publishing House, 2019
2. L.M. Deshmukh, Industrial Safety Management,McGraw Hill Education,2017
3. A.K.Guptha, Reliability, Maintenance and Safety Engineering, Laxmi Publications,2015

Reference Books

1. R.C.Mishra, Maintenance Engineering and Management, PHI Learning Pvt. LtdI, 2012
2. Elsayed, Reliability Engineering, 3rd Editions Pearson. 2020

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3. B.S Dhallon, Engineering Maintenance a modern approach, C.R.R Publishers.2002
4. Alakesh Manna, A Text Book of Reliability and Maintenance Engineering, IK International Publishing House 2011
5. NVS Raju Plant Maintenance and Reliability Engineering, Cengage Learning, 2011

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2. https://onlinecourses.nptel.ac.in/noc19_me40/preview
3. https://www.youtube.com/watch?v=v-eltsixu4I
4. https://www.youtube.com/watch?v=USGuag1Jids
5. https://www.youtube.com/watch?v=fleaH8McK0s

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

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

(K. VELMURUGAN)

U20MEE830 NON-DESTRUCTIVE EVALUATION AND TESTING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basic principles of NDET techniques.
- To understand the Radiography testing techniques and its applications.
- To learn the working principles of Eddy Current and Ultrasonic Testing methods.
- To describe Acoustic Emission testing in industrial applications.
- To analysis various defects caused by casting and welding.

Course Outcomes

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

CO1 - Obtain the fundamental knowledge about different NDT methods. **(K2)**
CO2 - Understand the theory of non-destructive testing methods is used for different materials. **(K2)**
CO3 - Appy the Eddy Current Testing (ET) and ultrasonic methods on components surface. **(K4)**
CO4 - Apply emerging techniques like holography and MRI. **(K2)**
CO5 - Understand various defects and methods to select appropriate NDET method. **(K2)**

UNIT I INTRODUCTION TO NDET **(9 Hrs)**

Introduction to non-destructive testing and evaluation, Codes, standards, specification and procedures, visual examination, liquid penetrant testing and magnetic particle testing. Applications and limitations of each of these techniques.

UNIT II RADIOGRAPHIC TESTING **(9 Hrs)**

Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrameter, radiographic imaging, Exposure chart, inspection standards and techniques, neutron radiography. Real Time Radiography, Advantages and Limitations, Applications, Case studies.

UNIT III EDDY CURRENT TESTING AND ULTRASONIC TESTING **(9 Hrs)**

Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.

UNIT IV EMERGING TECHNIQUES **(9 Hrs)**

Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography. Advantages and Limitations, Applications, Case studies.

UNIT V DEFECTS IN MATERIALS **(9 Hrs)**

Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Case studies.

Text Books

1. Baldevraj, Jayakumar T., Thavasimuthu M., “Practical Non-Destructive Testing”, 3rd edition, Narosa Publishers. 2008.
2. Earl, N.Mallory, ‘‘Nondestructive testing’’ Nova science publishers Inc, 2011.
3. Gerhard Huebschen, Hans-Georg Herrmann, Iris Altpeter, Ralf Tschuncky, ‘‘Materials Characterization Using Nondestructive Evaluation (NDE) Methods’’ Elsevier Science, 2016.
4. Anderson, S.Ramachandran, T.Rajesh Kumar, Nondestructive testing, 1st edition, Airwalk Publications, 2017.
5. Giuseppe Lacidogna, ‘‘Nondestructive Testing (NDT)’’, MDPI, 2021.

Reference Books

1. Paul E Mix, “Introduction to nondestructive testing: a training guide”, Wiley, 2nd edition
2. New Jersey, 2005.
3. Ravi Prakash, “Nondestructive Testing Techniques”, 1st. edition, New Age International Publishers, 2010.
4. Fausteo Pedro Garcia Maruez, Nondestructive testing, Intech open, 2016.

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5. D.G.Aggelis, Emerging Technologies in Nondestructive testing VI, CRC, 2016.
6. Nathan Ida and Norbert Meyendorf, ‘‘Handbook of advanced nondestructive evaluation’’ Springer International publishing, 2019.

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1. https://www.youtube.com/watch?v=oqMXbxk4RHI
2. https://www.ndt.net/index.php
3. https://www.cpcc.edu/programs/nondestructive-examination-technology
4. https://www.fujifilm.com/us/en/business/industrial-materials/non-destructive-testing
5. https://www.olympus-ims.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	1	-	-	-	-	1	1	1	2	2
2	3	-	-	-	2	1	-	-	-	-	1	1	1	1	2
3	3	-	-	-	2	1	-	-	-	-	1	2	1	1	2
4	3	-	-	-	2	1	-	-	-	-	1	1	1	2	2
5	3	-	2	1	2	1	-	2	-	-	1	2	1	1	2

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

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OPEN ELECTIVE - I

		L	T	P	C	Hrs
U20EEO401	**SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS**	3	0	0	3	45

(Common to ECE, ICE, MECH, CIVIL, Mechatronics)

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.

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4. Michael Boxwell, “The Solar Electricity Handbook”, Green stream Publishing, 10th Edition, 2016.
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

(K. VELMURUGAN)

U20EEO402 **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.

Web References

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)

U20ECO401	ENGINEERING COMPUTATION WITH MATLAB (Common to EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics)	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 OkyereAltla, “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

(K.VELMURUGAN)

CONSUMER ELECTRONICS

		L	T	P	C	Hrs
U20ECO402	(Common to EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT)	**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

(K. VELMURUGAN)

U20CSO401	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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2. https://www.geeksforgeeks.org/web-technology/
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
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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	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

(K.VELMURUGAN)

U20CSO402	ANALYSIS OF ALGORITHMS	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	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, 3rdEdition, 2009.
3. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Pearson Education, Third Edition, 2012.

Reference Books

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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2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
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/

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	2	1	-	-	-	-	-	1	-	-
2	3	2	3	3	2	2	1	-	-	-	-	-	1	-	1
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

(K.VELMURUGAN)

U20ITO401	DATABASE SYSTEM: DESIGN & DEVELOPMENT (Common to EEE, ECE, ICE, CCE, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand the various data models, conceptualize E-R diagram and depict using relational model
- Gain knowledge about database languages and frame query using Relational Algebra and SQL
- Understand and design an efficient database schema using the various normal forms
- Impart knowledge on data storage and transaction processing, concurrency control techniques and recovery procedures
- Explore knowledge on tools and practice case studies

Course Outcomes

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

CO1 - Explain the concepts of Database Management System and develop Entity Relationship model and Relational Models for a given application **(K2)**

CO2 - Manipulate and build database queries using Structured Query Language and relational algebra **(K2)**

CO3 - Apply data normalization principles to develop a normalized database for a given application. **(K3)**

CO4 - Explain various storage & indexing techniques, transactions and recovery techniques **(K2)**

CO5 - Apply tools like NoSQL, MongoDB, Cassandra on real time applications **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Database Systems– Data Models – Database System Architecture - Entity-Relationship Model - ER Diagram- Extended ER Model –ER into Relational Model - Relational Model: Structure of Relational Databases, Database Schema, Keys, Tables

UNIT II DATABASE LANGUAGES (9 Hrs)

Relational Algebra – Extended-Relational Algebra Operations –SQL: Introduction – DDL – DML –Integrity Constraints-Set Operations-Joins – Nested Queries -View- Trigger - Stored Procedures

UNIT III RELATIONAL-DATABASE DESIGN (9 Hrs)

Introduction to Schema Refinement – Decomposition – Lossless Decomposition – Functional Dependencies – Normal Forms - First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form.

UNIT IV DATA STORAGE (9 Hrs)

RAID - File Organization - Indexing, Ordered Index, Index files, Hashing - Static and dynamic hashing.
Transactions: Transaction concepts and states– Concurrent Execution-Serializability-Concurrency Control: Lock based Protocol - Timestamp based Protocol - Recovery System: – Log-Based Recovery – Shadow Paging

UNIT V CASE STUDY (9 Hrs)

NoSQL – Document Database : MongoDB - Multi-dimensional: Cassandra

Text Books

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, 7thEdition – McGraw-Hill Higher Education, International Edition, 2019.
2. Ramez Elmasri, and Shamkant B. Navathe, Fundamentals of Database Systems (7th edition), Publisher: Pearson,2016

Reference Books

1. Raghu Ramakrishnan, - Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
2. Date C J, Kannan A and Swamynathan S, - An Introduction to Database Systems‖, 8th Edition, Pearson Education, New Delhi, 2006.
3. Alan Beaulieu, Mastering SQL Fundamentals, Second Edition, O'Reilly,2009
4. Kristina Chodorow; Shannon Bradshaw MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, Inc., 2018.

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5. Pramod J. Sadalage (Author), Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Kindle Edition.

Web References

1. http://www.database.com/
2. http://cassandra.apache.org/
3. https://www.mongodb.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
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2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
5	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1

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

(K.VELMURUGAN)

U20ITO402	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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Web References

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)

U20ICO401	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

U20ICO402	INDUSTRIAL SAFETY MANAGEMENT (Common to CSE, IT, MECH, CCE, AI&DS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To get adequate knowledge about Energy conversion.
- To get adequate knowledge about Energy management
- To understand the Air pollutants and global climate
- To get knowledge about the Safety measures
- To Know about the Safety preventions in Power Plants

Course Outcomes

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

CO1- Understand the energy conversion and its management **(K1)**

CO2 - Understand the energy management and energy conservation in industries **(K2)**

CO3 - Understand about the pollutions and different types of pollutions **(K1)**

CO4 -Understand the safety measures and policies **(K1)**

CO5 - Understand the safety codes and standards **(K1)**

UNIT I ENERGY CONVERSION (9 Hrs)

Energy conversion – world fossil fuel reserves – world energy consumption – historical lives of fossil fuels – global energy and environmental management – environmental aspects of fossil, nuclear, hydro and biomass energy conversion – gaseous emissions – solid waste – liquid waste

UNIT II ENERGY MANAGEMENT (9 Hrs)

Energy management – need for energy conservation – energy auditing – conducting real time continuous energy audits – data collection – automated data acquisition – data analysis – role of energy manager – energy audit instruments – gas analyzer – energy conservation in industries: boilers, pumps, fans, compressed air systems, refrigeration and air conditioning systems, DG sets, electrical motors, variable speed motors

UNIT III AIR POLLUTANTS AND POLLUTION CONTROL (9 Hrs)

Air pollutants and global climate – air pollutant effects. Pollution control laws and regulation – national and international – role of environmental monitoring in environmental management systems – continuous emissions monitoring systems. Pollution control – review of pollution control methods in thermal power plants –industrial – nuclear – automobiles – disposal/treatment of solid and liquid wastes –alternate fuels

UNIT IV SAFETY MEASURES (9 Hrs)

Safety and productivity – causes of accidents in industries – accidents reporting and investigation – measuring safety performance – workman compensation rules.

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UNIT V SAFETY PREVENTIONS (9 Hrs)

Safety codes and standards – general safety considerations in power plants, pressure vessels and pressurized pipe lines – operation and inspection of extinguishers – preventing the spread of fire – emergency exit facilities

Text Books

1. Blake Roland. P, “Industrial safety”, Prentice Hall of India, 2014
2. Callaghan. P. O, “Energy Management”, McGraw Hill Book Co., 2011

Reference Books

1. Culp. A. W, “Principles of Energy Conservation”, McGraw Hill Book Co., 2012
2. Noel de Nervers, “Air Pollution Control Engineering”, McGraw Hill Book Co.,2009

Web References

1. https://www.youtube.com/watch?v=9cLsR-78Nsk
2. https://www.academia.edu/7775550/BASIC_CONCEPTS_IN_INDUSTRIAL_SAFETY

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

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

(K.VELMURUGAN)

U20CEO401	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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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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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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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)

U20CEO402 **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

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2. Basic civil engineering : S.S.Bhavikatti New Age International Limited, 2010
3. Interior Design and Decoration: Seetharaman P.2019

Web References

1. https://www.youtube.com/watch?v=XsFeVuVQE-E
2. https://www.youtube.com/watch?v=LYvDoy7MtkE
3. https://www.youtube.com/watch?v=zjZVlFt3WQY
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

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MEDICAL ELECTRONICS

		L	T	P	C	Hrs
U20BMO401	(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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2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapetic systems
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

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	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

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BASIC DBMS

		L	T	P	C	Hrs
U20CCO401	(Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME Branches)	**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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1. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
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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U20CCO402	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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2. https://nptel.ac.in/courses/108/102/108102096/
3. http://www.electronics-tutorials.ws

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4. www.tutorialspoint.com
5. https://nptel.ac.in/courses/108/104/108104091/

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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		L	T	P	C	Hrs
U20ADO401	**KNOWLEDGE REPRESENTATION AND REASONING** (Common to EEE,ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various processes based on its context techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes

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

CO1 - Analyze and design knowledge based systems intended for computer implementation. **(K3)**
CO2 - Acquire theoretical knowledge about principles for logic-based representation and reasoning. **(K2)**
CO3 - Ability to understand knowledge-engineering process. **(K2)**
CO4 - Ability to implement the process according to the context. **(K3)**
CO5 - Learn the process, knowledge acquisition and sharing of ontology. **(K2)**

UNIT I EVOLUTION OF KNOWLEDGE REPRESENTATION (9 Hrs)

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic. Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT II ONTOLOGY AND ITS CLASSIFICATION (9 Hrs)

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time.

UNIT III KNOWLEDGE REPRESENTATION (9 Hrs)

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation.

UNIT IV PROCESSES, CONTEXTS AND AGENTS (9 Hrs)

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT V KNOWLEDGE SOUP, ACQUISITION AND SHARING (9 Hrs)

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics. Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition.

Text Books

1. John F. Sowa, Thomson Learning “Knowledge Representation logical, Philosophical, and Computational Foundations”, Course Technology Inc. publication, 1999.
2. Ronald J. Brachman, Hector J. Levesque, ”Knowledge Representation and Reasoning”, Morgan Kaufmann; 1st edition, 2004.
3. Eileen Cornell Way “Knowledge Representation and Metaphor” Springer; 1st edition, 1991.

Reference Books

1. Trevor Bench-Capon, “Knowledge representation: an approach to artificial intelligence”, Academic Press, 2014.
2. Yulia Kahl, Michael Gelfond “Knowledge Representation, Reasoning, and the Design of Intelligent Agents The Answer-Set Programming Approach”, Cambridge University Press; 1st edition, 2014.
3. Arthur B. Markman, “Knowledge representation” Psychology Press; 1st edition, 1998.

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4. Sanida Omerović, Grega Jakus, V. Milutinovic, Sašo Tomažič “Concepts, Ontologies, and Knowledge Representation” Springer; 2013.
5. Bernhard Nebel, Gerhard Lakemeyer “Foundations of Knowledge Representation and Reasoning” Springer, 1994.

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1. https://www.javatpoint.com/knowledge-representation-in-ai
2. https://nptel.ac.in/courses/106/106/106106140/
3. https://www.youtube.com/watch?v=kXlr6ydiPAQ

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

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

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INTRODUCTION TO DATA SCIENCE

		L	T	P	C	Hrs
U20ADO402	(Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To learn the basics of data science
- To enable the students to understand the statistics and probability.
- To understand the tools in developing and visualizing data.
- To gain good knowledge in the application areas of data science.
- To inculcate the perceiving, ethics surrounding privacy and acting of data science applications.

Course Outcomes

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

CO1 - Explore the fundamental concepts of data science. **(K2)**
CO2 - To understand the Mathematical Knowledge for Data Science. **(K2)**
CO3 - Visualize and present the inference using various tools. **(K3)**
CO4 - To expose the different opportunities in Industries. **(K3)**
CO5 - Learn to think through the ethics surrounding privacy, data sharing and decision-making. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE (9 Hrs)

Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape – Who is Data Scientist - Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modeling – Presentation.

UNIT II MATHEMATICAL PRELIMINARIES (9 Hrs)

Probability: Probability vs. Statistics – Compound Events and Independence – Conditional Probability – Probability Distribution. Descriptive Statistics: Centrality Measures – Variability Measures - Interpreting Variance – Characterizing Distributions. Correlation Analysis: Correlation Coefficient – The Power and Significance – Detection Periodicities.

UNIT III DATA SCIENCE TOOLS (9 Hrs)

Introduction to Data Science Tool – Data Cleaning Tools – Data Munging and Modelling Tools – Data Visualization Tools – Tools for Data Science.

UNIT IV INDUSTRIALIZATION, OPPORTUNITIES AND APPLICATIONS (9 Hrs)

Data Economy and Industrialization – Introduction: Data Economy, Data Industry, Data Services – Data Science Application: Introduction, General Application Guidance - Different Domain – Advertising – Aerospace and Astronomy – Arts, Creative Design and Humanities – Bioinformatics – Consulting Services – Ecology and Environment – Ecommerce and Retail - Education – Engineering – Finance and Economy – Gaming.

UNIT V ETHICS AND RECENT TRENDS (9 Hrs)

Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

Text Books

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, “Introducing Data Science”, Manning Publications Co., 1st edition, 2016.
2. Chirag Shah, “A Hands on Introduction to Data Science“, Cambridge University Press, 2020.
3. SinanOzdemir, “Principles of Data Science”, Packt Publication, 2016.
4. D J Patil, Hilary Mason, Mike Loukides, “Ethics and Data Science”, O’ Reilly, 1st edition, 2018.

Reference Books

1. Hector Guerrero, “Excel Data Analysis: Modeling and Simulation”, Springer International Publishing, 2nd Edition, 2019.
2. Paul Curzon, Peter W. Mc Owan, “The Power of Computational Thinking”, World Scientific Publishing, 2017.
3. Steven S. Skiena, “Data Science Design Manual”, Spring International Publication, 2017.

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4. Rajendra Akerkar, Priti Srinivas Sajja, “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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1. https://www.youtube.com/watch?v=-ETQ97mXXF0&ab_channel=edureka%21
2. https://www.javatpoint.com/data-science
3. https://www.coursera.org/browse/data-science /

COs/POs/PSOs Mapping

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

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

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OPEN ELECTIVE- II

		L	T	P	C	Hrs
U20EEO503	CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT)	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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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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2. https://nptel.ac.in/courses/112/107/112107291/
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

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	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

(K.VELMURUGAN)

U20EEO504	INDUSTRIAL DRIVES AND CONTROL (Common to ECE, ICE, MECH, Mechatronics, AI&DS)	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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2. www.siemens.com/metal
3. www.siemens.comn/sugar
4. www.abb.com/industries
5. www.krupp polysius.com
6. www.voith.paper.com
7. www.abb.com/drives

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	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)

U20ECO503	ELECTRONIC PRODUCT DESIGN AND PACKAGING (Common to EEE, CSE, IT, ICE, MECH, CCE, BME, 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.

Reference Books

1. Blackwell (Ed), “The electronic packaging handbook”, CRC Press, 2000.
2. R.S.Khandpur, “Printed Circuit Board”, Tata McGraw Hill, 2005

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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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1. http://www.logopeople.in/blog/awesome-packaging-design-of-electronic-products-for-inspiration/
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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1	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
2	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
3	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
4	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
5	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-

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

(K.VELMURUGAN)

U20ECO504 **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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2. https://www.youtube.com/watch?v=AiQpYO5E-go
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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1	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
2	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
3	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
4	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-
5	3	1	1	-	-	-	-	-	-	1	-	-	-	-	-

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

(K.VELMURUGAN)

U20CSO503 **PLATFORM TECHNOLOGY**

(Common to EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS)

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.

Web References

1. https://www. nptel.ac.in/
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

(K.VELMURUGAN)

U20CSO504	GRAPHICS DESIGNING (Common to EEE, ECE, ICE, MECH, CIVIL, BME, FT)	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.

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3. Ken Pender, “Digital color in Graphics Design”, CRC Press 2012.

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/

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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)

U20ITO503	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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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/

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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)

	MOBILE APP DEVELOPMENT	L	T	P	C	Hrs
U20ITO504	(Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS)	**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. Schller, “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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1. Developers : http://developer.android.com/index.html
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

(K. VELMURUGAN)

DISASTER MANAGEMENT

U20CEO503

(Common to EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT)

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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1. http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf
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)

U20CEO504	AIR POLLUTION AND SOLID WASTE MANAGEMENT (Common to EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT)	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.

Reference books

1. P. Aarne Vesilind, William Worrell & Debra Reinhart, 2002, Solid Waste Engineering, Cengage Learning India pvt. Ltd.

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2. Dr. Y Anjaneyulu, 2002, Air Pollution and Control Technologies, Allied Publisher pvt. Ltd.
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)

U20BMO503	BIOMETRIC SYSTEMS (Common to EEE, ECE, CSE, IT, ICE, CCE, 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

(K.VELMURUGAN)

MEDICAL ROBOTICS

U20BMO504 (Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , 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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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

(K.VELMURUGAN)

U20CCO503	NETWORK ESSENTIALS (Common to EEE, MECH, 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 protocolsuite-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.

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3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan and Firouz Mosharraf, “Computer Networks a Top Down Approach”, Tata McGraw-Hill, 2017.
5. Rich Seifert, James Edwards, ”The All New Switch Book: The Complete Guide to LAN Switching Technology”, 2nd Edition , Wiley Publishing Inc, 2011

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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

(K.VELMURUGAN)

U20CCO504 **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 pro cess, 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

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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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U20ADO503	PRINCIPLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE)	L	T	P	C	Hrs
		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 References

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

DATA SCIENCE APPLICATION OF VISION

U20ADO504

(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 References

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

U20HSO601 **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. Kari 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.
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

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5. Kumar, A., Jain, P. K., & Pathak, P. M. Reverse engineering in product manufacturing: an overview. DAAAM international scientific book.

Web References

1. http://www.worldcat.org/title/product-design-and-development/oclc/904505863
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
6. https://swayam.gov.in/nd1_noc20_de05/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	-	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

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U20HSO602 **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.

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.

Web References

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)

U20HSO603 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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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

Web References

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)

U20HSO604 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)

U20HSO605 **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)

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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 editio n)

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3. https://finance.yahoo.com/
4. https://icmai.in/icmai/
5. https://nptel.ac.in/courses/110/107/110107144/
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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)

OPEN ELECTIVE – IV

U20EEO705	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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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

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	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)

U20EEO706	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.

Reference Books

1. P. Venkataseshaiah K.V. Sharma, “Energy Management and Conservation”, Dreamtech Press, 1stEdition, 2020.
2. Amit K. Tyagi, “Handbook on Energy Audits and Management”, TERI, 1st Edition, 2003.

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3. ICAI, “Electricity in buildings good practice guide”, McGraw-Hill Education, 1st Edition, 2017.

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2. https://www.youtube.com/watch?v=onIhwmbL8CA
3. https://www.youtube.com/watch?v=CTt4y8bokWs
4. https://ieeexplore.ieee.org/document/7977655
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

(K. VELMURUGAN)

U20ECO705	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

(K. VELMURUGAN)

U20ECO706	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, VIEdition, 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

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5. Curtis D. Johnson, “Process Control Instrumentation Technology”, Prentice Hall International Edition, 2015.

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1. https://www.first-sensor.com/en/applications/industrial/
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

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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

U20CSO705 **ARTIFICIAL INTELLIGENCE** **L T P C Hrs**

(Common to EEE, ICE, CIVIL, MECH,CCE, FT) **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)

U20CSO706 **CLOUD TECHNOLOGY AND ITS APPLICATIONS** **L T P C Hrs**

(Common to EEE, ICE, MECH, CIVIL, BME, CCE, Mechatronics) **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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Reference Books

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.

Web References

1. www.coltdatacentres.net/Cloud Technology.
2. www.zdnet.com.
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)

U20ITO705	AUTOMATION TECHNIQUES & TOOLS - DEVOPS	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics)	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)

U20ITO706	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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Web References

1. https://www.coursera.org/courses?query=augmented%20reality
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

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U20ICO705 **INDUSTRIAL AUTOMATION**

(Common to EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics)

L	T	P	C	Hrs
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.

Web References

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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4. https://onlinecourses.nptel.ac.in/noc20_me39/preview
5. https://nptel.ac.in/content/syllabus_pdf/108105088.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	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)

U20ICO706 **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

Web References

1. hhttps://www.intechopen.com/chapters/47872
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%252Fwww.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

(K. VELMURUGAN)

U20CEO705 **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

Web References

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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)

U20CEO706 **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.

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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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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

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U20MCO702 **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.

Web References

1. https://www.youtube.com/watch?v=wNeYPfNV8QI
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)

U20MCO703 **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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1. https://nptel.ac.in/courses/108/105/108105063/
2. https://www.automationmag.com/
3. https://www.springer.com/gp/book/9783319771786.
4. https://library.automationdirect.com/industrial-automation-top-10-trends/
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

(K.VELMURUGAN)

U20CCO705	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.

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3. Steven S. Skiena, “Data Science Design Manual”, Spring International Publication, 2017.
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

(K.VELMURUGAN)

		L	T	P	C	Hrs
U20CCO706	**MOBILE APPLICATIONS DEVELOPMENT USING ANDROID**	3	0	0	3	45

(Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)

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

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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 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

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	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

(K.VELMURUGAN)

	DATA SCIENCE APPLICATION OF NLP	L	T	P	C	Hrs
U20AD0705	(Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics)	**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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2. https://towardsdatascience.com/your-guide-to-natural-language-processing-nlp-48ea2511f6e1
3. https://www.nlp.com/what-is-nlp/

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	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

(K. VELMURUGAN)

U20AD0706	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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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

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
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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

(K. VELMURUGAN)