SHREE VENKATESHWARA HI-TECH ENGINEERING COLLEGE
(Autonomous) Gobichettipalayam,
Erode-638455

Regulation 2023 (Autonomous)

Curriculum and Syllabus

Choice Based Credit System (CBCS)

BE- MECHANICAL ENGINEERING

SHREE VENKATESHWARA HI-TECH ENGINEERING COLLEGE
(Autonomous)
Gobichettipalayam, Erode -638455

Regulation 2023 (UG)
Curriculum and Syllabus
BE-Mechanical Engineering

I. Program Educational Objective (PEO)

PEO1: **Successful Career:** Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and testing, smart manufacturing, technical services, and research.

PEO2: **Core Competency:** Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise.

PEO3: **Technological Development:** To develop the advanced technology and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.

PEO4: **Technical Knowledge:** To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems.

PEO5: **Proficiency:** To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

II. Program Outcomes (POs)

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

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

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

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

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

6. **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.

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

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

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

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

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

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

III. Program Specific Outcomes (PSOs)

PSO1: **Design and Development**: Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.

PSO2: **Investigate**: Apply the knowledge acquired to investigate the problems in Mechanical Engineering with due consideration for environmental and social impacts.

PSO3: **Engineering Analysis**: Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

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Mapping of Course Outcome and Programme Outcome

Year	Sem	Course name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	Professional English - I	1.6	2.2	1.8	2.2	1.5	3	3	3	1.6	3	3	3	-	-	-
		Matrices and Calculus	3	3	1	1	0	0	0	0	2	0	2	3	-	-	-
		Engineering Physics	3	3	1.6	1.2	1.8	1	-	-	-	-	-	1	-	-	-
		Engineering Chemistry	2.8	1.3	1.6	1	-	1.5	1.8	-		-	-	1.5	-	-	-
		Problem Solving and Python Programming	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
		தமிழர் மரபு /Heritage of Tamils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Problem Solving and Python Programming Laboratory	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
		Physics and Chemistry Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-
			2.6	1.3	1.6	1	1	1.4	1.8	-	-	-	-	1.3	-	-	-
		English Laboratory	3	3	3	3	1	3	3	3	3	3	3	3	-	-	-
	II	Professional English - II	3	3	3	3	2.75	3	3	3	2.2	3	3	3	-	-	-
		Numerical Methods and Statistics	3	3	1	1	1	0	0	0	2	0	2	3	-	-	-
		Materials Science	3	1.3	2	1.3	2.3	1	1.3	-	-	-	-	2	-	-	-
		Basic Electrical and Electronics Engineering	2	1.8	1	-	-	-	-	1	-	-	-	2	-	-	1
		Engineering Graphics	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
		தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Engineering Practices Laboratory	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
		Basic Electrical and Electronics Engineering Laboratory	3	3	2	1	1	-	-	1.5	2	-	-	-	-	-	1
		Communication Laboratory	2.4	2.8	3	3	1.8	3	3	3	3	3	3	3	-	-	-
	III	Transforms and Partial Differential Equations	3	3	1	1	-	-	-	-	2	-	-	3	-	-	-
		Engineering Mechanics	3	2	2.6	1	1	-	-	-	-	-	-	2	3	1	-
		Fluid Mechanics and Machinery	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
		Engineering Thermodynamics	3	3	2	1	-	1	-	-	2	-	1	2	3	2	3
		Engineering Materials and Metallurgy	3	1	3	2	2	2	2	1	-	-	-	2	2	1	2

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II		Manufacturing Processes	3	-	2	-	2	2	3	1	1	-	-	1	3	1	-
		Entrepreneurship And Startup	2	2	2	1.6	1	-	-	-	-	-	-	-	2	2	2
		Computer Aided Machine Drawing	1	2	-	-	3	-	-	-	3	-	-	3	2	2	2
		Manufacturing Process and Machining Laboratory	3	-	-	-	-	-	1	-	2	-	-	1	2	1	-
	IV	Theory of Machines	3	2	2	-	2	-	-	1	-	-	-	1	3	1	-
		Thermal Engineering	2.4	2.8	2.8	-	2.6	-	-	-	2.6	-	-	-	3	-	-
		Hydraulics and Pneumatics	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
		Manufacturing Technology	3	3	3	1	1	1	3	-	-	3	-	2	3	2	2
		Strength of Materials	2.4	2.8	2.8	2.8	-	2	2	-	-	-	-	1	2	2	3
		Environmental Sciences and Sustainability	3	2	1	1	-	2	2	-	-	-	-	2	-	-	-
		Material Testing and Fluid Mechanics and Machinery Laboratory	3	2.6	1.2	3	2.9	1	-	-	3	-	-	2	2.9	2	1
		Thermal Engineering Laboratory	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
III	V	Design of Machine Elements	2	2	3	-	-	-	-	1	1	-	-	2	3	2	2
		Metrology and Measurements	3	2	2	2	--	-	-	-	1	-	-	1	3	2	1
		Metrology and Dynamics Laboratory	-	2	2	3	-	2	2	-	1	2	2	-	2.6	2	2
	VI	Heat and Mass Transfer	3	3	3	2	-	-	-	1	3	2	-	1	3	2	1
		CAD Laboratory	3	2	3	1	3	-	-	-	1	1	1	2	3	2	2
		Additive Manufacturing Laboratory	3	2	1	1	3	–	–	–	3	–	–	3	2	2	2
IV	VII	Mechatronics and IOT	3	2	2	2	2	-	-	-	-	-	-	2	1	2	3
		Computer Integrated Manufacturing	2.8	2.4	2.8	1.3	2.4	-	-	-	1.5	1	1	1.4	2.8	2.4	2.8
		Human Values and Ethics	-	-	-	-	-	2	-	3	-	-	-	1	-	-	-
		Design and Fabrication Project	2.6	2.5	2.6	2	2.25	-	-	-	1	3	2.3	2	2.75	2	2.25
	VIII	Project Work/Internship	2.6	2	2.2	2	2	-	-	-	1.8	2.6	1.6	1.8	2.2	2.3	2.2

1 - low, 2 - medium, 3 - high, '-' - no correlation

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SUMMARY OF CREDITS

S.No	Course Category	Credits per Semester								Total Credits	Credits in %	Credits as per AU Curriculum	Credits as per AICTE Model Curriculum
		I	II	III	IV	V	VI	VII	VIII				
1	HSS	4	3					6		13	7.69	12	12
2	BS	12	7	4	2					25	14.79	25	29
3	ES	5	11	9						25	14.79	25	27
4	PC			11	20	9	8	8		56	33.14	56	58
5	PE					9	12			21	12.43	21	9
6	OE						3	9		12	7.10	12	9
7	EEC	1	2	1		1		2	10	17	10.06	16	16
8	MC		√		√	√ / √	√						-
Total Credits / Semester		22	23	25	22	19	23	25	10	169	100	167	160

CATEGORIZATION OF COURSES

i. Humanities and Social Sciences including Management Courses (HSS)
ii. Basic Science Courses (BS)
iii. Engineering Science Courses (ES)
iv. Professional Core Courses (PC)
v. Professional Elective Courses (PE)
vi. Open Elective Courses (OE)
vii. Mandatory Courses (MC)
viii. Employability Enhancement Courses (EEC)
ix. Other Courses (OC)

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

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Regulation 2023 (UG)
Curriculum and Syllabus
BE-Mechanical Engineering

SEMESTER I

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Induction Program											
1.	23IPA11	Induction Programme	-	-	-	-	-	0	-	-	-
Theory											
2.	23ENT11	Professional English - I	HSS	3	0	0	3	3	40	60	100
3.	23MAT11	Matrices and Calculus	BS	3	1	0	4	4	40	60	100
4.	23PHT11	Engineering Physics	BS	3	0	0	3	3	40	60	100
5.	23CYT11	Engineering Chemistry	BS	3	0	0	3	3	40	60	100
6.	23CST11	Problem Solving and Python Programming	ES	3	0	0	3	3	40	60	100
7.	23TAT11	தமிழர் மரபு / Heritage of Tamils	HSS	1	0	0	1	1	40	60	100
Practicals											
8.	23CSL11	Problem Solving and Python Programming Laboratory	ES	0	0	4	4	2	60	40	100
9.	23PCL11	Physics and Chemistry Laboratory	BS	0	0	4	4	2	60	40	100
10.	23ENL11	English Laboratory	EEC	0	0	2	2	1	60	40	100
			Total	**16**	**1**	**10**	**27**	**22**			

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SEMESTER II

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23ENT21	Professional English - II	HSS	2	0	0	2	2	40	60	100
2.	23MAT21	Numerical Methods and Statistics	BS	3	1	0	4	4	40	60	100
3.	23PHT22	Materials Science	BS	3	0	0	3	3	40	60	100
4.	23EET22	Basic Electrical and Electronics Engineering	ES	3	0	0	3	3	40	60	100
5.	23MET21	Engineering Graphics	ES	2	0	4	6	4	40	60	100
6.	23TAT21	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HSS	1	0	0	1	1	40	60	100
Practicals											
7.	23MEL21	Engineering Practices Laboratory	ES	0	0	4	4	2	60	40	100
8.	23EEL22	Basic Electrical and Electronics Engineering Laboratory	ES	0	0	4	4	2	60	40	100
9.	23ENL21	Communication Laboratory	EEC	0	0	4	4	2	60	40	100
Mandatory Courses											
10.	23MDC21	Mandatory Course - I Yoga for Human Excellence	MC	0	0	1	1	0	100	-	100
			Total	**14**	**1**	**17**	**32**	**23**			

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SEMESTER III

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23MAT32	Transforms and Partial Differential Equations	BS	3	1	0	4	4	40	60	100
2.	23MET31	Engineering Mechanics	ES	2	1	0	3	3	40	60	100
3.	23MET32	Fluid Mechanics and Machinery	ES	3	1	0	4	4	40	60	100
4.	23MET33	Engineering Thermodynamics	PC	3	0	0	3	3	40	60	100
5.	23MET34	Engineering Materials and Metallurgy	PC	3	0	0	3	3	40	60	100
6.	23MET35	Manufacturing Processes	PC	3	0	0	3	3	40	60	100
7.	23EST31	Entrepreneurship And Startup	EEC	1	0	0	1	1	100	-	100
Practicals											
8.	23MEL31	Computer Aided Machine Drawing	ES	0	0	4	4	2	60	40	100
9.	23MEL32	Manufacturing Process and Machining Laboratory	PC	0	0	4	4	2	60	40	100
			Total	**18**	**2**	**10**	**29**	**25**			

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SEMESTER IV

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23MET41	Theory of Machines	PC	3	0	0	3	3	40	60	100
2.	23MET42	Thermal Engineering	PC	4	0	0	4	4	40	60	100
3.	23MET43	Hydraulics and Pneumatics	PC	3	0	0	3	3	40	60	100
4.	23MET44	Manufacturing Technology	PC	3	0	0	3	3	40	60	100
5.	23MET45	Strength of Materials	PC	3	0	0	3	3	40	60	100
6.	23CYT41	Environmental Sciences and Sustainability	BS	2	0	0	2	2	40	60	100
Practicals											
7.	23MEL41	Material Testing and Fluid Mechanics and Machinery Laboratory	PC	0	0	4	4	2	60	40	100
8.	23MEL42	Thermal Engineering Laboratory	PC	0	0	4	4	2	60	40	100
Mandatory Courses											
9.	23MDC41	Mandatory Course - II Soft and Analytical Skills-I	MC	1	0	0	1	0	100	-	100
			Total	**19**	**0**	**8**	**26**	**22**			

@ The students individually undergo training in reputed Firms/Research Institutes/Laboratories for the specified duration (2 weeks) during IV semester summer vacation. After completion of training, a detailed report should be submitted within ten days from the commencement of V semester.

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SEMESTER V

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23MET51	Design of Machine Elements	PC	4	0	0	4	4	40	60	100
2.	23MET52	Metrology and Measurements	PC	3	0	0	3	3	40	60	100
3.		Professional Elective I*	PE	-	-	-	-	3	-	-	100
4.		Professional Elective II*	PE	-	-	-	-	3	-	-	100
5.		Professional Elective III*	PE	-	-	-	-	3	-	-	100
Practicals											
6.	23MEL51	Summer Internship@	EEC	0	0	0	0	1	100	-	100
7.	23MEL52	Metrology and Dynamics Laboratory	PC	0	0	4	4	2	60	40	100
Mandatory Courses											
8.	23MDC51	Mandatory Course - III Soft and Analytical Skills-II	MC	1	0	0	1	0	100	-	100
9.		Mandatory Course-IV&	MC	3	0	0	3	0	100	-	100
			Total	**20**	**0**	**4**	**24**	**19**			

*** Professional Elective – I to III shall be chosen from the list of Professional Electives (Verticals) offered by same Programme**

@ The students undergone summer internship during IV semester summer vacation and same will be evaluated in V semester.

& Mandatory Course-IV is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-IV)

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SEMESTER VI

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23MEI61	Heat and Mass Transfer	PC	3	0	2	5	4	50	50	100
2.		Professional Elective IV*	PE	-	-	-	-	3	-	-	100
3.		Professional Elective V*	PE	-	-	-	-	3	-	-	100
4.		Professional Elective VI*	PE	-	-	-	-	3	-	-	100
5.		Professional Elective VII*	PE	-	-	-	-	3	-	-	100
6.		Open Elective – I**	OE	-	-	-	-	3	-	-	100
Practicals											
7.	23MEL61	CAD Laboratory	PC	0	0	4	4	2	60	40	100
8.	23MEL62	Additive Manufacturing Laboratory	PC	0	0	4	4	2	60	40	100
Mandatory Courses											
9.		Mandatory Course - V&	MC	3	0	0	3	0	100	-	100
			Total	**21**	**0**	**10**	**31**	**23**			

*** Professional Elective – IV to VII shall be chosen from the list of Professional Electives (Verticals) offered by same Programme**

**** Open Elective – I shall be chosen from the list of open electives offered by other Programmes**

& Mandatory Course-V is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-V)

@ The students individually undergo training in reputed Firms/Research Institute/Laboratories for the specified duration (2 weeks) during VI semester summer vacation. After completion of training, a detailed report should be submitted within ten days from the commencement of VII semester.

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SEMESTER VII

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Theory											
1.	23MEI71	Mechatronics and IOT	PC	3	0	2	5	4	50	50	100
2.	23MEI72	Computer Integrated Manufacturing	PC	3	0	2	5	4	50	50	100
3.	23UHV71	Universal Human Values-2	HSS	2	1	0	3	3	40	60	100
4.		Elective – Management #	HSS	3	0	0	3	3	40	60	100
5.		Open Elective – II**	OE	-	-	-	-	3	-	-	100
6.		Open Elective – III**	OE	-	-	-	-	3	-	-	100
7.		Open Elective – IV**	OE	-	-	-	-	3	-	-	100
Practicals											
8.	23MEL71	Summer Internship@	EEC	0	0	0	0	1	100	-	100
9.	23MEL72	Design and Fabrication Project	EEC	0	0	2	2	1	100	-	100
			Total	**21**	**0**	**6**	**27**	**25**			

 # Elective – Management shall be chosen from the list of Elective management courses.

**** Open Elective – II to IV shall be chosen from the list of open electives offered by other Programmes**

@ The students undergone summer internship during VI semester summer vacation and same will be evaluated in VII semester.

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SEMESTER VIII

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
Practicals											
1.	23MEL81	Project Work / Internship@	EEC	0	0	20	20	10	60	40	100
			Total	**0**	**0**	**20**	**20**	**10**			

@ The students individually undergo training in reputed Firms/Research Institute/Laboratories for the specified duration during VIII semester. After completion of training, a detailed report should be submitted within project period from the commencement of VIII semester.

TOTAL CREDITS: 169

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MANDATORY COURSES IV											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MDC52	Introduction to Women and Gender Studies	MC	3	0	0	3	0	100	-	100
2.	23MDC53	Elements of Literature	MC	3	0	0	3	0	100	-	100
3.	23MDC54	Film Appreciation	MC	3	0	0	3	0	100	-	100
4.	23MDC55	Disaster Risk Reduction and Management	MC	3	0	0	3	0	100	-	100

MANDATORY COURSES V											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MDC61	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	3	0	100	-	100
2.	23MDC62	History of Science and Technology in India	MC	3	0	0	3	0	100	-	100
3.	23MDC63	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0	100	-	100
4.	23MDC64	State, Nation Building and Politics in India	MC	3	0	0	3	0	100	-	100
5.	23MDC65	Industrial Safety	MC	3	0	0	3	0	100	-	100

ELECTIVE – MANAGEMENT COURSES											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MSE71	Principles of Management	HSS	3	0	0	3	3	40	60	100
2.	23MSE72	Total Quality Management	HSS	3	0	0	3	3	40	60	100
3.	23MSE73	Engineering Economics and Financial Accounting	HSS	3	0	0	3	3	40	60	100
4.	23MSE74	Human Resource Management	HSS	3	0	0	3	3	40	60	100
5.	23MSE75	Knowledge Management	HSS	3	0	0	3	3	40	60	100
6.	23MSE76	Industrial Management	HSS	3	0	0	3	3	40	60	100

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6	VERTICAL 7	VERTICAL 8	VERTICAL 9	VERTICAL 10
MODERN MOBILITY SYSTEMS	PRODUCT AND PROCESS DEVELOPMENT	ROBOTICS AND AUTOMATION	DIGITAL AND GREEN MANUFACTURING	PROCESS EQUIPMENT AND PIPING DESIGN	CLEAN AND GREEN ENERGY TECHNOLOGIES	COMPUTATIONAL ENGINEERING	DIVERSIFIED COURSES GROUP 1	DIVERSIFIED COURSES GROUP 2	DIVERSIFIED COURSES GROUP 3
Automotive Materials, Components, Design & Testing	Value Engineering	Sensors and Instrumentation	Digital Manufacturing and IoT	Design of Pressure Vessels	Bioenergy Conversion Technologies	Computational Solid Mechanics	Automobile Engineering	Turbo Machines	Advanced Vehicle Engineering
Conventional and Futuristic Vehicle Technology	Additive Manufacturing	Electrical Drives and Actuators	Modern Robotics	Failure Analysis and NDT Techniques	Carbon Footprint estimation and reduction techniques	Computational Fluid Dynamics and Heat transfer	Measurements and Controls	Non-traditional Machining Processes	Advanced Internal Combustion Engineering
Renewable Powered Off Highway Vehicles and Emission Control Technology	CAD/CAM	Embedded Systems and Programming	Lean Manufacturing	Material Handling and solid processing Equipment	Energy Conservation in Industries	Theory on Computation and Visualization	Design Concepts in Engineering	Industrial safety	Casting and Welding Processes
Vehicle Health Monitoring, Maintenance and Safety	Design For X	Robotics	Green Manufacturing Design and Practices	Rotating Machinery Design	Energy Efficient Buildings	Computational Bio- Mechanics	Composite Materials and Mechanics	Thermal Power Engineering	Process Planning and Cost Estimation
CAE and CFD Approach in Future Mobility	Ergonomics in Design	Smart Mobility and Intelligent Vehicles	Environment Sustainability and Impact Assessment	Thermal and Fired Equipment design	Energy Storage Devices	Advanced Statistics and Data Analytics	Electrical Drives and Control	Design of Transmission System	Surface Engineering
Hybrid and Electric Vehicle Technology	New Product Development	Haptics and Immersive Technologies	Energy Saving Machinery and Components	Industrial Layout Design and Safety	Equipment for Pollution Control	CAD and CAE	Power Plant Engineering	Design for Manufacturing	Precision Manufacturing
Thermal Management of Batteries and Fuel Cells	Product Life Cycle Management	Drone Technologies	Green Supply Chain Management	Design Codes and Standards	Renewable Energy Technologies	Machine Learning for Intelligent Systems	Refrigeration and Air Conditioning	Power Generation Equipment Design	Gas Dynamics and Jet Propulsion
-	-	-	-	-	-	-	Dynamics of Ground Vehicles	-	Operational Research

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2023 (Clause 12).

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VERTICAL 1 : MODERN MOBILITY SYSTEMS											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE11	Automotive Materials, Components, Design and Testing	PE	2	0	2	4	3	50	50	100
2.	23MEE12	Conventional and Futuristic Vehicle Technology	PE	3	0	0	3	3	40	60	100
3.	23MEE13	Renewable Powered Off Highway Vehicles and Emission Control Technology	PE	3	0	0	3	3	40	60	100
4.	23MEE14	Vehicle Health Monitoring, Maintenance and Safety	PE	3	0	0	3	3	40	60	100
5.	23MEE15	CAE and CFD Approach in Future Mobility	PE	2	0	2	4	3	50	50	100
6.	23MEE16	Hybrid and Electric Vehicle Technology	PE	3	0	0	3	3	40	60	100
7.	23MEE17	Thermal Management ofBatteries and Fuel Cells	PE	3	0	0	3	3	40	60	100

VERTICAL 2 : PRODUCT AND PROCESS DEVELOPMENT											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE21	Value Engineering	PE	3	0	0	3	3	40	60	100
2.	23MEE22	Additive Manufacturing	PE	2	0	2	4	3	50	50	100
3.	23MEE23	CAD/CAM	PE	3	0	0	3	3	40	60	100
4.	23MEE24	Design For X	PE	3	0	0	3	3	40	60	100
5.	23MEE25	Ergonomics in Design	PE	3	0	0	3	3	40	60	100
6.	23MEE26	New Product Development	PE	3	0	0	3	3	40	60	100
7.	23MEE27	Product Life Cycle Management	PE	3	0	0	3	3	40	60	100

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VERTICAL 3: ROBOTICS AND AUTOMATION											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE31	Sensors and Instrumentation	PE	3	0	0	3	3	40	60	100
2.	23MEE32	Electrical Drives and Actuators	PE	3	0	0	3	3	40	60	100
3.	23MEE33	Embedded Systems and Programming	PE	2	0	2	4	3	50	50	100
4.	23MEE34	Robotics	PE	3	0	0	3	3	40	60	100
5.	23MEE35	Smart Mobility and Intelligent Vehicles	PE	3	0	0	3	3	40	60	100
6.	23MEE36	Haptics and Immersive Technologies	PE	3	0	0	3	3	40	60	100
7.	23MEE37	Drone Technologies	PE	3	0	0	3	3	40	60	100

VERTICAL 4: DIGITAL AND GREEN MANUFACTURING											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE41	Digital Manufacturing and IoT	PE	2	0	2	4	3	50	50	100
2.	23MEE42	Modern Robotics	PE	2	0	2	4	3	50	50	100
3.	23MEE43	Lean Manufacturing	PE	3	0	0	3	3	40	60	100
4.	23MEE44	Green Manufacturing Design and Practices	PE	3	0	0	3	3	40	60	100
5.	23MEE45	Environment Sustainability and Impact Assessment	PE	3	0	0	3	3	40	60	100
6.	23MEE46	Energy Saving Machinery and Components	PE	3	0	0	3	3	40	60	100
7.	23MEE47	Green Supply Chain Management	PE	3	0	0	3	3	40	60	100

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VERTICAL 5: PROCESS EQUIPMENT AND PIPING DESIGN											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE51	Design of Pressure Vessels	PE	3	0	0	3	3	40	60	100
2.	23MEE52	Failure Analysis and NDT Techniques	PE	2	0	2	4	3	50	50	100
3.	23MEE53	Material Handling and Solid Processing Equipment	PE	3	0	0	3	3	40	60	100
4.	23MEE54	Rotating Machinery Design	PE	3	0	0	3	3	40	60	100
5.	23MEE55	Thermal and Fired Equipment Design	PE	3	0	0	3	3	40	60	100
6.	23MEE56	Industrial Layout Design and Safety	PE	2	0	2	4	3	50	50	100
7.	23MEE57	Design Codes and Standards	PE	3	0	0	3	3	40	60	100

VERTICAL 6: CLEAN AND GREEN ENERGY TECHNOLOGIES											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE61	Bioenergy Conversion Technologies	PE	3	0	0	3	3	40	60	100
2.	23MEE62	Carbon Footprint Estimation and Reduction Techniques	PE	3	0	0	3	3	40	60	100
3.	23MEE63	Energy Conservation in Industries	PE	3	0	0	3	3	40	60	100
4.	23MEE64	Energy Efficient Buildings	PE	3	0	0	3	3	40	60	100
5.	23MEE65	Energy Storage Devices	PE	3	0	0	3	3	40	60	100
6.	23MEE66	Equipment for Pollution Control	PE	3	0	0	3	3	40	60	100
7.	23MEE67	Renewable Energy Technologies	PE	3	0	0	3	3	40	60	100

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VERTICAL 7: COMPUTATIONAL ENGINEERING											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE71	Computational Solid Mechanics	PE	3	0	0	3	3	40	60	100
2.	23MEE72	Computational Fluid Dynamics and Heat transfer	PE	3	0	0	3	3	40	60	100
3.	23MEE73	Theory on Computation and Visualization	PE	3	0	0	3	3	40	60	100
4.	23MEE74	Computational Bio-Mechanics	PE	3	0	0	3	3	40	60	100
5.	23MEE75	Advanced Statistics and Data Analytics	PE	3	0	0	3	3	40	60	100
6.	23MEE76	CAD and CAE	PE	2	0	2	4	3	50	50	100
7.	23MEE77	Machine Learning for Intelligent Systems	PE	3	0	0	3	3	40	60	100

VERTICAL 8: DIVERSIFIED COURSES GROUP 1											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE81	Automobile Engineering	PE	3	0	0	3	3	40	60	100
2.	23MEE82	Measurements and Controls	PE	3	0	0	3	3	40	60	100
3.	23MEE83	Design Concepts in Engineering	PE	3	0	0	3	3	40	60	100
4.	23MEE84	Composite Materials and Mechanics	PE	3	0	0	3	3	40	60	100
5.	23MEE85	Electrical Drives and Control	PE	3	0	0	3	3	40	60	100
6.	23MEE86	Power Plant Engineering	PE	3	0	0	3	3	40	60	100
7.	23MEE87	Refrigeration and Air Conditioning	PE	3	0	0	3	3	40	60	100
8.	23MEE88	Dynamics of Ground Vehicles	PE	3	0	0	3	3	40	60	100

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VERTICAL 9: DIVERSIFIED COURSES GROUP 2											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEE91	Turbo Machines	PE	3	0	0	3	3	40	60	100
2.	23MEE92	Non-traditional Machining Processes	PE	3	0	0	3	3	40	60	100
3.	23MEE93	Industrial safety	PE	3	0	0	3	3	40	60	100
4.	23MEE94	Thermal Power Engineering	PE	3	0	0	3	3	40	60	100
5.	23MEE95	Design of Transmission System	PE	3	0	0	3	3	40	60	100
6.	23MEE96	Design for Manufacturing	PE	3	0	0	3	3	40	60	100
7.	23MEE97	Power Generation Equipment Design	PE	3	0	0	3	3	40	60	100

VERTICAL 10: DIVERSIFIED COURSES GROUP 3											
S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
1.	23MEEX1	Advanced Vehicle Engineering	PE	3	0	0	3	3	40	60	100
2.	23MEEX2	Advanced Internal Combustion Engineering	PE	3	0	0	3	3	40	60	100
3.	23MEEX3	Casting and Welding Processes	PE	3	0	0	3	3	40	60	100
4.	23MEEX4	Process Planning and Cost Estimation	PE	3	0	0	3	3	40	60	100
5.	23MEEX5	Surface Engineering	PE	3	0	0	3	3	40	60	100
6.	23MEEX6	Precision Manufacturing	PE	3	0	0	3	3	40	60	100
7.	23MEEX7	Gas Dynamics and Jet Propulsion	PE	3	0	0	3	3	40	60	100
8.	23MEEX8	Operational Research	PE	3	0	0	3	3	40	60	100

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SHREE VENKATESHWARA HI-TECH ENGINEERING COLLEGE
(Autonomous)
Gobichettipalayam, Erode -638455

Regulation 2023 (UG)
Curriculum and Syllabus

OPEN ELECTIVES

S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
OFFERED BY DEPARTMENT OF CIVIL ENGINEERING											
1.	23CEO11	Civil and Infrastructure Engineering	OE	3	0	0	3	3	40	60	100
2.	23CEO12	Environmental Pollution and waste management	OE	3	0	0	3	3	40	60	100
3.	23CEO13	Environmental Impact Assessment	OE	3	0	0	3	3	40	60	100
4.	23CEO14	Building Services	OE	3	0	0	3	3	40	60	100
5.	23CEO15	Water, Sanitation and Health	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING											
1.	23CSO11	Foundation of AR/VR	OE	2	0	2	4	3	50	50	100
2.	23CSO12	Web Designing	OE	2	0	2	4	3	50	50	100
3.	23CSO13	Block Chain fundamentals	OE	2	0	2	4	3	50	50	100
4.	23CSO14	Knowledge Management	OE	2	0	2	4	3	50	50	100
5.	23CSO15	Cloud Computing Essentials	OE	2	0	2	4	3	50	50	100
OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING											
1	23ECO11	Basics of Electronics in Automation	OE	3	0	0	3	3	40	60	100
2	23ECO12	Wireless Optical Communication	OE	3	0	0	3	3	40	60	100
3	23ECO13	Soft Computing techniques	OE	3	0	0	3	3	40	60	100
4	23ECO14	Consumer electronics	OE	3	0	0	3	3	40	60	100
5	23ECO15	Principles of communication Engineering	OE	3	0	0	3	3	40	60	100

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S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
OFFERED BY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING											
1.	23EEO11	Renewable Energy Sources	OE	3	0	0	3	3	40	60	100
2.	23EEO12	Electrical Vehicle	OE	3	0	0	3	3	40	60	100
3.	23EEO13	Energy Auditing and Conservation	OE	3	0	0	3	3	40	60	100
4.	23EEO14	Domestic and Industrial Electrical Installations	OE	3	0	0	3	3	40	60	100
5.	23EEO15	Embedded system design and control	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF MECHANICAL ENGINEERING											
1.	23MEO11	Industrial Instrumentation	OE	3	0	0	3	3	40	60	100
2.	23MEO12	Energy Technology	OE	3	0	0	3	3	40	60	100
3.	23MEO13	Reverse Engineering	OE	3	0	0	3	3	40	60	100
4.	23MEO14	Fire Safety Engineering	OE	3	0	0	3	3	40	60	100
5.	23MEO15	Entrepreneurship Development	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE											
1.	23ADO11	Introduction to Big Data	OE	3	0	0	3	3	40	60	100
2.	23ADO12	Principles of Data Science	OE	3	0	0	3	3	40	60	100
3.	23ADO13	Data Visualization and its Applications	OE	3	0	0	3	3	40	60	100
4.	23ADO14	Data Warehousing and Mining	OE	3	0	0	3	3	40	60	100
5.	23ADO15	Principles of Cyber Security	OE	3	0	0	3	3	40	60	100

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S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
OFFERED BY DEPARTMENT OF INFORMATION TECHNOLOGY											
1.	23ITO11	Basics of Java Programming	OE	3	0	0	3	3	40	60	100
2.	23ITO12	Ethical Hacking	OE	3	0	0	3	3	40	60	100
3.	23ITO13	E-Commerce and Applications	OE	3	0	0	3	3	40	60	100
4.	23ITO14	Basics of Android Application Development	OE	3	0	0	3	3	40	60	100
5.	23ITO15	Introduction to Web Design	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF PHARMACEUTICAL TECHNOLOGY											
1.	23PTO11	Nutraceuticals	OE	3	0	0	3	3	40	60	100
2.	23PTO12	IPR for Pharma Industry	OE	3	0	0	3	3	40	60	100
3.	23PTO13	Pharmaceutical Nanotechnology	OE	3	0	0	3	3	40	60	100
4.	23PTO14	Basics of Human Anatomy and physiology	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF BIOMEDICAL ENGINEERING											
1.	23BMO11	Biosensors and Instrumentation	OE	3	0	0	3	3	40	60	100
2.	23BMO12	Medical Robotics	OE	3	0	0	3	3	40	60	100
3.	23BMO13	Biometric technology	OE	3	0	0	3	3	40	60	100
4.	23BMO14	Healthcare Management systems	OE	3	0	0	3	3	40	60	100
5.	23BMO15	IoT in Healthcare	OE	3	0	0	3	3	40	60	100

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S.No	Course Code	Course Title	Category	Periods / Week			Total Contact Period	Credits	Max.Marks		
				L	T	P			CA	ES	TM
OFFERED BY DEPARTMENT OF CYBER SECURITY											
1	23CRO11	Mobile Device Security	OE	3	0	0	3	3	40	60	100
2	23CRO12	Malware Analysis	OE	3	0	0	3	3	40	60	100
3	23CRO13	Hardware Security	OE	3	0	0	3	3	40	60	100
4	23CRO14	Web and Mobile Application Security	OE	3	0	0	3	3	40	60	100
5	23CRO15	Information Security	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING											
1	23AMO11	AI for Everyone	OE	3	0	0	3	3	40	60	100
2	23AMO12	Machine learning and its Applications	OE	3	0	0	3	3	40	60	100
3	23AMO13	Quantum AI	OE	3	0	0	3	3	40	60	100
4	23AMO14	Reinforcement Learning	OE	3	0	0	3	3	40	60	100
5	23AMO15	Network Automation Using AIML	OE	3	0	0	3	3	40	60	100
OFFERED BY DEPARTMENT OF BIOTECHNOLOGY											
1	23BTO11	Biotechnology for Engineers	OE	3	0	0	3	3	40	60	100
2	23BTO12	Enzyme Technology	OE	3	0	0	3	3	40	60	100
3	23BTO13	Introduction to Plant Biotechnology	OE	3	0	0	3	3	40	60	100
4	23BTO14	Biofuels	OE	3	0	0	3	3	40	60	100
5	23BTO15	Forensic Technology	OE	3	0	0	3	3	40	60	100

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23IPA11	INDUCTION PROGRAMME (Common to B.E./B.Tech. all Branches)	L	T	P	C
		-	-	-	0

This is a mandatory **2 week programme** to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by **AICTE** with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity:

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts:

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance 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, grow into engineering design later

(iii) Universal Human Values:

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get 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.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity:

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules:

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People:

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area:

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations:

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities:

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop.

For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

REFERENCES:

1. Guide to Induction program from AICTE

22/09/2023

23ENT11	PROFESSIONAL ENGLISH – I (Common to B.E./B.Tech. all Branches)	L T P C 3 0 0 3

COURSE OBJECTIVES:

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

UNIT-I **INTRODUCTION TO EFFECTIVE COMMUNICATION AND FUNDAMENTALS OF COMMUNICATION** **10**

Introduction to Effective Communication- Barriers of Communication, Seven C's of Effective Communication, Effective Listening, Effective Speaking, Excellence in Reading, Ways to Develop Language and Communication Skills.

Reading- Reading Brochures (Technical Context), Telephone Messages/ Social Media Messages Relevant to Technical Contexts and Emails.

Writing- Writing Emails / Letters Introducing Oneself.

Grammar- Present Tense (Simple and Progressive); Question Types: Wh/ Yes or No/ and Tags.

Vocabulary- Synonyms; One Word Substitution; Abbreviations & Acronyms (as Used in Technical Contexts)

UNIT-II **NARRATION AND SUMMATION** **9**

Reading - Reading Biographies, Travelogues, Newspaper Reports, Excerpts from Literature, and Travel & Technical Blogs.

Writing - Guided writing, Paragraph Writing, Short Report on an Event (Field Trip etc.)

Grammar - Past Tense (Simple); Subject-Verb Agreement; and Prepositions.

Vocabulary - Word Forms (Pre ixes& Suf ixes); Synonyms and Antonyms; Phrasal Verbs.

UNIT-III **DESCRIPTION OF A PROCESS / PRODUCT** **9**

Reading - Reading Advertisements, Gadget Reviews; User Manuals.

Writing - Writing De initions; Instructions; and Product /Process Description.

Grammar - Imperatives; Adjectives; Degrees of Comparison; Present & Past Perfect Tenses.

Vocabulary- Compound Nouns, Homonyms; and Homophones, Discourse Markers (Connectives & Sequence Words)

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UNIT-IV **CLASSIFICATION AND RECOMMENDATIONS** **9**

Reading - Newspaper Articles; Journal Reports –and Non Verbal Communication (Tables, Pie Charts etc...)
Writing - Note-making / Note-taking (*Study skills to be taught, not tested); Writing Recommendations; Transferring Information from Non Verbal (Chart , Graph etc, to Verbal Mode)
Grammar - Articles; Pronouns - Possessive & Relative Pronouns.
Vocabulary - Collocations; Fixed / Semi Fixed Expressions

UNIT-V **EXPRESSION** **8**

Reading - Reading Editorials; and Opinion Blogs;
Writing - Essay Writing (Descriptive or Narrative).
Grammar- Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences.
Vocabulary - Cause & Effect Expressions – Content vs. Function Words.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

CO1:	Use appropriate words in a professional context
CO2:	Gain understanding of basic grammatical structures and use them in right context
CO3:	Read and infer the denotative and connotative meanings of technical text
CO4:	Read and interpret information presented in tables, charts and other graphic forms
CO5:	Write de initions, descriptions, narrations and essays on various topics

TEXT BOOKS:

1. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd, 2020.
2. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, & CO, Department of English, Anna University, "English for Science & Technology" Cambridge University Press, 2021.

REFERENCE BOOKS:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication–Principles and Practices", Oxford Univ. Press, New Delhi, 2016.

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2. Lakshminarayanan, "A Course Book on Technical English", Scitech Publications (India) Pvt.Ltd. 2012.
3. Aysha Viswamohan, "English For Technical Communication (With CD)", Mcgraw HillEducation, ISBN : 0070264244, 2008.
4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House, 2016.

E. RESOURCES:

- https://learnenglish.britishcouncil.org/

CO's-PO's MAPPING :

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

1- Low, 2- Medium, 3-High, "-" No Correlation

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23MAT11	MATRICES AND CALCULUS (Common to B.E./B.Tech. all Branches)	L T P C 3 1 0 4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications
- To familiarize the students with differential calculus
- To familiarize the student with functions of several variables. This is needed in many branches of engineering
- To make the students understand various techniques of integration
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

UNIT-I **MATRICES** **9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications : Stretching of an elastic membrane.

UNIT-II **DIFFERENTIAL CALCULUS** **9+3**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules(sum, product, quotient, chain rules) - Implicit differentiation - Applications : Maxima and Minima of functions of one variable.

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

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT-IV **INTEGRAL CALCULUS** **9+3**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Improper integrals - Applications : Hydrostatic force and pressure, moments and centre of mass.

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UNIT-V **MULTIPLE INTEGRALS** **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centre of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to :

CO1:	Use the matrix algebra methods for solving practical problems
CO2:	Apply differential calculus tools in solving various application problems.
CO3:	Use differential calculus ideas on several variable functions
CO4:	Apply different methods of integration in solving practical problems
CO5:	Apply multiple integral ideas in solving areas, volumes and other practical problems

TEXT BOOKS :

1. James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2019. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5,7.1 - 7.4 and 7.8]
2. Grewal. B. S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018

REFERENCE BOOKS :

1. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2022
2. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2021
3. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016

CO's – PO's MAPPING:

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

1- Low, 2- Medium , 3-High, "-" No Correlation

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23PHT11	ENGINEERING PHYSICS	L	T	P	C
	(Common to B.E./B. Tech. all branches)	3	0	0	3

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics
- Provide knowledge of elastic property, thermal property of materials and its applications
- Impart knowledge of laser and their applications
- Introduce the essential principles of fiber optics and its applications
- Equipping the students to successfully understand the importance of quantum physics

UNIT-I **MECHANICS** **10**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia – theorems of M.I – M.I of a diatomic molecule – torque – rotational dynamics of rigid bodies – rotational energy state of a rigid diatomic molecule – torsional pendulum – double pendulum

UNIT-II **PROPERTIES OF MATTER AND THERMAL PHYSICS** **10**

Elasticity- Hooke's law – stress – strain diagram – Poisson's ratio – Factors affecting elasticity –bending of beams-Bending moment equation – Depression of a cantilever–Young's modulus by uniform bending – I-shaped girders-Modes of heat transfer – thermal conductivity – Newton's law of cooling – Linear heat flow – Lee's disc method – conduction through compound media (series and parallel)

UNIT-III **LASER** **9**

Lasers: Stimulated absorption – Spontaneous emission – Stimulated emission – Population inversion-Einstein's coefficients derivation and their relations – Pumping methods – Types of lasers – Nd:YAG, CO_2 laser, Semiconductor lasers (homojunction & heterojunction) – Industrial and Medical Applications of lasers

UNIT-IV **FIBER OPTICS** **8**

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle – Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending – Fiber optics communication system (qualitative) – Temperature and displacement sensors – fiber optic endoscope

UNIT-V **QUANTUM PHYSICS** **8**

Photons and light waves – Electrons and matter waves – Compton effect: theory of scattering –Derivation and experimental verification – The Schrodinger equation (Time dependent and

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time independent forms) – particle in a one-dimensional rigid box for eigen value and eigen function – tunneling (qualitative) – scanning tunneling microscope

TOTAL: 45 PERIODS

COURSE OUTCOME:

At the end of the course the students will be able to

CO1: Understand the importance of mechanics.
CO2: Describe the Elastic property of solid materials and thermal conductivity of solids in industrial applications
CO3: Demonstrate a foundational knowledge in lasers
CO4: The students will get knowledge on fiber optics
CO5: Understand the importance of quantum physics

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics," McGraw Hill Education (IndianEdition), 2017
2. Arthur Beiser, Shobhit Mahajan, S.Rai Choudhury, "Concepts of Modern Physics," McGraw-Hill (Indian Edition), 2017

REFERENCE BOOKS:

1. K.Thyagarajan and A.Ghatak, "Lasers: Fundamentals and Applications," Laxmi Publications, (Indian Edition), 2023
2. D.Halliday, R.Resnick and J.Walker, "Principles of Physics," Wiley (Indian Edition), 2021
3. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students," Springer-Verlag, 2012

CO's- PO's MAPPING

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

1- Low, 2- Medium , 3-High, "-" No Correlation

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23CYT11	ENGINEERING CHEMISTRY (Common to B.E./B. Tech. all branches)	L T P C 3 0 0 3

COURSE OBJECTIVES:

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

UNIT-I **WATER AND ITS TREATMENT** **9**

Water: Sources and impurities, **Water quality parameters:** turbidity, pH, hardness, alkalinity, TDS, COD and BOD. **Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)

UNIT-II **NANOCHEMISTRY** **9**

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: De inition, properties and uses of – nanoparticle, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, electrochemical deposition. **Applications** of nanomaterials with examples in medicine, agriculture, energy, electronics and catalysis.

UNIT-III **PHASE RULE AND COMPOSITES** **9**

Phase rule: Introduction, de inition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system – Pattinson's process.

Composites: Introduction: De inition & Need for composites; **Constitution**: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (iber, particulates, lakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites.

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UNIT-IV **FUELS AND COMBUSTION** **9**

Fuels: Introduction: Classi ication of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Solid biofuels, Compressed biogas, Power alcohol and biodiesel.**
Combustion of fuels: Introduction: Calori ic value - higher and lower calori ic values, Theoretical calculation of calori ic value; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT-V **ENERGY SOURCES AND STORAGE DEVICES** **9**

Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; **Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able

CO1:	To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	To apply the knowledge of phase rule and composites for material selection requirements.
CO4:	To recommend suitable fuels for engineering processes and applications.
CO5:	To recognize different forms of energy resources and apply them for suitable applications in energy sectors

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018
2. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018

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REFERENCE BOOKS:

1. Shashi Chawla, "A Text Book of Engineering Chemistry", Dhanpar Rai & Co (Pvt.) Ltd, New Delhi, 2011
2. O.G. Palanna, "Engineering Chemistry", McGraw Hill Education (India) Private Limited, 2nd Edition, 2017
3. Dr. A.Ravikrishnan, "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Limited, 23rd Edition, 2023

CO's- PO's MAPPING:

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

1- Low, 2- Medium , 3-High, "-" No Correlation

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23CST11	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to: B.E. / B.Tech. all Branches)	L 3	T 0	P 0	C 3

COURSE OBJECTIVES:

- To solve problems using computational thinking methods using pseudo code and flowchart
- To understand the fundamentals of algorithmic problem solving basics and strategies
- To define variables data types and error messages
- To learn to solve problems using Python conditionals loops lists tuples and dictionaries to represent complex data
- To understand the functions modules and do input/output with files in Python

UNIT-I **COMPUTATIONAL THINKING** **8**

Introduction - Problem solving and Decomposition - Abstraction - Notations Pseudo code - Flow chart - Programming language

UNIT-II **ALGORITHMIC PROBLEM SOLVING** **8**

Algorithm Implementation - Top down design - Simple strategies for developing algorithms - Iteration - Recursion - Fundamental algorithms - Anticipating and Dealing with Errors

UNIT-III **BASICS BUILDING BLOCKS OF PYTHON** **9**

Variables - Immutable variables - Data types - Operators - Python Reserved Words - Understanding error messages

UNIT-IV **CONTROL STATEMENTS AND STRUCTURED TYPES** **10**

Control Flow - Indenting - if Statement - while Loop - break and continue - for Loop - String - Lists - Tuples - Sets - Dictionaries

UNIT-V **FUNCTIONS, MODULES AND FILES** **10**

Definition - Hiding redundancy - Arguments and return values - Variable Number of Arguments - Scope - Passing Functions to a Function - Mapping Functions in a Dictionary - Lambda function – Recursive Functions - Modules: Standard Modules - OS and SYS modules - User defined Modules - Importing modules – Writing into a File - Reading from a File - File Methods

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Develop algorithmic solutions for simple computational problems to develop and execute simple Python programs.

CO2 : Write the Algorithms for problem solving basics and strategies to solve complex problems

CO3 : Compose simple Python programs using to illustrate variables data types and error messages.

CO4 : Represent compound data using Python conditionals loops lists tuples dictionaries for solving problems

CO5 : Create functions modules read and write data from/to files in Python programs.

TEXT BOOKS:

1. R. G. Dromey "How to Solve it by Computer", Pearson Education., 2015
2. Charles Dierbach "Introduction to Computer Science using Python: A Computational Problem- Solving Focus", Wiley India., 2015

REFERENCE BOOKS:

1. John V. Guttag "Introduction to Computation and Programming using Python", The MIT press. 2021 (3rd Edition).
2. Paul Gries, Jennifer Campbell, Jason Montojo "Practical Programming: An Introduction to Computer Science using Python 3", Pragmatic Programmers., 2013 , Second edition
3. Robert Sedgewick, Kevin Wayne, Robert Dondero "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India., 2016
4. Karl Beecher "Computational Thinking - A beginner's guide to problem solving and Programming", BCS Learning &Development., 2017

E-RESOURCES:

1. http://www.flowgorithm.org/
2. https://www.python.org/
3. https://nptel.ac.in/courses/106104074

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	-	-	-	-	-	2	2	3	3	3
CO2	2	3	3	3	2	-	-	-	-	-	2	-	3	3	3
CO3	2	2	-	2	2	-	-	-	-	-	1	-	3	3	3
CO4	1	2	-	-	1	-	-	-	-	-	1	-	2	3	3
CO5	2	2	-	-	2	-	-	-	-	-	1	2	2	3	3
AVG	**2**	**3**	**3**	**3**	**2**	-	-	-	-	-	**2**	**2**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23TAT11	HERITAGE OF TAMILS (Common to B.E./B. Tech. all branches)	L T P C 1 0 0 1

COURSE OBJECTIVES:

- To understand the Sangam and modern literature of Tamil
- To learn the heritage of Tamil culture
- To recognize the various art forms of Tamils
- To explain the Thinai concept of Tamils
- To realize the contribution of Tamils to Indian national movement and Indian culture

UNIT-I **LANGUAGE AND LITERATURE** **3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature- Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land- Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modernliterature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT-II **HERITAGE – ROCK ART PAINTINGS TO MODERN ART - SCULPTURE** **3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT-III **FOLK AND MARTIAL ARTS** **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam,Valari, Tiger dance - Sports and Games of Tamils.

UNIT-IV **THINAI CONCEPTS OF TAMILS** **3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT-V **CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE** **3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural In luence of Tamils over the otherparts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

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COURSE OUTCOMES:

At the end of the course the student will be able to

CO1:	Gain knowledge about various literatures of Tamil
CO2:	Learn the uniqueness of Tamil cultural heritage
CO3:	Find various art forms of Tamil Nadu
CO4:	Understand the Thinai concepts in Tamil
CO5:	Distinguish the contribution of Tamils to Indian national movement and Indian culture

E- RESOURCES:

1. https://www.tamilvu.org/

CO's –PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	-	-	-	-	-	1	1	1	-	1	-	-
CO3	-	-	-	-	-	1	1	1	-	1	-	-
CO4	-	-	-	-	-	1	1	1	-	1	-	-
CO5	-	-	-	-	-	1	1	1	-	1	-	-
AVG	-	-	-	-	-	1	1	1	-	1	-	-

1- Low, 2- Medium , 3-High, "-" No Correlation

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23TAT11	தமிழர் மரபு	L T P C 1 0 0 1

(B.E./B.Tech- அனைத்து பாடப்பிரிவுகளுக்கும் பொதுவானது)

பாடநெறி நோக்கங்கள்:

- தமிழின் இலக்கியங்கள் மற்றும் நவீன இலக்கியங்களைப் புரிந்துகொள்ளுதல்
- தமிழ் கலாச்சார பாரம்பரியத்தைக் கற்றுக்கொள்ளுதல்
- தமிழர்களின் பல்வேறு கலைவடிவங்களைக் கண்டறிதல்
- தமிழர்களின் திணைக்கோட்பாடுகளை விளக்குதல்
- இந்திய சுதந்திர போராட்ட இயக்கங்களுக்கும் இந்திய கலாச்சாரத்திற்குமான தமிழர்களின் பங்களிப்பை உணர்தல்

அலகு - I மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் ஆறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த மதங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு - II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு - III நாட்டப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு - IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவு, கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

Chairman
BoS / S&H

அலகு - V

இந்திய தேசிய இயக்கம் மற்றும்
இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிற்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

மொத்தம்: 15 பாடவேளைகள்

பாடநெறி முடிவுகள்:

இப்பாடத்தைப் படிப்பதின் முடிவில் மாணவர்கள்

CO1: தமிழின் பல்வேறு இலக்கியங்களைப் பற்றிய அறிவைப் பெறுவார்கள்
CO2: தமிழ் கலாச்சார பாரம்பரியத்தின் தனித்தன்மையைக் கற்றுக்கொள்வார்கள்
CO3: தமிழகத்தின் பல்வேறு கலைவடிவங்களைக் கண்டறிவார்கள்
CO4: தமிழர்களின் திணைக்கோட்பாடுகளை அறிந்துகொள்வார்கள்
CO5: தமிழ் சுதந்திரப்போராட்ட வீரர்கள் மற்றும் தமிழ் கலாச்சாரத்தை இந்தியாவின் மற்ற பகுதியுடன் ஒப்பிடும் திறனைப் பெறுவார்கள்

மின் -ஆதாரங்கள்:

1. https://www.tamilvu.org/

CO's -PO's விவரணையாக்கம்::

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	-	-	-	-	-	1	1	1	-	1	-	-
CO3	-	-	-	-	-	1	1	1	-	1	-	-
CO4	-	-	-	-	-	1	1	1	-	1	-	-
CO5	-	-	-	-	-	1	1	1	-	1	-	-
AVG	-	-	-	-	-	1	1	1	-	1	-	-

1- Low, 2- Medium , 3-High, "-" No Correlation

Chairman
BoS / S&H

	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
23CSL11	(Common to: B.E. / B.Tech. all Branches)	0	0	4	2

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

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

TOTAL : 60 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Develop algorithmic solutions to simple computational problems

CO2 : Develop and execute simple Python programs.

CO3 : Implement programs in Python using conditionals and loops for solving problems.

CO4 : Deploy functions to decompose a Python program.

CO5 : Process compound data using Python data structures and Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

E-RESOURCES:

1. http://www.flowgorithm.org/
2. https://www.python.org/
3. https://nptel.ac.in/courses/106104074

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	-	2	-	3	3	
CO3	2	2	-	2	2	-	-	-	-	-	1	-	3	3	3
CO4	1	2	-	-	1	-	-	-	-	-	1	-	2	3	3
CO5	2	2	-	-	2	-	-	-	-	-	1	-	2	3	3
AVG	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS/CSE&IT

23PCL11	PHYSICS AND CHEMISTRY LABORATORY (Common to B.E./B. Tech. all branches)	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY
(Any Seven Experiments)

COURSE OBJECTIVES:

- Determination of the physical parameters such as young's modulus by Uniform bending method, Non-Uniform bending method, Simple harmonic oscillations of cantilever and rigidity modulus of wire
- To impart knowledge in the determination of the thermal conductivity of a bad conductor by Lee's Disc method and band gap of a semiconductor
- Determination of the wavelength of the laser using grating, numerical aperture and acceptance angle in an optical iber and width of the groove in an compact disc by using laser
- Determination of the velocity of sound and compressibility of liquids by using ultrasonic interferometer
- Knowledge on the frequency of alternating current using electrically vibrating tuning fork by using Melde's apparatus

LIST OF EXPERIMENTS

1. Determination of Young's modulus by Uniform bending method
2. Determination of Young's modulus by non-uniform bending method
3. Simple harmonic oscillations of cantilever
4. Determination of rigidity modulus of wire and moment of inertia of regular objects – Torsion pendulum
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method
6. Determination of band gap of a semiconductor
7. Determination of the wavelength of the laser using grating
8. a) Determination of numerical aperture and acceptance angle in an optical iber
   b) Determination of width of the groove in an compact disc by using laser
9. Determination of the velocity of sound and compressibility of liquids by using ultrasonic interferometer
10. Determination of the frequency of alternating current using electrically vibrating tuning fork -Melde's apparatus

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Experiment and determine the physical characteristics of given solid materials using Young's modulus-Uniform bending method, non-uniform bending method, cantilever method and Torsion Pendulum.

CO2: Experiment and determine the thermal conductivity of a bad conductor using Lee's Disc method and band gap energy of a given semiconducting material using Zener diode.

CO3: Experiment and determine the optical property of light sources, acceptance angle of optical iber and width of the groove in an compact disc using Laser.

CO4: Experiment and determine the velocity of ultrasonic waves using ultrasonic interferometer.

CO5: Experiment and determine the frequency of alternating current using electrically vibrating tuning fork by using Melde's apparatus

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BoS / S&H

TEXT BOOKS:

1. Dr. P. Mani, Engineering Physics Practicals, Dhanam Publications (2022)

CO's – PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	-	-	-	-	-	-	-
CO2	3	3	1	1	-	-	-	-	-	-	-	-
CO3	3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	3	1	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-
AVG	3	3	1	1	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY

(Any Seven Experiments)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity.
- To acquire the knowledge in total hardness and dissolved oxygen and its impacts in industries through experiments
- To understand the impacts of chlorine in water sample through volumetric analysis.
- To induce the students to familiarize with electroanalytical techniques in the determination of impurities in aqueous solutions.
- To determine the amount of metal ions through spectroscopic techniques.

LIST OF EXPERIMENTS

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in a water sample
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Conductometric titration of barium chloride against sodium sulphate (precipitation titration).
9. Estimation of iron content of the given solution using potentiometer.
10. Estimation of sodium /potassium present in water using a lame photometer.

TOTAL: 30 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Analyse the quality of water samples with respect to their acidity and alkalinity of water samples

CO2: Examine the water quality parameters like total hardness and DO with volumetric analysis.

CO3: Learn the permissible limit of chlorine in the given water sample

CO4: Analyse the impurities in solution by electro analytical techniques quantitatively

CO5: Determine the amount of metal ions through spectroscopic techniques.

CO's – PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	3	3	1	-	-	-	1
CO2	3	2	2	-	-	3	3	1	-	-	-	1
CO3	3	2	1	-	-	3	3	1	-	-	-	1
CO4	3	2	2	-	1	2	1	-	-	-	-	-
CO5	3	2	1	-	1	2	1	-	-	-	-	-
Avg.	3	2	1	-	1	3	2	1	-	-	-	1

TEXT BOOKS:

1. "Vogel's Textbook of Quantitative Chemical Analysis", (8th Edition, 2014)
2. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbookof Quantitative Chemical Analysis", (2009)

Chairman
BoS / S&H

23ENL11	ENGLISH LABORATORY (Common to B.E./B.Tech. all Branches)	L T P C 0 0 2 1

COURSE OBJECTIVES:

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

UNIT-I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening- Listening for General Information-Speci ic Details- Conversation: Introduction toClassmates - Audio / Video (Formal & Informal); Telephone Conversation; Listening to Voicemail & Messages; Listening and Filling a Form.
Speaking- Making Telephone Calls- Self Introduction; Introducing a Friend; - Politeness Strategies- Making Polite Requests, Making Polite Offers, Replying to Polite Requests and Offers- Understanding Basic Instructions (Filling out a Bank Application for Example).

UNIT-II NARRATION AND SUMMATION 6

Listening - Listening to Podcasts, Anecdotes / Stories / Event Narration; Documentaries and Interviews with Celebrities.
Speaking - Narrating Personal Experiences / Events-Talking about Current and Temporary Situations & Permanent and Regular Situations - Describing Experiences and Feelings- Engaging in Small Talk- Describing Requirements and Abilities.

UNIT-III DESCRIPTION OF A PROCESS / PRODUCT 6

Listening - Listen to Product and Process Descriptions; A Classroom Lecture; and Advertisements about Products.
Speaking - Picture Description- Describing Locations in Workplaces- Giving Instruction to Use the Product- Explaining Uses and Purposes- Presenting a Product- Describing Shapes and Sizes and Weights- Talking about Quantities (Large & Small)- Talking about Precautions.

UNIT-IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to Technology, Entertainment and Design (TED) Talks; Listening to Lectures - and Educational Videos.
Speaking – Small Talk; Discussing and Making Plans-Talking about Tasks-Talking about Progress- Talking about Positions and Directions of Movement- Talking about Travel Preparations- Talking about Transportation.

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UNIT-V **EXPRESSION** **6**

Listening - Listening to Debates/ Discussions; Different Viewpoints on an Issue; and Panel Discussions.
Speaking - Making Predictions- Talking about a Given Topic-Giving Opinions- Understandinga Website- Describing Processes.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To listen to and understand general and complex academic information
CO2: To listen to and understand different points of view in a discussion
CO3: To speak luently and accurately in formal and informal communicative contexts
CO4: To describe products and processes and explain their uses clearly as well as accurately
CO5: To express their opinions effectively in both formal and informal discussions

E. RESOURCES:

- https://www.ted.com/about/programs-initiatives/ted-talks-education
- https://learnenglish.britishcouncil.org/

CO's & PO's MAPPING:

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

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / S&H

23ENT21	PROFESSIONAL ENGLISH – II (Common to B.E./B.Tech. all Branches)	L T P C 2 0 0 2

COURSE OBJECTIVES:

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

UNIT-I **MAKING COMPARISONS** 6

Reading - Reading Advertisements, User Manuals, Brochures Emails.

Writing - Professional Emails, Email Etiquette - Compare and Contrast Essay.
Grammar - Mixed Tenses, Prepositional Phrase.

UNIT-II **EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING** 6

Reading - Reading Longer Technical Texts– Cause and Effect Essays, and Letters / Emails of Complaint.
Writing - Writing Responses to Complaints.
Grammar - Active Passive Voice Transformations, In initive and Gerunds.

UNIT-III **PROBLEM SOLVING** 6

Reading - Case Studies, Excerpts from Literary Texts, News Reports etc.
Writing - Letter to the Editor, Checklists, Problem Solution Essay / Argumentative Essay.
Grammar - Error Correction; If Conditional Sentences.

UNIT-IV **CLASSIFICATION AND RECOMMENDATIONS** 6

Reading - Newspaper Articles.
Writing - Recommendations, Transcoding, Accident Report, Survey Report
Grammar - Reported Speech, Modals.
Vocabulary - Conjunctions- Use of Prepositions.

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UNIT-V **EXPRESSION** 6

Reading - Company Pro iles, Statement of Purpose, (SOP), An Excerpt of Interview with Professionals.
Writing - Job / Internship Application – Cover Letter & Resume.
Grammar - Numerical Adjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

CO1:	Compare and contrast products and ideas in technical texts.
CO2:	Identify and report cause and effects in events, industrial processes through technical texts
CO3:	Analyse problems in order to arrive at feasible solutions and communicate them in the written format
CO4:	Present their ideas and opinions in a planned and logical manner
CO5:	Draft effective resumes in the context of job search.

TEXT BOOKS:

1. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd, 2020.
2. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, & CO, Department of English, Anna University, "English for Science & Technology" Cambridge University Press, 2021.

REFERENCE BOOKS:

1. Raman, Meenakshi, Sharma & Sangeeta, "Professional English", Oxford University Press, New Delhi, 2019.
2. Dr. V. Chellammal, "Learning to Communicate", Allied Publishers, New Delhi, 2003
3. V.N. Arora and Laxmi Chandra, "Improve Your Writing", Oxford University Press, NewDelhi, 2001.

E. RESOURCES:

- https://learnenglish.britishcouncil.org/

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CO'S-PO'S MAPPING :

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

1. Low, 2- Medium, 3-High, "-" No Correlation

Chairman
BoS / S&H

23MAT21	NUMERICAL METHODS AND STATISTICS (Common to B.E./B.Tech. all Branches)	L T P C 3 1 0 4

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations
- To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of engineering and statistical quality control

UNIT-I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting-Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT-II INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules

UNIT-III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

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

UNIT-IV TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large andsmall samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes

UNIT-V DESIGN OF EXPERIMENTS 9+3

One way and two way classifications - Completely randomized design – Randomized block design -- Latin square design - 2^2 factorial design.

TOTAL : 60 PERIODS

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BoS / S&H

COURSE OUTCOMES:

At the end of the Course the students will be able to

CO1 : Apply the numerical techniques of interpolation in various intervals and differentiation and integration for engineering problems

CO2 : Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations

CO3 : Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications

CO4 : Apply the concept of testing of hypothesis for small and large samples in real life problems

CO5 : Apply the basic concepts of classifications of design of experiments in the field of agriculture

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2023
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2019

REFERENCE BOOKS:

1. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020
2. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage
4. Learning, New Delhi, 8th Edition, 2014
5 Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, India, 2022

CO's – PO's MAPPING

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

1- **Low, 2- Medium , 3-High, "-" No Correlation**

Chairman
BoS / S&H

23PHT22	MATERIALS SCIENCE (for B.E. MECH and CIVIL)	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To introduce the basics of heat transfer through different materials, thermal performance of building and various thermal applications
- To impart knowledge on the ventilation and air conditioning of buildings
- To introduce the concepts of sound
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To discuss the basics of new engineering materials

UNIT-I **THERMAL APPLICATIONS** **9**

Principles of heat transfer, steady state of heat low, conduction through compound media-series and parallel-conductivity of rubber tube and powder materials - heat transfer through fenestrations, thermal insulation and its bene its - heat gain and heat loss estimation - factors affecting the thermal performance of buildings - central heating.

UNIT-II **VENTILATION AND REFRIGERATION** **9**

Requirements, principles of natural ventilation - ventilation measurements, design for natural ventilation - Window types and packaged air conditioners - chilled water plant - fan coil systems - water piping - cooling load - Air conditioning systems for different types of buildings - Protection against ire to be caused by A.C.Systems.

UNIT-III **ACOUSTICS** **9**

Introduction-Classi ication of sound – Characteristics of sound - decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coef icient and its determination –factors affecting acoustics of buildings and their remedies.

UNIT-IV **OPTICAL PROPERTIES OF MATERIALS** **9**

Classi ication of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode – OLED

UNIT-V **NEW ENGINEERING MATERIALS** **9**

Ceramics – types and applications – Composites: classi ication, role of matrix and reinforcement – processing of ibre reinforced plastics and ibre reinforced metals –

Chairman
BoS / S&H

Metallic glasses: Properties, preparation and applications – Shape memory alloys: Characteristics and applications –Carbon nanotubes: Properties and applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Acquire knowledge about heat transfer through different materials, thermal performance of building and thermal insulation

CO2: Gain knowledge on the ventilation and air conditioning of buildings

CO3: Understand the concepts of sound and its measurements

CO4: Understand the optical properties of materials and working principles of various optical devices

CO5: Familiarize with ceramics, composites, metallic glasses, shape memory alloys, and their important applications

TEXT BOOKS:

1. Marko Pinteric, "Building Physics", Springer 2021
2. Jasprit Singh, "Semiconductor Optoelectronics: Physics and Technology", Mc-Graw Hill India (2019)
3. M.F.Ashby, P.J.Ferreira and D.L.Schodek. "Nanomaterials, Nanotechnologies and Design: an Introduction for Engineers", 2011

REFERENCE BOOKS:

1. Hugo Hens, "Applied Building Physics", Wiley, 2016
2. K.G.Budinski and M.K.Budinski. "Engineering Materials: Properties and Selection",Pearson Education, 2016
3. Pallab Bhattacharya, "Semiconductor Optoelectronic Devices", Pearson, 2017
4. Dr.P.Mani, "Physics for Civil Engineering", Dhanam Publications, 2022

CO's – PO's MAPPING:

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

1- Low, 2- Medium , 3-High, "-" No Correlation

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BoS / S&H

		L	T	P	C
23EET22	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (For B.E./B.Tech- CIVIL, CSE, MECH, AI&DS, BME, IT, Pharm.Tech branches)**	3	0	0	3

COURSE OBJECTIVES:

- To learn the basic concepts of electric circuits and analysis.
- To analyze the magnetic circuits and domestic wiring.
- To understand the basics of working principles and application of electrical machines.
- To impart knowledge about analog devices and their characteristics.
- To educate on the fundamental concepts of digital electronics.

UNIT-I **ELECTRIC CIRCUITS** **10**

Basic components of electric circuits, Charge, Current, Voltage and Power, Voltage and current sources, Ohm's law, Kirchhoff's laws, Series and parallel connected independent sources, Resistors in series and parallel, Voltage division and current division rule, Mesh current and node voltage methods of analysis-DC Circuits.

UNIT-II **MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS** **10**

Magnetic circuits-definitions-MMF, flux, reluctance, Magnetic field intensity, Flux density, Fringing, Self and Mutual inductances-simple problems. Domestic wiring, Wires and Cables - types, Earthing, Protective devices, Switch fuse unit, Safety precautions and First Aid.

UNIT-III **ELECTRICAL MACHINES** **10**

Construction and working principle- DC generators, EMF equation, Types and applications. Working principle of DC motors, Types and applications. Construction, Working principle and applications of 1ϕ Transformer, Three phase alternator, Three phase induction motor and Synchronous motor.

UNIT-IV **ANALOG ELECTRONICS** **8**

Resistor, Inductor and Capacitor in electronic circuits, PN Junction diodes, Rectifier, Zener diode-Characteristics-Applications, Construction and characteristics of bipolar junction transistor-Biasing, JFET, MOSFET, IGBT, SCR, Amplifier –Applications.

UNIT-V **DIGITAL ELECTRONICS** **7**

Review of number systems, Binary codes, Error detection and correction codes, Combinational logic Circuits, Representation of logic functions-SOP and POS forms, K-map representations, Minimization using K maps - Simple Problems.

TOTAL: 45 PERIODS

Chairman
BoS / EEE

COURSE OUTCOME

At the end of this course the students will be able to:

CO1	Explain circuit's behavior using circuit laws and analyze the mesh analysis and nodal analysis.
CO2	Analyze the Magnetic circuits, earthing and wiring.
CO3	Understand the working principle and applications of electrical machines.
CO4	Aanalyze the characteristics of analog electronic devices.
CO5	Explain the basic concepts of digital electronics.

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020.
2. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019.
3. James A Svoboda, Richard C. Dorf, Dorf's Introduction to Electric Circuits, Wiley,2018.
4. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCE BOOKS:

1. Muhammad H.Rashid, "Spice for Circuits and electronics", 4th Edition., Cengage India,2019.
2. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 2017.
4. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	1	-	-	3	2	1
CO2	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2
CO3	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	1	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	1	-	-	3	3	3
AVG	3	3	2	2	-	-	-	-	-	1	-	-	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / EEE

23MET21	ENGINEERING GRAPHICS (BE/B.Tech-Common to all Branches)	L	T	P	C
		2	0	4	4

Course Objectives:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing projection of points, lines and plane surface.
- Drawingprojection of solids and freehand sketching.
- Drawing of sectioned solids and development of surfaces
- Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT-I PLANE CURVES **5+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT-II PROJECTION OF POINTS, LINES AND PLANE SURFACE **6+12**

Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND FREEHAND SKETCHING **6+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Orthographic projection- Freehand sketching of multiple views from pictorial views of objects.

UNIT-IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **7+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

UNIT-V ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+12**

Principles of isometric projection — isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL : 90 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Construct the conic curves, involutes and cycloid

CO2: Solve practical problems involving projection of lines, Planes.

CO3: Draw Projection of solids and can draw freehand sketch.

CO4: Draw projection of sectioned solids and development of surfaces

CO5: Draw the isometric and perspective projections.

TEXT BOOKS:

1. K Venugopal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2013.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

REFERENCE BOOKS:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edit ion, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/102/112102304/
2. https://onlinecourses.nptel.ac.in/noc20_me79/preview
3. https://www.youtube.com/watch?v=ANEvQyt3PnU

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
Avg	**3**	**1**	**2**	-	**2**	-	-	-	-	**3**	-	**2**	**2**	**2**	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23TAT21	TAMILS AND TECHNOLOGY (Common to B.E./B. Tech. all branches)	L T P C 1 0 0 1

COURSE OBJECTIVES:

- To understand about weaving and ceramic technology of Tamils
- To compare the design and constructive technology of Cheras, Cholas, Pallavas and Nayakkars
- To gain knowledge in various manufacturing technology of Tamils
- To analyse the agriculture and ishery knowledge of Tamils
- To learn about scienti ic Tamil and its usage in online platforms

UNIT-I **WEAVING AND CERAMIC TECHNOLOGY** 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graf iti on Potteries.

UNIT-II **DESIGN AND CONSTRUCTION TECHNOLOGY** 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT-III **MANUFACTURING TECHNOLOGY** 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT-IV **AGRICULTURE AND IRRIGATION TECHNOLOGY** 3

Dam, Tank, ponds, Sluice, Signi icance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Speci ic Society

UNIT-V **SCIENTIFIC TAMIL & TAMIL COMPUTING** 3

Development of Scienti ic Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

Chairman
BoS / S&H

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: Relate the weaving ceramic technology of Tamils
CO2: Understand the knowledge of Tamils in design and construction technology
CO3: Recognize the manufacturing technology knowledge of Tamils
CO4: Criticize the agriculture and ishery knowledge of Tamils
CO5: Apply scienti ic Tamil in Various online platforms

E- RESOURCES:

1. https://www.tamilvu.org/
2. https://sorkuvai.com/

CO's -PO's MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	1	1	1	1	1	-	1
CO2	2	-	-	-	-	2	2	2	2	2	-	2
CO3	2	-	-	-	-	2	2	2	2	2	-	2
CO4	1	-	-	-	-	1	1	1	1	1	-	1
CO5	2	-	-	-	-	2	2	2	2	2	-	2
AVG	2	-	-	-	-	2	2	2	2	2	-	2

Chairman
BoS / S&H

23TAT21

தமிழரும் தொழில்நுட்பமும்

L	T	P	C
1	0	0	1

(B.E./B.Tech- அனைத்து பாடப்பிரிவுகளுக்கும் பொதுவானது)

பாடநெறி நோக்கங்கள்:

- நெசவு மற்றும் பானைத்தொழில்நுட்பத்தைப் புரிந்து கொள்ளுதல்
- சேர, சோழ, பல்லவ மற்றும் நாயக்கர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பத்தை ஒப்பிடுதல்
- தமிழர்களின் பல்வேறு உற்பத்தி தொழில்நுட்பத்தைப் பற்றிய அறிவைப் பெறுதல்
- தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவைப் பெற்றுக்கொள்ளுதல்
- அறிவியல் தமிழையும் அதன் இணையப்பயன்பாட்டையும் கற்றல்

அலகு - I நெசவு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத்தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்சங்க காலத்தில் நெசவுத்தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்

அலகு - II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப்பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோவில்களும் - சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை

அலகு - III உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் காட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்

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அலகு - IV **வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம்** **3**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்

அலகு - V **அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்** **3**

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்

மொத்தம்: 15 பாடவேளைகள்

பாடநெறி முடிவுகள்:

இப்பாடத்தைப் படிப்பதின் முடிவில் மாணவர்கள்

CO1: நெசவு மற்றும் பானைத்தொழில்நுட்பத்தை பற்றிப் புரிந்துகொள்வார்கள்
CO2: வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பத்தில் தமிழர்களின் அறிவைப் பெறுவார்கள்
CO3: தமிழர்களின் உற்பத்தி தொழில்நுட்பத்தை கண்டறிவார்கள்
CO4: தமிழர்களின் வேளாண்மை மற்றும் கடல்சார் அறிவைக் குறித்து விவாதிப்பார்கள்.
CO5: பல்வேறு இணையப் பயன்பாடுகளில் அறிவியல் தமிழைப் பயன்படுத்திப்பார்ப்பார்கள்

மின் -ஆதாரங்கள்:

1. https://www.tamilvu.org/
2. https://sorkuvai.com/

CO's –PO's விவரணையாக்கம்:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	1	1	1	1	1	-	1
CO2	2	-	-	-	-	2	2	2	2	2	-	2
CO3	2	-	-	-	-	2	2	2	2	2	-	2
CO4	1	-	-	-	-	1	1	1	1	1	-	1
CO5	2	-	-	-	-	2	2	2	2	2	-	2
AVG	2	-	-	-	-	2	2	2	2	2	-	2

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23MEL21	ENGINEERING PRACTICES LABORATORY (BE/B.Tech-Common to all Branches)	L	T	P	C
		0	0	4	2

Course Objectives:

- Acquire skills in operating hand tools and instruments. Provide hands on training on common household plumbing work and wood work
- Provide hands on training on welding processes.
- Provide hands on training on various simple machining processes. Making a tray out of metal sheet using sheet metal work.
- Wiring various electrical joints in common household electrical wire network.
- Soldering and testing simple electronic circuits. Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)

I) CIVIL ENGINEERING PRACTICES (12)

PLUMBING WORK:

Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components - External thread cutting

WOOD WORK:

Hands-on-exercise: Sawing, Planing and Making joints

II) MECHANICAL ENGINEERING PRACTICES (18)

WELDING WORK:

Fabrication of Models with MS Plate using Arc Welding

BASIC MACHINING WORK:

a) Simple Turning
b) Drilling and Tapping Practice

SHEET METAL WORK:

Model making – Trays and funnels

ASSEMBLING AND DISMANTLING WORK:

Assembling a centrifugal pump

GROUP B (ELECTRICAL & ELECTRONICS)

III) ELECTRICAL ENGINEERING PRACTICES (15)

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

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IV) ELECTRONIC ENGINEERING PRACTICES **(15)**

SOLDERING WORK:

Soldering simple electronic circuits and checking continuity

ELECTRONIC ASSEMBLY AND TESTING WORK:

Assembling and testing electronic components on a small PCB

ELECTRONIC EQUIPMENT STUDY:

a) Study elements of smart phone
b) Assembly and dismantle of LED TV
c) Assembly and dismantle of computer/ laptop

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Make a wooden model using carpentry Process.

CO2: Make various shapes using welding processes.

CO3: Make various shapes using manufacturing processes like machining and sheet metal work.

CO4: Wires various electrical joints in common household electrical wire network.

CO5: Solder and test simple electronic circuits. Assemble and test simple electronic components on PCB.

REFERENCE:

1. Manual prepared by the faculty of Civil, Mechanical, Electrical and Electronics and Communication Engineering Department, SVHEC.

E-RESOURCES:

1. https://www.youtube.com/watch?v=GPnQjCrb83Y
2. https://www.youtube.com/watch?v=njwdsMI3PcY

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO2	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO3	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO4	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
CO5	3	-	-	3	-	-	-	-	-	-	-	-	2	1	1
Avg	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23EEL22	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

(for B.E./B.Tech- CIVIL, MECH, Pharm.Tech branches)

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Verification of ohms and Kirchhoff's Laws.
2. Speed control of DC Shunt Motor.
3. Load test on Self Excited DC Shunt Generator.
4. Load test on Single phase Transformer.
5. Load Test on 1Ø Induction Motor.
6. Characteristics of PN and Zener Diodes.
7. Characteristics of BJT and MOSFET.
8. Characteristics of SCR.
9. Half wave and Full Wave rectifiers.
10. Implementation of Binary Adder and Subtractor.
11. Study of Logic Gates.
12. Study of DSO.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1	Verify the Ohm's and Kirchhoff's Laws.
CO2	Analyze experimentally the load characteristics of electrical machines.
CO3	Analyze the characteristics of basic electrical devices.
CO4	Use DSO to measure the various parameters.
CO5	Analyze the characteristics of basic electronic devices.

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REFERENCE BOOKS:

1. SVHEC- Basic Electrical and Electronics Engineering Laboratory Manual.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	2	-	-	-	3	3	-
CO2	3	3	2	1	1	-	-	-	2	-	-	-	3	3	-
CO3	3	3	2	1	1	-	-	-	2	-	-	-	3	1	-
CO4	3	3	2	1	1	-	-	-	2	-	-	-	3	1	-
CO5	3	3	2	1	1	-	-	-	2	-	-	-	3	1	-
AVG	3	3	2	1	1	-	-	-	2	-	-	-	3	2	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / EEE

23ENL21	COMMUNICATION LABORATORY (Common to B.E./B.Tech. all Branches)	L T P C 0 0 4 2

COURSE OBJECTIVES:

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

UNIT-I **MAKING COMPARISONS** **12**

Speaking - Role Play Exercises Based on Workplace Contexts- Talking about Competition- Discussing Progress toward Goals- Talking about Experiences- Talking about Events in Life-Discussing Past Events.
Writing - Writing Emails (Formal & Semi-Formal)

UNIT-II **EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING** **12**

Speaking - Discussing News Stories – Talking about Frequency- Talking about Travel Problems-Discussing Travel Procedures- Talking about Travel Problems- Making Arrangements-Describing Arrangements- Arrangements Discussing Plans and Decisions-Discussing Purposes and Reasons- Understanding Common Technology Terms.
Writing -Writing Different Types of Emails.

UNIT-III **PROBLEM SOLVING** **12**

Speaking - Discussing Predictions- Describing the Climate- Discussing Forecasts and Scenarios- Talking about Purchasing- Discussing Advantages and Disadvantages- Making Comparisons- Discussing Likes and Dislikes- Discussing Feelings about Experiences-Discussing Imaginary Scenarios.
Writing - Short Essays and Reports- Formal/Semi-Formal letters.

UNIT-IV **CLASSIFICATION AND RECOMMENDATIONS** **12**

Speaking - Discussing the Natural Environment- Describing Systems- Describing Position and Movement Explaining Rules (Example- Discussing Rental Arrangements)-Understanding Technical Instructions.

Writing - Writing Instructions -Writing a Short Article.

Chairman
BoS / S&H

UNIT-V **EXPRESSION** **12**

Reading - Describing Things Relatively-Describing Clothing-Discussing Safety Issues (Making Recommendations) Talking about Electrical Devices-Describing Controlling Actions.

Writing - Job Application (Cover Letter + Curriculum Vitae) – Writing Recommendations.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the Course the students will able to

- **CO1:** Speak effectively in group discussions held in a formal/semi formal contexts
- **CO2:** Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
- **CO3:** Create emails, letters and effective job applications with resume.
- **CO4:** Write critical reports to convey data and information with clarity and precision
- **CO5:** Deliver suitable instructions and recommendations for safe execution of tasks

E-RESOURCES:

- https://www.englishclub.com/speaking/
- https://learnenglish.britishcouncil.org/

CO's-PO's MAPPING :

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

1- Low, 2- Medium, 3-High, "-" No Correlation

Chairman
BoS / S&H

23MDC21	YOGA FOR HUMAN EXCELLENCE (Common to B.E./B.Tech. all Branches)	L T P C 0 0 1 0

UNIT-I **SIMPLIFIED PHYSICAL EXERCISES** **3**

Physical exercises: Hand exercises – Leg exercises. Breathing exercises: Eye exercises – Kapalabathi. Makarasana. Body massages: Acupressure – Relaxation.

UNIT-II **KAYA KALPA** **3**

Kaya Kalpa Exercise – Aswini Mudra – Moola Bandha – Ojas Breath (Kayakalpa Exercise should be learnt directly from the World Community Service Centre.)

UNIT-III **MEDITATION** **3**

Agna. Santhi : Clearence. Thuriya. Thuriyatheetham meditation

UNIT-IV **HUMAN RESOURCES DEVELOPMENT** **3**

Eradication of worries – Bene its of Blessings – Greatness of Friendship – Neutralization of anger - Individual peace and world peace

UNIT-V **YOGASANAS** **3**

Suriya Namaskar, Padmasana, Vajrasana, Sukasana, Chakrasana (side posture), Viruchasana, Bhujangasana, Yoga mudra, Ustrasana, Maha Mudra, Vakkarasana.

TOTAL : 15 PERIODS

TEXT BOOKS:

1. Yoga Practices – I: VISION, Vethathiri Publications.

2. Yogasana – Vethathiri Publications

REFERENCE BOOKS:

1. Simpli ied Physical Exercises – Vethathiri Publications.

2. Sound health through yoga – Dr. K. Chandrasekaran.

Chairman
BoS / S&H

23MAT32 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (for B.E. CIVIL, MECH, BME & BIO-TECHNOLOGY)

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations
- To acquaint the student with Fourier, transform techniques used in wide variety of situations
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT-I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation

UNIT-II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT-III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Fourier series solutions of one- dimensional wave equation – One dimensional equation of heat conduction

UNIT-IV FOURIER TRANSFORMS 9+3

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

UNIT-V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z – transforms

TOTAL : 60 PERIODS

Chairman

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Understand how to solve the given standard partial differential equations.

CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO3: Appreciate the physical significance of Fourier series techniques in solving one dimensional heat flow problems and one-dimensional wave equations

CO4: Understand Fourier transform and its properties and to handle various types of problems using different kind of integral Transforms.

CO5: Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems

TEXT BOOKS:

1. Grewal B.S.,"Higher Engineering Mathematics",44thEdition, Khanna Publishers, New Delhi, 2023.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2023.

REFERENCE BOOKS:

1. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.
2. James. Glyn., "Advanced Modern Engineering Mathematics", 5thEdition, Pearson Education, New Delhi, 2018.
3. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
4. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ma37/preview
2. https://onlinecourses.nptel.ac.in/noc24_ma20/preview

CO's - PO's MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	-	-	-	2	-	-	3
CO2	3	3	1	1	-	-	-	-	2	-	-	3
CO3	3	3	1	1	-	-	-	-	2	-	-	3
CO4	3	3	1	1	-	-	-	-	2	-	-	3
CO5	3	3	1	1	-	-	-	-	2	-	-	3
Avg	**3**	**3**	**1**	**1**	-	-	-	-	**2**	-	-	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / CSE

23MET31	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To Learn the use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- To introduce the equilibrium of rigid bodies, vector methods and free body diagram
- To study and understand the distributed forces, surface, loading on beam and intensity.
- To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
- To develop basic dynamics concepts – force, momentum, work and energy;

UNIT-I BASICS AND STATICS OF PARTICLES 9

Introduction – Units and Dimensions – Laws of Mechanics – Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of A Force into Components, Rectangular Components of a Force, unit vectors. Equilibrium of a particle- newton's first law of motion, Space and Free-Body Diagrams, forces in space, equilibrium of a particle in space.

UNIT-II EQULIBRIUM OF RIGID BODIES 9

Free body diagram – Types of supports –Action and reaction forces –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 – Single equivalent force - Equilibrium of Rigid bodies in two dimensions – Analysis of trusses using method of joints - Equilibrium of Rigid bodies in three dimensions.

UNIT-III PROPERTIES OF SURFACES AND SOLIDS 9

Determination of Areas and Volumes – First moment of area and Centroid of sections – T section- I section- Angle section Hollow section from primary simpler sections – Second moment of plane areas – Parallel axis theorem and Perpendicular axis theorem – T section - I section- Angle section- Hollow section – Polar moment of Inertia – Product of Inertia- Principal Moment of Inertia of plane area- Mass moment of inertia

UNIT-IV FRICTION 9

The laws of dry friction, coef icients of friction, angles of friction, wedge friction, wheel friction, rolling resistance, ladder friction.

UNIT-V DYNAMICS OF PARTICLES 9

Kinematics - rectilinear motion and curvilinear motion of particles. Kinetics- newton's second law of motion -equations of motions, Dynamic equilibrium, energy and momentum methods - work of a force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Illustrate the vector and scalar representation of forces and moments

CO2: Analyse the rigid body in equilibrium

CO3: Evaluate the properties of distributed forces

CO4: Determine the friction and the effects by the laws of friction

CO5: Calculate dynamic forces exerted in rigid body

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, "Vector Mechanics for Engineers: Statics and Dynamics", McGraw Higher Education., 12thEdition, 2019.
2. Kumaravelan R. and Yugananth P., "Engineering Mechanics", 2nd Edition, Scitech Publications, 2015.
3. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCE BOOKS:

1. Hibbeller, R.C., "Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics", 13th edition,Prentice Hall, 2013.
2. Timoshenko S, Young D H, Rao J V and SukumarPati, "Engineering Mechanics", 5thEdition, McGraw HillHigher Education, 2013.
3. Kottiswaran N., "Engineering Mechanics Statics and Dynamics", 10th Edition, Sri Balaji Publications Pvt.Ltd., 2013.

E-RESOURCES:

1. https://nptel.ac.in/courses/112106180
2. https://www.youtube.com/watch?v=nGfVTNfNwnk

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	-	2	3	1	-
CO2	3	2	2	1	1	-	-	-	-	-	-	2	3	1	-
CO3	3	2	3	1	1	-	-	-	-	-	-	2	3	1	-
CO4	3	2	3	1	1	-	-	-	-	-	-	2	3	1	-
CO5	3	2	3	1	1	-	-	-	-	-	-	2	3	1	-
Avg	**3**	**2**	**2.6**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET32	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students :

- To introduce the students about properties of the fluids, behavior of fluids under static conditions.
- To impart basic knowledge of the flow through pipes and boundary layer concept.
- To understand the importance of dimensional analysis and model studies.
- To understand the importance of various types of flow in turbines.
- To understand the importance of various types of flow in pumps.

UNIT-I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – Rate of flow, concept of control volume - continuity equation, energy equation and momentum equation-Applications.

UNIT-II FLOW THROUGH PIPES AND BOUNDARY LAYER 9

Laminar flow through circular conduits - friction factor - Major Loses - Darcy Weisbach equation and chezys formula - minor losses- Moody diagram - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT-III DIMENSIONAL ANALYSIS AND MODEL STUDIES 9

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT-IV TURBINES 9

Theory of rotodynamic machines - Classification of turbines – Working principles –Pelton wheel - Modern Francis turbine - Kaplan turbine - Velocity Triangle - Work done - Efficiencies – Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT-V PUMPS 9

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and its variations – Pumps in parallel and series - Rotary pumps Classifications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the properties and behavior of fluid in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics

CO2: Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.

Chairman
BoS / Mech

CO3: Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies

CO4: Explain the working principles of various turbines and design the various types of turbines.

CO5: Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXT BOOKS:

1. Bansal R.K. "Fluid Mechanics and Hydraulic Machines", 9th revised Edition, Laxmi Publications,
2. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016

REFERENCE BOOKS:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

E-RESOURCES:

1. https://nptel.ac.in/courses/112104118
2. https://egyankosh.ac.in/handle/123456789/31951
3. https://archive.nptel.ac.in/courses/112/105/112105206

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
Avg	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	**2**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET33	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives:

At the end of the course the students would be able to

1. Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
2. Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.
3. Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
4. Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
5. Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

UNIT-I BASICS, ZEROTH AND FIRST LAW 9

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT-II SECOND LAW AND ENTROPY 9

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.

UNIT-III AVAILABILITY AND APPLICATIONS OF II LAW 9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High-and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT-IV PROPERTIES OF PURE SUBSTANCES 9

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT-V GAS MIXTURES AND THERMODYNAMIC RELATIONS 9

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, Joule- Thomson experiment - Clausius-Clapeyron equation.

Total Hours 45

Chairman
BoS / Mech

COURSE OUTCOME

At the end of the course the students would be able to

- **CO1** Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
- **CO2** Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.
- **CO3** Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
- **CO4** Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
- **CO5** Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXT BOOKS:

1. Nag .P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.
3. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.

REFERENCE BOOKS:

1. Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.
2. Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
3. Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.
4. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106310/
2. https://ocw.mit.edu/courses/5-60-thermodynamics-kinetics-spring-2008/pages/lecture-notes/
3. http://ndl.iitkgp.ac.in/document/Mk82ZERlbkovZWhUNGV2T3oxamN0UT09

CO & PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	1	-	-	2	-	1	2	3	2	3
CO2	3	3	2	1	-	1	-	-	2	-	1	2	3	2	3
CO3	3	3	2	1	-	1	-	-	2	-	1	2	3	2	3
CO4	3	3	2	1	-	1	-	-	2	-	1	2	3	2	3
CO5	3	3	2	1	-	1	-	-	2	-	1	2	3	2	3
AVG	**3**	**3**	**2**	**1**	-	**1**	-	-	**2**	-	**1**	**2**	**3**	**2**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET34	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To learn the constructing the phase diagram and using of iron-iron carbide phase diagram formicrostructure formation.
- To learn selecting and applying various heat treatment processes and its microstructureformation.
- To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering ield.
- To illustrate the different polymer, ceramics and composites and their uses in engineering ield.
- To learn the various testing procedures and failure mechanism in engineering ield.

UNIT-I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

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

UNIT-II HEAT TREATMENT 9

De inition – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening andtempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram– continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability,Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame andInduction hardening.

UNIT-III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA -Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass,Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment –super alloys – shape memory alloys- Properties and Applications.

UNIT-IV NON-METALLIC MATERIALS 9

Polymers – types of polymers, commodity and engineering polymers – Properties and applications ofPE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers –Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al_2O_3,SiC, Si_3N_4, PSZ and SIALON –Composites- Matrix and reinforcement Materials-applications of Composites - Nano composites.

UNIT-V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics-Griffith'stheory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell,Vickers and Rockwell), Micro and nano-hardness tests, Impact test Izod and charpy, fatigue and creepfailure mechanisms.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classi ication.

CO2: Explain isothermal transformation, continuous cooling diagrams and different heattreatment processes.

CO3: Clarify the effect of alloying elements on ferrous and non-ferrous metals

CO4: Summarize the properties and applications of non-metallic materials

CO5: Explain the testing of mechanical properties.

TEXT BOOKS:

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of IndiaPrivate Limited, 9th edition ,2018.
2. Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994

REFERENCE BOOKS:

1. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materialsand Metallurgy, Laxmi Publications, 2006
2. Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material andMetallurgy, University Sciences Press, 2008
3. G.S. Upadhyay and AnishUpadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2020.
4. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 6th edition, 2019
5. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, 2nd edition Re print2019.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/113/102/113102080/
2. https://archive.nptel.ac.in/courses/112/104/112104203/
3. https://archive.nptel.ac.in/courses/113/105/113105099/
4. https://www.youtube.com/watch?v=uAKjmubJsJk

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	2	-	-	-	-	-	-	-	2	2	1	2
CO2	3	1	3	1	-	2	-	1	-	-	-	2	2	1	2
CO3	3	1	3	-	-	-	-	-	-	-	-	2	2	1	2
CO4	3	1	3	-	-	-	2	-	-	-	-	2	2	1	2
CO5	3	1	3	2	2	-	-	-	-	-	-	2	2	1	2
Avg	3	1	3	2	2	2	2	1	-	-	-	2	2	1	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET35	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Illustrate the working principles of various metal casting processes
- Learn and Apply the working principles of various metal joining processes
- Analyse the working principles of bulk deformation of metals
- Learn the working principles of sheet metal forming process
- Study and Practice the working principles of plastics molding

UNIT-I METAL CASTING PROCESSES 9

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications – Molding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – low pressure, gravity- Tilt pouring, high pressure die casting- Centrifugal Casting – CO2 casting –Defects in Sand casting process-remedies.

UNIT-II METAL JOINING PROCESSES 9

Fusion welding processes – Oxy fuel welding – Filler and Flux materials--Arc welding, Electrodes, Coating and specifications – Gas Tungsten arc welding –Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding –- Resistance welding Processes -Electron beam welding –Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects –inspection &remedies – Brazing - soldering – Adhesive bonding.

UNIT-III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging –cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wiredrawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion. Introduction to shaping operations.

UNIT-IV SHEET METAL PROCESSES 9

Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.

UNIT-V MANUFACTURE OF PLASTIC COMPONENTS 9

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

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the principle of different metal casting processes

CO2: Describe the various metal joining processes.

CO3: Illustrate the different bulk deformation processes

CO4: Apply the various sheet metal forming process.

CO5: Apply suitable molding technique for manufacturing of plastics components

TEXT BOOKS:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 4th Edition, 2013.
2. P.N.Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5th edition, 2018.
3. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997.

REFERENCE BOOKS:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. S. Gowri P.Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107145/#
2. https://archive.nptel.ac.in/courses/112/107/112107219/
3. https://onlinecourses.nptel.ac.in/noc20_me67

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	2	3	1	1	-	-	1	3	1	-
CO2	3	-	2	-	-	2	3	1	1	-	-	1	3	1	-
CO3	3	-	2	-	-	2	3	1	1	-	-	1	3	1	-
CO4	3	-	2	-	-	2	3	1	1	-	-	1	3	1	-
CO5	3	-	2	-	2	2	3	1	1	-	-	1	3	1	-
Avg	**3**	**-**	**2**	**-**	**2**	**2**	**3**	**1**	**1**	**-**	**-**	**1**	**3**	**1**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23EST31	ENTREPRENEURSHIP AND STARTUP	L	T	P	C
		1	0	0	1

Course Objectives:

The main learning objective of this course is to prepare the students :

- To develop a knowledge on basic concepts of entrepreneurship.
- To know about business opportunities and project evaluation criteria.
- To explore the concept of startups, government schemes and other financial institutions support

UNIT-I ENTREPRENEURSHIP CONCEPTS 5

Entrepreneurship-Meaning-Origin-Functions-Factors Affecting Entrepreneurial Growth- - Role of Entrepreneurship in Economic Development- Skills required for an Entrepreneur - Barriers to Entrepreneurship - Stages in Entrepreneurial Process.

UNIT-II PROJECT FORMULATION AND IDENTIFICATION 5

Identification of business opportunities -Project formulation- Project Classification and Identification - Project Objectives - Technical Analysis, Financial Analysis – Environmental Appraisal of Project - EDP Phases - Project Report Preparation.

UNIT-III START UP OPPORTUNITIES AND FINANCE 5

The New Industrial Revolution- Business Start-up - Rise of the startup Economy- Government Initiatives - Government schemes and incentives - Institutional service to entrepreneur - Sources of Finance.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Enhanced the knowledge of entrepreneurship qualities and skills to startup a business.

CO2: Understand the project classification and prepare a feasibility report.

CO3: Provide vision for the own Start-up and its importance for economic development.

Chairman
BoS / MBA

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	-	-	-	-	-	3	2	2
CO2	2	3	1	3	-	-	-	-	-	-	-	-	2	1	2
CO3	1	-	3	2	2	-	-	-	-	-	-	-	1	3	2
Avg	2	2	2	1.6	1	-	-	-	-	-	-	-	2	2	2

TEXT BOOKS:

1. Gupta C.B and Srinivasan N.P- Entrepreneurial development-Sultan Chand and Sons- Latest edtion.
2. Khanka S.S.-Entrepreneurial Development-S.Chand & Co,RamNagar, New Delhi, Latest edtion.

REFERENCE BOOKS:

1. Vasant Desai-Project Management and Entrepreneurship-Himalaya Publishing House, 2023.
2. P.Narayana Reddy – Entrepreneurship Text and Cases- Cengage learning.2022.
3. Prasanna Chandra- Projects planning, analysis, selection, implementation and review Tata McGraw-Hill Publishing Co, Latest edtion.
4. Donald F.Kuratko -Entrepreneurship theory, process & practice-9th Edition-Cengage Learning, 2022.

Chairman
BoS / MBA

23MEL31	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

At the end of the course the students would be able to

1. Acquire proficiency in 2D drafting and 3D modeling software, emphasizing practical skills.
2. Apply standard drawing practices, focusing on fits and tolerances in engineering design.
3. Create assembly drawings through both manual techniques and standard CAD packages.
4. Prepare standardized drawing layouts for modeled parts and assemblies.
5. Utilize CAD tools for precise documentation and effective communication in the design process.

PART-I DRAWING STANDARDS & FITS AND TOLERANCES 12

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

PART-II 2D DRAFTING 48

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.

1. Bearings – Bush Bearing,
2. Valves – Safety and Non-return Valves.
3. Couplings – Flange, Oldham's, Muff, Gear couplings.
4. Joints – Universal, Knuckle, Gib& Cotter, Strap, Sleeve &Cotter joints.
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, multi-plate clutch.
6. Machine Components – Screw Jack, Machine Vice, LatheTail Stock, Lathe Chuck, Plummer Block, Vane and Gear pumps.

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

Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D CAD software.

TOTAL : 60 PERIODS

COURSE OUTCOME

At the end of the course the students would be able to

CO1	Prepare comprehensive drawing layouts for modeled assemblies, including accurate Bills of Materials (BoM).
CO2	Demonstrate the ability to create precise orthogonal views for machine components using 3D modeling.
CO3	Develop skills in preparing standard drawing layouts for various modeled parts, ensuring clarity and adherence to industry standards.
CO4	Showcase proficiency in integrating BoM within assembly drawings for effective documentation and communication.
CO5	Apply learned techniques to generate standardized drawing layouts that meet industry requirements for modeled parts.

Chairman
BoS / Mech

TEXT BOOKS:

1. Gopalakrishna K.R., "Machine Drawing", 17th Edition, Subhas Stores Books Corner, Bangalore,2003.
2. N. D . Bhatt and V.M. Panchal, "Machine Drawing", 51st Edition, Charator Publishers,2022.
3. GoutamPohit and Goutam Ghosh, "Machine Drawing with AutoCAD", 1st Edition,Pearson Education, 2004

REFERENCE BOOKS:

1. Jun narkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
2. N. Siddeshwar, P. Kanniah, V.V.S. Sastri," Machine Drawing" , published by Tata McGrawHill,2006
3. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106310/
2. https://ocw.mit.edu/courses/5-60-thermodynamics-kinetics-spring-2008/pages/lecture-notes/
3. http://ndl.iitkgp.ac.in/document/Mk82ZERlbkovZWhUNGV2T3oxamN0UT09

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	3	-	-	-	3	-	-	3	2	2	2
CO2	1	2	-	-	3	-	-	-	3	-	-	3	2	2	2
CO3	1	2	-	-	3	-	-	-	3	-	-	3	2	2	2
CO4	1	2	-	-	3	-	-	-	3	-	-	3	2	2	2
CO5	1	2	-	-	3	-	-	-	3	-	-	3	2	2	2
AVG	**1**	**2**	-	-	**3**	-	-	-	**3**	-	-	**3**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEL32	MANUFACTURING PROCESS AND MACHINING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

The main learning objective of this course is to prepare the students to:

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

LIST OF EXPERIMENTS

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

TOTAL : 60 PERIODS

COURSE OUTCOME

At the end of the course the students will be able to

CO1: Demonstrate the safety precautions exercised in the mechanical workshop

CO2: Join two metals using GMAW

CO3: Make the gears using gear making machines

CO4: Make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.

CO5: Become and Analyze the defects in the cast and machined components

Chairman
BoS / Mech

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	-	2	-	-	1	2	1	-
CO2	3	-	-	-	-	-	1	-	2	-	-	1	2	1	-
CO3	3	-	-	-	-	-	1	-	2	-	-	1	2	1	-
CO4	3	-	-	-	-	-	1	-	2	-	-	1	2	1	-
CO5	3	-	-	-	-	-	1	-	2	-	-	1	2	1	-
Avg	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**-**	**1**	**2**	**1**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Reference:

1. Manual prepared by the faculty of Mechanical Engineering Department, SVHEC.

Chairman
BoS / Mech

23MET41	THEORY OF MACHINES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
- Study the basic concepts of toothed gearing and kinematics of gear trains.
- Analyzing the effects of friction in machine elements.
- Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

UNIT-I KINEMATICS OF MECHANISMS 9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT-II GEARS AND GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT-III FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes– Friction in vehicle propulsion and braking.

UNIT-IV FORCE ANALYSIS 9

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT-V BALANCING AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation. (Gyroscopic principles)

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the basics of mechanism.

CO2: Solve problems on gears and gear trains.

CO3: Examine friction in machine elements.

CO4: Calculate static and dynamic forces of mechanisms.

CO5: Calculate the balancing masses and their locations of reciprocating and rotating masses. Computing the frequency of free vibration, forced vibration and damping coefficient.

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019.
3. R.S.Khurmi, J.K.Gupta, "Theory of Machines", Eurasia Publishing House, S. Chand Pvt Limited, 2013.

REFERENCE BOOKS:

1. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2nd edition, 2014.
2. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104121/
2. https://archive.nptel.ac.in/courses/112/106/112106270/
3. https://www.youtube.com/watch?v=WmzAO3LdTTE

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	-	-	1	-	-	-	1	3	1	-
CO2	3	2	2	-	2	-	-	1	-	-	-	1	3	1	-
CO3	3	2	2	-	2	-	-	1	-	-	-	1	3	1	-
CO4	3	2	2	-	2	-	-	1	-	-	-	1	3	1	-
CO5	3	2	2	-	2	-	-	1	-	-	-	1	3	1	-
Avg	**3**	**2**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**1**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET42	THERMAL ENGINEERING	L	T	P	C
		4	0	0	4

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion(IC) engines and Gas Turbines
- To analyzing the performance of steam nozzle, calculate critical pressure ratio
- To Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
- To analyzing the working of IC engines and various auxiliary systems present in IC engines.
- To evaluating the various performance parameters of IC engines.

UNIT-I THERMODYNAMIC CYCLES **12**

Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles

UNIT-II STEAM NOZZLES AND INJECTOR **12**

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow..

UNIT-III STEAM AND GAS TURBINES **12**

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination

UNIT-IV INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION **12**

IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control.

UNIT-V INTERNAL COMBUSTION ENGINE PERFORMANCE AND AUXILIARY SYSTEMS **12**

Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging –Emission Norms

TOTAL : 60 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Apply thermodynamic concepts to different air standard cycles and solve problems..
- **CO2:** To solve problems in steam nozzle and calculate critical pressure ratio
- **CO3:** Explain the flow in steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems.
- **CO4:** Explain the functioning and features of IC engine, components and auxiliaries..
- **CO5:** Calculate the various performance parameters of IC engines.

TEXT BOOKS:

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

REFERENCE BOOKS:

1. Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
2. Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013..
3. Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd,2017

E-RESOURCES:

1. https://www.youtube.com/watch?v=2LPQX4F-GoA&list=PLwdnzlV3ogoWV-_n1YItO933MxgPXfEiM
2. https://onlinecourses.nptel.ac.in/noc23_me31

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	3	-	-	-	3	-	-	-	3	-	-
CO2	2	3	3	-	2	-	-	-	2	-	-	-	3	-	-
CO3	2	3	3	-	3	-	-	-	3	-	-	-	3	-	-
CO4	2	3	3	-	2	-	-	-	2	-	-	-	3	-	-
CO5	2	2	2	-	3	-	-	-	3	-	-	-	3	-	-
Avg	**2.4**	**2.8**	**2.8**	**-**	**2.6**	**-**	**-**	**-**	**2.6**	**-**	**-**	**-**	**3**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET43	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To provide the knowledge on the working principles of fluid power systems
- To study the fluids and components used in modern industrial fluid power system.
- To develop the design, construction and operation of fluid power circuits.
- To learn the working principles of pneumatic power system and its components.
- To provide the knowledge of trouble shooting methods in fluid power systems.

UNIT-I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory-– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps .

UNIT-II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols.

UNIT-III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.

UNIT-IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT-V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Apply the working principles of fluid power systems and hydraulic pumps.

CO2: Apply the working principles of hydraulic actuators and control components.

CO3: Design and develop hydraulic circuits and systems.

CO4: Apply the working principles of pneumatic circuits and power system and its components.

CO5: Identify various troubles shooting methods in fluid power systems.

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

REFERENCE BOOKS:

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
2. Joshi.P., Pneumatic Control", Wiley India, 2008.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance",TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106300/
2. https://archive.nptel.ac.in/courses/112/105/112105046/
3. https://www.youtube.com/watch?v=akZjDHD6JC4

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO2	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO3	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO4	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO5	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
Avg	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET44	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the concepts and basic mechanics of metal cutting and the factors affecting machinability.
- Learn working principles of basic and advanced turning machines.
- Understand the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
- Study the basic concepts of CNC of machine tools and constructional features of CNC.
- Learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre.

UNIT-I MECHANICS OF METAL CUTTING **9**

Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT-II TURNING MACHINES **9**

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle.

UNIT-III RECIPROCATING MACHINE TOOLS **9**

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods.

UNIT-IV CNC MACHINES **9**

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous -Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features.

UNIT-V PROGRAMMING OF CNC MACHINE TOOLS **9**

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Apply the mechanism of metal removal process and to identify the factors involved in improving machinability

CO2: Describe the constructional and operational features of centre lathe and other special purpose lathes.

CO3: Constructional and operational features of reciprocating machine tools

CO4: Apply the constructional features and working principles of CNC machine tools.

CO5: Demonstrate the Program CNC machine tools through planning, writing codes and setting up CNC machine tools to manufacture a given component

TEXT BOOKS:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 7th Edition, 2018..
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018.
3. Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2009.

REFERENCE BOOKS:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.
3. Peter Smid, CNC Programming Handbook, Industrial Press Inc., Third edition 2007.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_me04
2. https://onlinecourses.nptel.ac.in/noc19 me46

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	3	-	-	3	-	2	3	3	2
CO2	3	3	3	1	1	1	3	-	-	3	-	2	3	2	2
CO3	3	3	3	1	1	1	3	-	-	3	-	2	3	2	2
CO4	3	3	3	1	1	1	3	-	-	3	-	2	3	2	2
CO5	3	3	3	1	1	1	3	-	-	3	-	2	3	2	3
Avg	**3**	**3**	**3**	**1**	**1**	**1**	**3**	**-**	**-**	**3**	**-**	**2**	**3**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MET45	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Understand the concepts of stress, strain, principal stresses and principal planes
- Study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses
- Determine stresses and deformation in circular shafts and helical spring due to torsion.
- Compute slopes and deflections in determinate beams by various methods.
- Study the stresses and deformations induced in thin and thick shells

UNIT-I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumertric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

UNIT-II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams –Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT-III TORSION 9

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

UNIT-IV DEFLECTION OF BEAMS 9

Elastic curve – Governing differential equation - Double integration method - Macaulay's method – Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.

UNIT-V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses -Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lame's theory.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

CO2: Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

CO3: Apply basic equation of torsion in designing of shafts and helical springs.

CO4: Calculate slope and deflection in beams using different methods.

CO5: Analysis of stresses and deformations induced in thin and thick shells.

TEXT BOOKS:

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7th edition, 2018.
2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.
3. Vazirani. V.N, Ratwani. M.M, Duggal .S.K "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.

REFERENCE BOOKS:

1. Singh. D.K., "Strength of Materials", Ane Books Pvt Ltd., New Delhi, 2021.
2. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New
Delhi, 2015.
3. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi 2019

E-RESOURCES:

1. https://nptel.ac.in/courses/112107146
2. https://archive.nptel.ac.in/courses/112/107/112107147/

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	1	-	2	3
CO2	2	3	3	3	-	-	-	-	-	-	-	1	2	-	3
CO3	3	3	3	3	-	2	2	-	-	-	-	1	2	-	3
CO4	2	3	3	2	-	2	2	-	-	-	-	1	-	2	3
CO5	2	3	3	3	-	2	2	-	-	-	-	1	2	-	3
Avg	2.4	2.8	2.8	2.8	-	2	2	-	-	-	-	1	2	2	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / Mech

23CYT41 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C
(Common to B.E./B.Tech. all Branches)
2 0 0 2

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and sustainable practices
- To imbibe awareness on population issues and manmade activities

UNIT-I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity – values of biodiversity, India as a mega-diversity nation – threats to biodiversity – conservation of biodiversity.
Activity: Documentation of ecosystems/Biodiversity within Campus.

UNIT-II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.
Activity: Documentation of pollution issues in Erode district.

UNIT-III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation - New Energy Sources: Need and different types of new energy sources. Concept, origin and applications of - Hydrogen energy, Ocean energy, Tidal energy and geothermal energy conversion.
Activity: Documentation of available renewable resources in Erode district.

UNIT-IV SUSTAINABILITY AND MANAGEMENT 6

Development, GDP, Sustainability- concept, needs and challenges - Sustainable Development Goals - Concept of Carbon Credit, Carbon Footprint. Circular economy, ISO 14000 Series, Material Life Cycle Assessment, Environmental Impact Assessment. Green Engineering.
Activity: Documentation of sustainable goals of Tamilnadu. **Case Study:** E-Waste Management

UNIT-V HUMAN POPULATION AND DISASTER MANAGEMENT 6

Population growth, Population explosion— Family Welfare Program – Environment and human health. Human rights – HIV/AIDS – Women and Child Welfare – Role of Information Technology in environment and human health – Disaster management: Floods, earthquake, cyclone and landslides.
Activity: Documentation of women development schemes in Tamilnadu.

TOTAL HOURS 30

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2 : To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 : To identify and apply the understanding of renewable and non-renewable resources

CO4 : To recognize the different goals of sustainable development and sustainability practices and apply them for future development.

CO5 : To aware the population issues and to handle the disaster issues

TEXT BOOKS:

1. Dr. A.Ravikrishnan "Environmental Sciences and Sustainability", 2nd Edition, Sri Krishna Hitech Publishing Company Pvt. Ltd, 2022.

2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2010.

3. Gilbert M.Masters & Wendell P Ela, 'Introduction to Environmental Engineering and Science', 3rd edition, Prentice – Hall of India Pvt. Ltd, New Delhi, 2008.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2009.

2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2022.

3. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2023.

ONLINE SOURCES:

Unit 1: https://www.youtube.com/watch?v=Ar04qG1P8Es (IIT ROORKEE NPTEL) & https://www.youtube.com/watch?v=SHxAOoxhKTA (IIT KANPUR NPTEL)
Unit 2: https://www.youtube.com/watch?v=I7Z34WU257U (IIT ROORKEE NPTEL)
Unit 3: https://www.youtube.com/watch?v=1kUE0BZtTRc (NATIONAL GEOGRAPHIC)
Unit 4: https://www.youtube.com/watch?v=Crd3CFq5B4s (IITM NPTEL)
Unit 5: https://www.youtube.com/watch?v=sMqtwbKc8EA (FINANCIAL TIMES)

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CO's & PO's MAPPING:

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

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23MEL41	MATERIALS TESTING AND FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the mechanical properties of metals
- Study the mechanical properties ofwood
- Test spring in spring testing machine
- Study the principles in fluid mechanics by performing experiments in laboratory.
- Study the principles in fluid machinery theory by performing experiments in laboratory.

MATERIALS TESTINGLABORATORY **(30)**

LIST OF EXPERIMENTS:

(1) Tension test on mild steel rod.
(2) Torsion test on mild steel rod
(3) Hardness test on metal (Rockwell and BrinellHardness).
(4) Compression test on helical spring
(5) Deflection test on carriage spring.

FLUID MECHANICS AND MACHINERY LABORATORY **(30)**

LIST OF EXPERIMENTS:

(1) (a)Determination of coefficient of discharge of a venture meter
(b)Determination of friction factor for flow through pipes
(2) (a) Determination of metacentric height
(b) Determination of forces due to impact of jet on a fixed plate
(3) Characteristics of centrifugal pumps
(4) Characteristics of reciprocating pump
(5) Characteristics of Pelton wheel turbine

TOTAL : 60 PERIODS

COURSE OUTCOMES

At the end of the course the students will be able to

CO1 Determine the tensile, torsion and hardness properties of metals by testing

CO2 Determine the stiffness properties of helical spring and carriage spring.

CO3 Apply the conservation laws to determine the coefficient of discharge of a Venture meter and finding the friction factor of given pipe.

CO4 Apply the fluid static and momentum principles to determine the metacentric heightand forces due to impact of jet.

CO5 Determine the performance characteristics of turbine, rotodynamic pump and positive displacement pump.

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CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	1	-	-	3	-	-	2	2	2	1
CO2	3	2	1	3	3	1	-	-	3	-	-	2	3	2	1
CO3	3	3	2	3	2	1	-	-	3	-	-	2	3	2	1
CO4	3	3	1	3	3	1	-	-	3	-	-	2	3	2	1
CO5	3	3	1	3	3	1	-	-	3	-	-	2	3	2	1
Avg	**3**	**2.6**	**1.2**	**3**	**2.9**	**1**	**-**	**-**	**3**	**-**	**-**	**2**	**2.9**	**2**	**1**

Reference:

1. Manual prepared by the faculty of Mechanical Department, SVHEC

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23MEL42	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the valve timing diagram
- Study the port timing diagram
- Perform the characteristics test of IC engines.
- Study the Performance of refrigeration cycle / components.
- Study the Performance and Energy Balance Test on a Steam Generator.

PART I IC ENGINES LABORATORY **45**

List of Experiments

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on four – stroke Diesel Engine.
4. Heat Balance Test on 4 – stroke Diesel Engine.
5. Morse Test on Multi-Cylinder Petrol Engine.
6. Retardation Test on a Diesel Engine.
7. Determination of p-θ diagram and heat release characteristics of an IC engine.
8. Determination of Flash Point and Fire Point of various fuels / lubricants
9. Performance test on a two stage Reciprocating Air compressor
10. Determination of COP of a Refrigeration system

PART II STEAM LABORATORY **15**

List of Experiments

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Conduct tests to draw valve timing diagram

CO2: Conduct tests to draw port timing diagram

CO3: Conduct tests to evaluate performance characteristics of IC engines

CO4: Conduct tests to evaluate the performance of refrigeration cycle

CO5: Conduct tests to evaluate Performance and Energy Balance on a Steam Generator

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CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
CO2	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
CO3	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
CO4	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
CO5	2	2	1	1	-	-	-	-	1	-	-	1	1	1	1
Avg	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Reference:

1. Manual prepared by the faculty of Mechanical Department, SVHEC.

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23MDC41	SOFT AND ANALYTICAL SKILLS - I	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- ☐ To make the students aware of critical thinking.
- ☐ To understand the significance of emotional intelligence in self-growth.
- ☐ Basic Knowledge about the Arithmetic Ability.
- ☐ To solve the problems in Business Computations.
- ☐ Understand the basics of Data Interpretation

UNIT-I **CRITICAL THINKING** **3**

Active Listening –Observation –Curiosity –Introspection –Analytical Thinking –Open-mindedness – Creative Thinking.

UNIT-II **EMOTIONAL INTELLIGENCE** **3**

Transactional analysis – Empathy – Sympathy - Conflict management.

UNIT-III **ARITHMETIC ABILITY** **3**

Vedic Maths - Algebraic operations BODMAS, Fractions, Divisibility rules, LCM & GCD (HCF).

UNIT-IV **BUSINESS COMPUTATIONS** **3**

Time & Distance, Partnership, simple & compound interest.

UNIT-V **DATA INTERPRETATION** **3**

Line Graphs - Venn diagrams - Mixed Graphs.

TOTAL : 15PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Analyse and evaluate arguments and identify most common fallacies.

CO2 : Discover personal competence and techniques of building emotional intelligence.

CO3 : Enhance the Aptitude Round Clearing ability in interview process.

CO4 : Infer the concepts of Business Computations.

CO5 : Interrupt the data.

TEXT BOOKS:

1. Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.
2. Soft Skills: an Integrated Approach to Maximise Personality, Gajendra S. Chauhan, Sangeeta Sharma, Wiley India.

REFERENCE BOOKS:

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata Mc Graw Hill Publications.
4. Personality Development and Soft Skills, Barun K. Mitra, Oxford Press
5. Communication Skills for Engineers and Scientists , Sharma, Sangeeta & Binod Mishra., PHI India. (2 nd edition).

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23MET51	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		4	0	0	4

Course Objectives:

The main learning objective of this course is to prepare the students to:

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

(Use of PSG Design Data book is permitted)

UNIT – I FUNDAMENTAL CONCEPTS IN DESIGN **12**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards

UNIT – II DESIGN OF SHAFTS AND COUPLINGS **12**

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT – III DESIGN OF TEMPORARY AND PERMANENT JOINTS **12**

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints

UNIT – IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS **12**

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines-- Solid and Rimmed flywheels- connecting rods and crank shafts

UNIT-V BEARINGS **12**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, - Selection of Rolling Contact bearings –Design of Seals and Gaskets.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the design machine members subjected to static and variable loads

CO2: Apply the concepts design to shafts, key and couplings.

CO3: Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints

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CO4: Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.

CO5: Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

TEXT BOOKS:

1. Bhandari V B, "Design of Machine Elements", 4th Edition , Tata McGraw-Hill Book Co, 2016
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill , 2015 .

REFERENCE BOOKS:

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.
2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017.
3. Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup, et al. | 25 March 2019 .

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/105/112105125/
2. https://archive.nptel.ac.in/courses/112/106/112106137/
3. https://www.youtube.com/watch?v=060419AMIAg

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	-	-	-	1	1	-	-	2	3	2	2
CO2	2	2	3	-	-	-	-	1	1	-	-	2	3	2	2
CO3	2	2	3	-	-	-	-	1	1	-	-	2	3	2	2
CO4	2	2	3	-	-	-	-	1	1	-	-	2	3	2	2
CO5	2	2	3	-	-	-	-	1	1	-	-	2	3	2	2
Avg	**2**	2	**3**	-	-	-	-	**1**	**1**	-	-	**2**	**3**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MET52	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students:

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

UNIT-I BASICS OF METROLOGY 9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

UNIT-II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS 9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT-III TOLERANCE ANALYSIS 9

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT-IV METROLOGY OF SURFACES 9

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT-V ADVANCES IN METROLOGY 9

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi- sensor CMMs.

Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production - Computed tomography – White light Scanners

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the concepts of measurements to apply in various metrological instruments.

CO2: Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.

CO3: Apply the tolerance symbols and tolerance analysis for industrial applications.

CO4: Apply the principles and methods of form and surface metrology.

CO5: Apply the advances in measurements for quality control in manufacturing Industries.

TEXT BOOKS:

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

REFERENCE BOOKS:

1. AmmarGrous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical LaboratoryGuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5. Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley &Sons, 2015.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104250/
2. https://www.youtube.com/watch?v=vVvI9HgyWWk
3. https://www.scribd.com/document/622583923/Fundamentals-of-Dimensional-Metrology-Connie-L-Dotson-Z-lib-org

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
CO2	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
CO3	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
CO4	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
CO5	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
Avg	**3**	**2**	**2**	**2**	-	-	-	-	**1**	-	-	**1**	**3**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEL52	METROLOGY AND DYNAMICS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To study the different measurement equipment and use of this industry for quality inspection.
- To supplements the principles learnt in dynamics of machinery
- To understand how certain measuring devices are used for dynamic testing

UNIT-I **METROLOGY** **30**

LIST OF EXPERIMENTS

1. Calibration of precision measuring instruments-Vernier caliper, micrometer, dial gauge.
2. Measurement of linear measurements using Vernier height gauge
3. Measurement of dimensional tolerance using mechanical comparator (dial gauge)
4. Measurement of angle using Vernier bevel protractor
5. Measurement of taper angle using sine bar and slip gauge
6. Measurement of gear parameters using gear tooth Vernier
7. Measurement of thread parameters using profile projector
8. Measurement of straightness and flatness using two axis auto collimator.

UNIT-II **DYNAMICS LABORATORY** **30**

LIST OF EXPERIMENTS

1. Epicycle gear Train.
2. Determination of moment of inertia of flywheel and axle system
3. Determination of mass moment of inertia of a body about its axis of symmetry
4. Undamped free vibrations of a single degree freedom spring-mass system
5. Torsional Vibration (Undamped) of single rotor shaft system
6. Dynamic analysis of cam mechanism
7. Determine the characteristics of
   a. Motorized gyroscope
   b. Watts Governor, Proell Governor
8. Determination of critical speed of shafts

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	The students able to measure the gear tooth dimensions, angle using sine bar, straightness.
CO2:	Determine mass moment of inertia of mechanical element, governor effort and range of sensitivity.
CO3:	Determine the natural frequency and damping coefficient, critical speeds of shafts

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REFERENCE BOOKS:

1. Manual prepared by the faculty of Mechanical Engineering Department, SVHEC

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	2	3	-	2	2	-	1	2	2	-	3	2	2
CO2	-	2	2	3	-	2	2	-	1	2	2	-	2	2	2
CO3	-	2	2	3	-	2	2	-	1	2	2	-	3	2	2
Avg	-	2	2	**3**	-	2	2	-	**1**	2	2	-	2.6	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MDC51	SOFT AND ANALYTICAL SKILLS - II	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- ☐ To enhance the collaboration and cooperation between individuals towards a common goal.
- ☐ To provide a critical perspective on the socialization of men and women.
- ☐ Basic Knowledge about the Verbal Reasoning.
- ☐ To solve the problems in Quantitative Aptitude.
- ☐ Understand the basics of Data Interpretation

UNIT-I **TEAM SKILLS** **3**

Trust and collaboration - Team building – Shouldering responsibilities

UNIT-II **GENDER SENSITIZATION** **3**

Media and the Social Context - Social Networks - Gender Sensitization

UNIT-III **VERBAL REASONING** **3**

Verbal Reasoning: Syllogism, Blood relationship

UNIT-IV **QUANTITATIVE APTITUDE** **3**

Ratio and proportion, Problems on ages, Partnership.

UNIT-V **DATA INTERPRETATION** **3**

Tabulation – Profit & loss, Percentage.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Share and exchange knowledge and ideas, clarify doubts, and arrive at a collective decision or understanding.

CO2 : Meet the needs of an increasingly ethnically and gender-diverse workplace.

CO3 : Enhance the Aptitude Round Clearing ability in interview process

CO4 : Solve problems pertaining to quantitative ability.

CO5 : Interrupt the data.

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TEXT BOOKS:

1. Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.
2. Soft Skills: an Integrated Approach to Maximise Personality, Gajendra S. Chauhan, Sangeeta Sharma, Wiley India

REFERENCE BOOKS:

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata Mc Graw Hill Publications.
4. Personality Development and Soft Skills, Barun K. Mitra, Oxford Press
5. Cornerstone: Developing Soft Skills, Sherfield, Pearson India

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23MEI61	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	2	4

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To learn the principal mechanism of heat transfer under steady state and transient conditions.
- To learn the fundamental concept and principles in convective heat transfer.
- To learn the design of heat exchangers.
- To study the fundamental concept and principles in radiation heat transfer.
- To develop the basic concept and diffusion mass transfer.

UNIT-I CONDUCTION 9

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction – plane and Composite Systems

UNIT-II CONVECTION 9

Forced Convection: External Flow – Flow over Plates, Cylinders Spheres. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres., Natural convection

UNIT-III HEAT EXCHANGERS 9

Heat Exchanger Types – Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods.

UNIT-IV RADIATION 9

Black Body and Gray body Radiation - Radiosity - View Factor Relations, Radiation Shields.

UNIT-V MASS TRANSFER 9

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state and Transient Diffusion - Stefan flow

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS:30 PERIODS

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall.
3. Determination of heat transfer coefficient of air under natural convection.
4. Determination of heat transfer coefficient of air under forced convection.
5. Heat transfer from pin-fin under natural and forced convection..
6. Effectiveness of Parallel / counter flow heat exchanger
7. Determination of Stefan – Boltzmann constant.
8. Determination of emissivity of a grey surface.

TOTAL : 75 PERIODS

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BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
- **CO2:** Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
- **CO3:** Explain the LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.
- **CO4:** Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
- **CO5:** Apply diffusive mass transfer equations to solve problems for different applications.

TEXT BOOKS:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2021
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5thEdition – 2019

REFERENCE BOOKS:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2022.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2021
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, NewDelhi, 2019
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/108/112108149/
2. https://www.youtube.com/playlist?list=PL5F4F46C1983C6785

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	1	3	2	-	1	3	2	1
CO2	3	3	3	3	-	-	-	1	3	2	-	1	3	2	1
CO3	3	3	3	2	-	-	-	1	3	2	-	1	3	2	1
CO4	3	3	3	2	-	-	-	1	3	2	-	1	3	2	1
CO5	3	3	3	2	-	-	-	1	3	2	-	1	3	2	1
Avg	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**1**	**3**	**2**	**-**	**1**	**3**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEL61	CAD LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Understand the basic concepts and functions of Computer-Aided Design (CAD) systems.
- Gain hands-on experience in 3D modeling of individual mechanical components.
- Develop the ability to assemble standard machine elements virtually using CAD software.
- Apply modeling techniques to sheet metal components with practical design features.
- Generate accurate 2D drafts from 3D models with standard views and dimensions.

3D GEOMETRIC MODELLING

1. Introduction of Computer Aided Design(CAD)
2. 3D Modeling of Machine Components.
3. 3D Assembly Modeling - Flange Coupling
4. 3D Assembly Modeling - Knuckle Joint.
5. 3D Assembly Modeling - Universal Joint
6. 3D Assembly Modeling - Screw Jack
7. 3D Assembly Modeling - Machine Vise
8. 3D Assembly Modeling - Plummer Block
9. 3D Modeling of sheet metal components.
10. Generate 2D drafts from 3D models.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Demonstrate familiarity with CAD software and apply fundamental sketching and modeling commands.

CO2: Model mechanical components in 3D using parametric design techniques.

CO3: Assemble machine elements in a virtual CAD environment and verify constraints/interferences.

CO4: Create basic sheet metal models and prepare them for manufacturing through flat pattern generation.

CO5: Produce engineering drawings from 3D models with standard projections, dimensions, and annotations.

REFERENCE BOOKS:

1. Manual prepared by the faculty of Mechanical Engineering Department, SVHEC

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	3	-	-	-	-	2	-	1	3	-	-
CO2	2	3	2		3	-	-	-	-	2	-	1	3	2	-
CO3	2	3	3	2	3	-	-	-	2	2	2	1	3	3	2
CO4	2	2	2	-	3	-	-	-	-	2	-	1	2	3	-
CO5	2	2	-	-	3	-	-	-	-	3	-	1	2	-	-
Avg	2	2	2	2	3	-	-	-	2	2	2	1	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEL62	ADDITIVE MANUFACTURING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To understand the fundamentals of Additive Manufacturing (AM) technologies with a focus on FDM and DLP.
- To develop skills in slicing 3D models and setting printing parameters using appropriate software.
- To gain practical experience in fabricating mechanical parts using FDM and DLP 3D printers.
- To study the influence of design, orientation, and print settings on final product quality.

I. STUDY EXPERIMENTS 5

1. Study of Additive Manufacturing Processes, (Introduction to FDM, DLP, and other AM processes Materials used in AM (PLA, Resin, ABS – overview)
2. Study of 3D Printer Components and Working, (FDM and DLP printer structure, motion system, extruder, UV curing mechanism, Safety and maintenance procedures).

II. SLICING EXPERIMENTS 25

1. Slicing of Simple Mechanical Components for FDM
2. Slicing of Simple Mechanical Components for DLP
3. Slicing to Verify the Effect of Process Parameters and Support Structures

III. FDM FABRICATION EXPERIMENTS 15

1. Fabrication of Calibration Cube using FDM Printer
2. Fabrication of Spur Gear using FDM Printer
3. Fabrication of Tolerance Fit Assembly using FDM Printer (*Shaft and Hole Assembly)*
4. Fabrication of a Universal Joint/Flange coupling/Plummer block/ Knuckle Joint using FDM

IV. DLP FABRICATION EXPERIMENTS 15

1. Fabrication of Snap-Fit Part using DLP Printer
2. Fabrication of Overhang Test using DLP Printer
3. Fabrication of Mini Gear Assembly using DLP Printer
4. Dimensional Accuracy Comparison – FDM vs. DLP

TOTAL : 60 PERIODS

NOTE:

Students may also be trained in 3D CAD modeling.

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the principles, types, and materials used in various Additive Manufacturing (AM) processes including FDM and DLP.

CO2: Identify and explain the components and working of FDM and DLP 3D printers including motion systems, extruders, and curing mechanisms.

CO3: Apply slicing software to prepare 3D models for printing by optimizing layer height, infill, supports, and other process parameters.

CO4: Fabricate basic and functional mechanical components using FDM and DLP printers and assess

CO5: Analyze the influence of process parameters and design decisions on the quality and performance of 3D printed parts through comparative experiments.

REFERENCE BOOKS:

1. Manual prepared by the faculty of Mechanical Engineering Department, SVHEC

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	–	–	–	3	–	–	3	2	2	2
CO2	3	2	1	1	3	–	–	–	3	–	–	3	2	2	2
CO3	3	2	1	1	3	–	–	–	3	–	–	3	2	2	2
CO4	3	2	1	1	3	–	–	–	3	–	–	3	2	2	2
CO5	3	2	1	1	3	–	–	–	3	–	–	3	2	2	2
Avg	**3**	**2**	**1**	**1**	**3**	–	–	–	**3**	–	–	**3**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEI71	MECHATRONICS AND IoT	L	T	P	C
		3	0	2	4

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce basic concepts of sensors, actuators, and signal conditioning in Mechatronic systems.
- Familiarize students with microcontroller programming and interfacing for mechanical control.
- Enable application of PLC programming for automation in fluid power and electro-mechanical systems.
- Develop practical skills in implementing IoT-enabled monitoring and control using Arduino and wireless modules.
- Expose students to case studies integrating Mechatronics and IoT in mechanical and automotive systems.

UNIT-I SENSORS AND ACTUATORS **9**

Operational Amplifiers – Inverting and Non-Inverting Configuration. Basic Signal Filtering and Protection Circuits. Data Acquisition System – Logging Basics.

Introduction to PLC – Architecture, Input/Output Processing. Basics of Ladder Logic Programming – Timers and Counters – Simple Automation Applications.

UNIT-II SIGNAL CONDITIONING CIRCUITS AND PLC **9**

Operational Amplifiers – Inverting and Non-Inverting Configuration. Basic Signal Filtering and Protection Circuits. Data Acquisition System – Logging Basics.

Introduction to PLC – Architecture, Input/Output Processing. Basics of Ladder Logic Programming – Timers and Counters – Simple Automation Applications.

UNIT-III FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS **9**

Introduction to IoT – Concept, Architecture, and Applications. Embedded Systems: Overview of Microcontrollers and Arduino. Comparison with SBCs (basic only).

Arduino IDE – Simple Programming for Sensor-Actuator Control. ESP8266 Wi-Fi Module – Overview. Cloud Platforms: Basic Usage of Think Speak or Blynk.

UNIT-IV CONTROLLERS **9**

Introduction to Programming Basics (C++ or Arduino Syntax). Arduino Hardware – Architecture, Digital and Analog I/O. Common Sensors: Interfacing LED, Push Button, Temperature, Ultrasonic.

ESP8266 – Sending Sensor Data to Cloud or Turning ON/OFF Actuator Remotely. Practical Examples Using Arduino (no Raspberry Pi, no Linux OS).

UNIT-V MECHATRONICS AND IoT CASE STUDIES **9**

Mechatronics Applications: Basic Overview of AGVs, Drones, and Autonomous Robots. Automotive Applications: Electronic Ignition, ABS – Principles (no deep control logic).

IoT Applications: Smart Pump Control, Remote Monitoring of Temperature/Pressure, Agriculture Sensor System, HVAC Monitoring, Vehicle Tracking (concept level only).

TOTAL : 45 PERIODS

Chairman
BoS / Mech

LIST OF EXPERIMENTS: 30 PERIODS

MECHATRONICS

1. Programming and Interfacing of Stepper motor using 8051/PLC.
2. Programming and Interfacing of Traffic Light Interface using 8051/PLC.
3. Sequencing of Hydraulic circuits.
4. Sequencing of Pneumatic circuits.
5. Electro-pneumatic/hydraulic control circuits.
6. Design and testing of basic Pneumatic/Hydraulic circuits using Automation studio software.

INTERNET OF THINGS

7. Write a program to turn ON/OFF motor using microcontroller/SBC through internet.
8. Write a program to interface sensors to display the data on the screen through internet.
9. Interface the sensors with microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through internet when sensor data is detected.
10. To interface Bluetooth/Wifi with microcontroller/SBC and write a program to send sensor data to smart phone using Bluetooth/wifi.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the principles of sensors, actuators, signal conditioning, and PLC in mechanical automation systems.

CO2: Apply embedded programming using Arduino/8051 to interface sensors and actuators for control and monitoring.

CO3: Develop and simulate mechatronic systems using motor control, fluid power sequencing, and PLC logic.

CO4: Implement basic IoT applications using Wi-Fi/Bluetooth modules for remote control and monitoring.

CO5: Integrate Mechatronics and IoT concepts to address real-world applications like AGVs, HVAC, and smart agriculture.

TEXT BOOKS:

1. Bradley D.A., Burd N.C., Dawson D., Loader A.J., "Mechatronics: Electronics in Products and Processes", Routledge, 2017.
2. Sami S.H and Kisheen Rao G "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

REFERENCE BOOKS:

1. John Billingsley, "Essentials of Mechatronics", Wiley, 2006
2. David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018.
3. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022
4. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
5. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013

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E-RESOURCES:

1. https://nptel.ac.in/courses/106105166
2. https://ndl.iitkgp.ac.in/he_search?key=mechatronics%20and%20IOT

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	2	1	2	3
CO2	3	3	3	1	2	-	-	-	-	-	-	2	1	2	3
CO3	3	1	2	1	2	-	-	-	-	-	-	2	1	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	1	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	1	2	3
Avg	**3**	**2**	**2**	**2**	**2**	-	-	-	-	-	-	**2**	**1**	**2**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEI72	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	2	4

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Understand the fundamentals and evolution of Computer Integrated Manufacturing (CIM).
- Learn the functioning of automated manufacturing systems and Group Technology.
- Gain knowledge of flexible manufacturing systems and process planning in manufacturing.
- Develop skills in CNC machining and CAM-based part programming.
- Apply theoretical concepts through practical exercises in CNC and CAD/CAM.

UNIT-I INTRODUCTION 9

Basics of CAD, CAM, CAD/CAM, and CIM - Hardware and software used in CIM - Key elements and implementation steps of CIM - Future automated factories and CIM management - Safety considerations and latest advancements in CIM.

UNIT-II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production lines and their types - Work part transfer methods - Basics of automated assembly systems - Material handling equipment - types - 10 principles of material handling - Automated Guided Vehicles : types, applications, guidance and safety.

UNIT-III CELLULAR MANUFACTURING 9

Group Technology - Part families - Parts Classification and coding - Production flow analysis and clustering - Machine cell design, composite part concept – Benefits.

UNIT-IV FLEXIBLE MANUFACTURING SYSTEM 9

FMS – Components – workstations – FMS layout configurations – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – FMS applications, Benefits.

UNIT-V PROCESS PLANNING 9

Process planning activities - Steps from design to manufacturing process - Classification and selection of manufacturing processes - Manual process planning - Computer-Aided Process Planning (CAPP) - Variant and generative process planning - Comparison of manual and computer-aided planning

TOTAL : 45 PERIODS

PRACTICAL EXERCISES : 30 PERIODS

1. CNC Turning Centre

i) Straight, Taper and Radial Turning.

ii) Thread Cutting.

iii) Rough and Finish Turning Cycle.

2.CNC Machining Centre

i) Linear Cutting.

ii) Circular Cutting.

iii) Canned Cycle Operations.

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3. COMPUTER AIDED PART PROGRAMMING

i) Generate CL Data and Post process data using CAM packages for Machining and Turning Centre.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the concepts, hardware, software, and elements involved in CIM and its future prospects.

CO2: Describe and analyze automated systems, material handling equipment, and AGVs in manufacturing.

CO3: Apply group technology principles, part classification, and cell design in cellular manufacturing.

CO4: Evaluate FMS layouts, components, computer control, and planning strategies.

CO5: Develop manual and computer-aided process plans and generate CNC part programs using CAM software.

TEXT BOOKS:

1. Mikell P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, Pearson Education, 5th Edition, 2021.
2. P. Radhakrishnan, S. Subramanian and V. Raju, CAD/CAM/CIM, New Age International Publishers, 4th Edition, 2018.

REFERENCE BOOKS:

1. Shivanand H. K., Benal M. M. and Koti V., Flexible Manufacturing System, New Age International Publishers, 2nd Edition, 2016.
2. P. N. Rao, CAD/CAM: Principles and Applications, McGraw-Hill Education, 3rd Edition, 2020.
3. Yoram Koren, The Global Manufacturing Revolution: Product-Process-Business Integration, Wiley, 2nd Edition, 2019.
4. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley, 7th Edition, 2022.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_me11/preview
2. https://elearn.nptel.ac.in/shop/nptel/computer-integrated-manufacturing/
3. https://www.classcentral.com/course/youtube-computer-integrated-manufacturing-47315

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	1	3	2	-
CO2	3	3	2	-	2	-	-	-	-	-	-	1	2	2	2
CO3	3	3	3	1	2	-	-	-	-	-	1	1	3	2	3
CO4	2	2	3	1	3	-	-	-	1	-	-	2	3	3	3
CO5	3	2	3	2	3	-	-	-	2	1	1	2	3	3	3
Avg	**2.8**	**2.4**	**2.8**	**1.3**	**2.4**	**-**	**-**	**-**	**1.5**	**1**	**1**	**1.4**	**2.8**	**2.4**	**2.8**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEL72 **DESIGN AND FABRICATION PROJECT**

L	T	P	C
0	0	2	1

Course Objectives:

The main learning objective of this course is to prepare the students to:

1. Comprehend the foundational concepts related to machine element selection and material compatibility for mechanical design tasks.
2. Apply design methodologies and engineering tools to create conceptual models of mechanical components.
3. Analyze various manufacturing processes and assess appropriate equipment for building mechanical systems.
4. Evaluate the functional performance and reliability of fabricated mechanical products through structured testing techniques.
5. Produce professional technical documentation that thoroughly communicates design intent, fabrication procedures, and performance analysis.

Course Guidelines:

1. Students shall work in groups of 2 to 4 under the supervision of a faculty member.
2. The topic (component/system/device) shall be finalized in consultation with the supervisor, preferably involving an industry partner.
3. Each group shall submit a project report and present the fabricated working model for internal assessment by a committee nominated by the Head of Department.
4. Final evaluation will include oral presentation and project report, assessed by internal examiner.

TOTAL: 30 PERIODS

COURSE OUTCOME

At the end of the course the students would be able to

CO1 Identify suitable machine elements and materials for a given mechanical application by analyzing functional and design requirements.

CO2 Apply appropriate design principles and engineering tools to develop a conceptual model of a mechanical product or component.

CO3 Fabricate the designed mechanical product or machine element using suitable manufacturing processes and equipment.

CO4 Demonstrate the working and functionality of the fabricated product through testing and evaluation.

CO5 Document the design and fabrication process through technical reports, including drawings, specifications, and performance analysis.

CO & PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	-	-	-	-	-	-	-	3	2	-
CO2	3	2	3	-	3	-	-	-	-	-	2	-	3	-	2
CO3	2	-	3	-	2	-	-	-	1	-	2	-	3	-	2
CO4	-	-	2	2	-	-	-	-	-	-	-	-	2	2	3
CO5	-	-	-	-	2	-	-	-	-	3	3	2	-	2	2
AVG	2.6	2.5	2.6	2	2.25	-	-	-	1	3	2.3	2	2.75	2	2.25

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MDC52	INTRODUCTION TO WOMEN AND GENDER STUDIES (Common to: B.E / B.Tech. all Branches)	L	T	P	C
		3	0	0	0

Course Objectives:

The main learning objective of this course is to prepare the students :

- To Define and differentiate core concepts in gender studies.
- To Identify and explain major feminist theories and their historical contexts.
- To Trace the evolution of women's movements globally and in India.
- To Analyze the intersection of gender and language in communication.
- To Critically evaluate gender representation in various media forms.

UNIT-I CONCEPTS 9

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT-II FEMINIST THEORY 9

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT-III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL 9

Rise of Feminism in Europe and America,Women's Movement in India.

UNIT-IV GENDER AND LANGUAGE 9

Linguistic Forms and Gender,Gender and narratives

UNIT-V GENDER AND REPRESENTATION 9

Advertising and popular visual media,Gender and Representation in Alternative Media,Gender and social media.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Analyze and articulate the fundamental concepts of gender, its social construction, and its distinction from biological sex.

CO2: Critically evaluate diverse feminist theoretical frameworks and their applications in understanding gendered experiences.

CO3: Appraise the historical development and impact of women's movements, both globally and within India.

CO4: Examine the intricate relationship between language, communication, and the construction/representation of gender.

CO5: Deconstruct and interpret gender representations in various forms of media and their societal implications.

TEXT BOOKS:

1. Aneja, Anu. Women's and Gender Studies in India: Crossings. 1st ed. Routledge India
2. John, Mary E. Women's Studies in India: A Reader. Penguin Books India.

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REFERENCE BOOKS:

1. Gillis, Melissa, and Andrew Jacobs. Introduction to Women's and Gender Studies: An Interdisciplinary Approach. 3rd ed. Oxford University Press, 2024.
2. Clemens, Colleen Lutz. Introduction to Women's & Gender Studies. 1st ed. The Pennsylvania Alliance for Design of Open Textbooks (PA-ADOPT), 2023.
3. Shaw, Susan M., and Janet Lee. Gendered Voices, Feminist Visions. 8th ed. Oxford University Press, 2022.
4. Aneja, Anu. Women's and Gender Studies in India: Crossings. 1st ed. Routledge, 2020.
5. Kang, Miliann, Donovan Lessard, Laura Heston, and Sonny Nordmarken. Introduction to Women, Gender, Sexuality Studies. University of Massachusetts Amherst Libraries, 2017 (with ongoing reviews/updates).

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	-	2	-	-	-	-	-	-	-
CO2	2	3	1	1	-	-	-	-	-	-	-	-
CO3	1	-	3	2	2	-	-	-	-	-	-	-
CO4	3	1	2	-	1	-	-	-	-	-	-	-
CO5	1	2	3	-	3	-	-	-	-	-	-	-
Avg	**1.6**	**1.4**	**2.2**	**0.6**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

CO, PO & PSO's MAPPING
1-low, 2-medium, 3- high, '-'-no correction

E-RESOURCES:

- http://www.womenstudies.in
- https://tiss.ac.in/view/6/hyderabad-campus/school-of-gender-studies/research-37

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BoS / MBA

23MDC53	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

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

UNIT-I INTRODUCTION TO ELEMENTS OF LITERATURE 9

a) Nature of Literature: Meaning, Characteristics, literature as an art form.
b) Functions of Literature: The aesthetic, moral, and cultural functions of literature.
c) Types of Literature: Introduction to the three main genres: Prose, Poetry, and Drama.

UNIT-II RELEVANCE OF LITERATURE 9

a) Enhances Reading, thinking, discussing and writing skills.
b) Develops finer sensibility for better human relationship.
c) Increases understanding of the problem of humanity without bias.

UNIT-III ELEMENTS OF FICTION 9

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

UNIT-IV ELEMENTS OF POETRY 9

a) Emotions and imaginations.
b) Figurative language.
c) Figures of Speech: Simile, metaphor, conceit, symbol, pun, personification irony and trend.

UNIT-V ELEMENTS OF DRAMA 9

a) Drama as representational art.
b) Drama as narration, mediation and persuasion.
c) Features of tragedy, comedy and satire.

TOTAL: 45 PERIODS

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COURSE OUTCOME:

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

TEXT BOOKS:

1) An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
2) The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2014.
3) The Elements of Drama, J.L.Styan, Literary Licensing, 2011.
4) An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
5) The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.

REFERENCE BOOKS:

1) To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

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		L	T	P	C
23MDC54	**FILM APPRECIATION** (BE/B.Tech- Common to all Branches)	3	0	0	0

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved overall century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

Theme - A:The Component of Films

A-1:The material and equipment
A-2:The story, screenplay and script
A-3:The actors, crew members, and the director
A-4:The process of film making... structure of a film

Theme- B: Evolution of Film Language

B-1:Film language, form, movement etc.
B-2: Early cinema... silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies

Theme-C: Film Theories and Criticism/ Appreciation

C-1:Real list theory; Auteurists
C-2:Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4:Film Criticism/Appreciation

Theme–D:Development of Films

D-1:Representative Soviet films
D-2:Representative Japanese films
D-3: Representative Italian films
D-4:Representative Hollywood film and the studio system

Theme-E: Indian Films

E-1:The early era
E-2:The important films made by the directors
E-3: The regional films
E-4:The documentaries in India

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

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23MDC55	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response
- To develop disaster response skills by adopting relevant tools and technology
- To Enhance awareness of institutional processes for Disaster response in the country
- To Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

UNIT-I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - Inter relations between Disasters and Sustainable development Goals

UNIT-II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT-III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

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UNIT-IV **TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT** **9**

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT-V **DISASTER MANAGEMENT: CASE STUDIES** **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)

CO2 : To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3 : To develop disaster response skills by adopting relevant tools and technology

CO4 : Enhance awareness of institutional processes for Disaster response in the country and

CO5 : Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

TEXT BOOKS:

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

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REFERENCE BOOKS:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/124/107/124107010/
2. https://nptel.ac.in/courses/124107010

CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	-	-	2	2	-	-	2	-	2	-	1
CO2	3	3	3	3	-	-	2	1	-	-	2	-	2		1
CO3	3	3	3	3	-	-	2	2	-	-	-	-	2		1
CO4	3	3	2	3	-	-	2	1	-	-	2	-	2		1
CO5	3	3	2	3	-	-	2	2	-	-	2	-	3		1

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / Civil

		L	T	P	C
23MDC61	**WELL BEING WITH TRADITIONAL PRACTICES - YOGA, AYURVEDA AND SIDDHA**	3	0	0	0

(Common to: B.E / B.Tech. all Branches)

Course Objectives:

The main learning objective of this course is to prepare the students :

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

UNIT-I HEALTH AND ITS IMPORTANCE 9

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT-II DIET 9

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes Different cooking methods, merits and demerits of each method

UNIT-III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 9

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social

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life. Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT-IV MENTAL WELLNESS 9

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

UNIT-V YOGA 9

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Learn the importance of different components of health

CO2: Gain confidence to lead a healthy life

CO3: Learn new techniques to prevent lifestyle health disorders

CO4: Understand the importance of diet and workouts in maintaining health

CO5: Analyze the holistic benefits of incorporating yoga into daily life, including its impact on physical and mental well-being.

TEXT BOOKS:

- Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
- Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	1	-	-	-	-	-	-	-
CO2	1	1	1	1	2	-	-	-	-	-	-	-
CO3	3	2	3	2	1	-	-	-	-	-	-	-
CO4	2	-	2	-	3	-	-	-	-	-	-	-
CO5	3	-	3	-	1	-	-	-	-	-	-	-
Avg	**2.2**	**0.6**	**2.2**	**0.6**	**1.6**	-	-	-	-	**-**	**-**	**-**

CO, PO & PSO's MAPPING
1-low, 2-medium, 3- high, '-'-no correction

REFERENCE BOOKS:

- What we know about emotional intelligence how it affects learning, work, relationships, and our mental health, by moshe zeidner, gerald matthews, and richard d. roberts
- A bradford book, the mit press, cambridge, massachusetts, london, england the mindful self-compassion workbook, kristin neff, ph.d christopher germer, ph.d, published by the guilford press a division of guilford publications, inc.370 seventh avenue, suite 1200, new york, ny 10001

E-RESOURCES:

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
- https://www.legit.ng/1163909-classes-food-examples-functions.html

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		L	T	P	C
23MDC62	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA (B.E./B. Tech. - Common to all branches)	3	0	0	0

Course Objectives:

- **To introduce the concepts and perspectives of history** with reference to science and technology, emphasizing objectivity, causation, evidence, and interpretation.
- **To familiarize students with major historiographical contributions** to the study of science and technology in India through the works of eminent scholars.
- **To provide an understanding of the evolution of science and technology in ancient and medieval India,** highlighting indigenous practices, cross-cultural exchanges, and their socio-economic impact.
- **To analyze the role of science and technology in colonial India,** focusing on the impact of Western science, institutional developments, and Indian responses.
- **To examine the progress of science and technology in post-independent India,** with emphasis on policy frameworks, global integration, and the social implications of emerging technologies like IT and biotechnology.

UNIT I – Concepts and Perspectives 9

Meaning of History - Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history - Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation versus evidence, concept of historical inevitability, Historical Positivism - Science and Technology – Meaning, Scope and Importance - Interaction of Science, Technology & Society - Sources of History on Science and Technology in India.

UNIT II – Historiography of Science and Technology in India 9

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III – Science and Technology in Ancient 9

Technology in pre-historic period - Beginning of agriculture and its impact on technology - Science and Technology during Vedic and Later Vedic times - Science and Technology from 1st century AD to C-1200.

UNIT IV – Science and Technology in Medieval India & Colonial India 9

Legacy of technology in Medieval India; Interactions with Arabs - Development in medical knowledge, interaction between Unani, Ayurveda and alchemy - Astronomy and Mathematics: interaction with Arabic Sciences - Science and Technology on the eve of British conquest - Science and the Empire - Indian response to Western Science - Growth of techno-scientific institutions.

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UNIT V – Science and Technology in Post-Independent India 9

Science, Technology and Development discourse - Shaping of the Science and Technology Policy - Developments in the field of Science and Technology - Science and Technology in globalizing India - Social implications of new technologies like Information Technology and Biotechnology.

Total Hours 45

CO's	COURSE OUTCOMES
	The students will be able to
CO1	Understand the fundamental concepts and perspectives of history and science & technology, and analyze the role of objectivity, causation, and evidence in historical study.
CO2	Examine and critically evaluate the contributions of key historians and scholars in the historiography of science and technology in India.
CO3	Analyze the evolution of science and technology in ancient and medieval India, including agricultural, medical, astronomical, and mathematical developments.
CO4	Evaluate the impact of colonialism on science and technology in India, including the introduction of Western scientific methods and the establishment of techno-scientific institutions.
CO5	Assess the developments in science and technology in post-independent India, including policy initiatives, global integration, and the societal implications of emerging technologies like IT and biotechnology.

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	1	-	-	3	3	2
CO2	3	3	2	1	-	-	-	-	-	1	-	-	3	3	2
CO3	3	3	3	2	-	-	-	-	-	1	-	-	3	3	2
CO4	3	3	3	2	-	-	-	-	-	1	-	-	3	3	1
CO5	3	3	3	2	-	-	-	-	-	1	-	-	3	3	1
Avg	3	3	3	2	-	-	-	-	-	1	-	-	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

Reference Books:

1. Dr. Binod Bihari Satpathy, History of Technology in India, 2021.

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		L	T	P	C
23MDC63	**POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY**	3	0	0	0

(Common to: B.E / B.Tech. all Branches)

Course Objectives:

The main learning objective of this course is to prepare the students :

- To understanding of human needs, desires, and the role of political-economic systems in fulfilling them.
- To know about the major political and economic ideologies, their principles, and historical applications.
- To understand the capitalism, communism, fascism, liberal democracy, welfare state, and Gandhian thought.
- To gain knowledge about the contributions of Indian civilization and indigenous approaches to a humane society.
- To learn the role of technology and education in shaping future social, political, and economic structures.

UNIT-I Foundations of Humane Society & Human Needs 9

Considerations for a humane society, holistic thought- Human being's desires – material and non-material needs - Harmony in self, harmony in relationships, society, and nature- Societal systems and their evolution

UNIT-II Capitalism, Liberal Democracy & Fascism 9

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire - Monopolies, imperialism, and their impact - Liberal democracy – principles, strengths, and limitations - Fascism and totalitarianism – features and historical context - World War I & II, Cold War influences on political-economic systems

UNIT-III Communism & Welfare State 9

Communism – Mode of production, theory of labour, surplus value, class struggle - Dialectical materialism & historical materialism - Russian & Chinese models of communism - Welfare state – concept, relationship with human desires, and social satisfaction

UNIT-IV Gandhian Thought & Indian Civilization 9

Gandhian philosophy – Swaraj, decentralized economy & polity - Community participation and control over one's life - Relationship with nature and sustainable living - Essential elements of Indian civilization

UNIT-V Technology, Education & Future Directions 9

Technology as a driver of society – benefits & risks - Role of education in shaping social structures - Possible future directions for a humane political-economic order - Concluding reflections on political & economic thought for a humane society

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Provides the concept of a humane society and analyze human desires in relation to societal harmony.

CO2: Compare and contrast different political-economic systems such as capitalism, communism, fascism, and welfare state.

CO3: Enhance the knowledge of historical and contemporary implementations of political and economic ideologies.

CO4: Ability to apply Gandhian principles and indigenous Indian perspectives to current socio-economic challenges.

CO5: Understanding the impact of technology and education on societal transformation and propose future-oriented strategies for a humane order.

TEXT BOOKS:

- Gandhi, M. K. "Hind Swaraj and Other Writings". Edited by Anthony J. Parel, 7th ed., Cambridge University Press, 2023.
- Smith, Adam. "The Wealth of Nations". Edited by Edwin Cannan, Modern Library, 2021.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	-	1	-	-	-	-	-	-	-
CO2	2	3	1	1	-	-	-	-	-	-	-	-
CO3	1	-	3	2	2	-	-	-	-	-	-	-
CO4	3	1	2	-	1	-	-	-	-	-	-	-
CO5	1	2	3	-	-	-	-	-	-	-	-	-
Avg	**1.6**	**1.4**	**2.2**	**0.6**	**0.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

CO, PO & PSO's MAPPING
1-low, 2-medium, 3- high, '-'-no correction

REFERENCE BOOKS:

- Sebo, Jeff. *The Moral Circle: Who Matters, What Matters, and Why*. W. W. Norton & Company, 2025.
- Williams, David Lay. *The Greatest of All Plagues: Economic Inequality in the Western Intellectual Tradition*. Princeton University Press, 2024.
- Saito, Kohei. *Capital in the Anthropocene*. Translated by Brian Bergstrom, Shueisha (Orig. pub. 2020 – Eng. trans. 2024). Shueisha, 2024.
- Chandler, Daniel. *Free and Equal: What Would a Fair Society Look Like?* Allen Lane, 2023.
- Eich, Stefan. *The Currency of Politics: The Political Theory of Money from Aristotle to Keynes*. Princeton University Press, 2022.

E-RESOURCES:

- https://plato.stanford.edu/entries/political-philosophy
- https://plato.stanford.edu/entries/political-philosophy

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23MDC64	STATE, NATION BUILDING AND POLITICS IN INDIA (Common to: B.E / B.Tech. all Branches)	L	T	P	C
		3	0	0	0

Course Objectives:

The main learning objective of this course is to prepare the students :

- To understand the concept, need, and role of the state and politics in society.
- To aware about the evolution of the nation-state and the changing meaning of sovereignty in a globalized context.
- To impart knowledge on development of Indian nationalism, constitutional philosophy, and the rationale for a parliamentary–federal system.
- To understand the challenges of nation-building and national integration in a diverse democratic society.
- To Evaluate contemporary political changes, new social movements, and their implications for the future of Indian democracy.

UNIT-I State, Politics and Sovereignty 9

Understanding the need and role of the State and politics - Development of the Nation-State Concept of sovereignty – traditional perspectives and changing contours in a globalized world - Forms of government – unitary & federal, presidential & parliamentary - Separation of powers: Executive, Legislature, and Judiciary

UNIT-II The Idea of India & National Awakening 9

The "Idea of India" – cultural, historical, and political dimensions - Revolt of 1857 and the rise of political consciousness - Social reform movements and their contribution to nationalism - Growth of political associations before 1885.

UNIT-III National Movement and Constitution Making 9

Formation of the Indian National Congress (1885) and phases of the national movement - Legacies of the freedom struggle - Constitution making process and the Constituent Assembly debates - Goals, objectives, and philosophy of the Constitution of India - Federal system – rationale for adoption in India

UNIT-IV Nation-Building and Challenges 9

National integration – meaning, significance, and mechanisms - Challenges of nation-building – diversity, regionalism, communalism, casteism, language issues - "State against democracy" – Rajni Kothari's perspective - Role of institutions and political leadership in nation-building

UNIT-V Contemporary Political Dynamics and Future Directions 9

New social movements – environmental, feminist, Dalit, tribal, farmers' movements - Changing nature of the Indian Political System – coalition politics, regional parties, populism - Impact of globalization, liberalization, and technology on Indian politics - Future scenario – reforms, citizen participation, and vision for a better India.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: To know the theoretical foundations of the state, sovereignty, and political systems.

CO2: Interpret the historical events leading to the Indian national movement and constitution-making.

CO3: Ability to understand the philosophical underpinnings and structural features of the Indian Constitution, including federalism.

CO4: Critically analyze challenges to national integration and nation-building in the Indian context.

CO5: Enhanced knowledge of the changing nature of Indian politics and propose informed approaches for strengthening democracy and governance.

TEXT BOOKS:

- Jayapalan, N. "Indian Political System". Atlantic Publishers & Distributors, 2023.
- Basu, Durga Das. "Introduction to the Constitution of India". 25th ed., LexisNexis, 2021.

CO, PO & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	1	1	-	-	-	-	-	-	-
CO2	1	1	-	2	3	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-
CO4	2	-	1	3	1	-	-	-	-	-	-	-
CO5	3	-	-	1	2	-	-	-	-	-	-	-
Avg	**2.2**	**0.6**	**0.8**	**1.6**	**1.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3- high, '-'-no correction

REFERENCE BOOKS:

- Bhatia, Gautam. *The Indian Constitution: A Conversation with Power*. HarperCollins India, 2025.
- Chakrabarty, Bidyut, and Rajendra K. Pandey. *Indian Political System: Institutions and Processes*. 1st ed., Routledge India, December 2024.
- Sharma, Mrityunjay. *Broken Promises: Caste, Crime and Politics in Bihar*. Westland Non-Fiction Publications, 2024.
- Jaishankar, S. *Why Bharat Matters*. Rupa & Co., 2024.
- Rajan, Raghuram, and Rohit Lamba. *Breaking the Mould: Reimagining India's Economic Future*. Penguin Random House India, December 2023.

E-RESOURCES:

- https://legislative.gov.in/constitution-of-india
- https://loksabha.nic.in/](https://loksabha.nic.in

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23MDC65	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

Course Objectives:

The main learning objective of this course is to prepare the students to:

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

UNIT-I SAFETY TERMINOLOGIES **9**

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT-II STANDARDS AND REGULATIONS **9**

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT-III SAFETY ACTIVITIES **9**

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT-IV WORKPLACE HEALTH AND SAFETY **9**

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT-V HAZARD IDENTIFICATION TECHNIQUES **9**

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

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the basic concept of safety.

CO2: Obtain knowledge of Statutory Regulations and standards.

CO3: Know about the safety Activities of the Working Place.

CO4: Analyze on the impact of Occupational Exposures and their Remedies

CO5: Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS:

1. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control, McGraw-Hill Education, 2005.
2. R.K. Jain and Prof. Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publishers, 4th Edition, 2006.

REFERENCE BOOKS:

1. Frank P. Lees, Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, Butterworth-Heinemann (Elsevier), UK, 4th Edition, 2012.
2. John Ridley and John Channing, Safety at Work, Routledge, 9th Edition, 2022.
3. Dan Petersen, Techniques of Safety Management: A Systems Approach, McGraw-Hill, 2003.
4. Alan Waring, Safety Management Systems, Chapman & Hall, England, 1996.
5. American Society of Safety Professionals (ASSP) ANSI/ASSP Z10 – Occupational Health and Safety Management Systems, Latest Edition, 2019.

E-RESOURCES:

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

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	1	3	2	2	3	-	1	3	3	-	-
CO2	2	3	-	-	1	3	2	3	3	-	1	3	3	-	-
CO3	2	2	-	-	1	2	2	2	3	-	1	2	3	-	-
CO4	3	3	-	-	2	3	2	2	3	-	1	3	3	-	-
CO5	3	2	-	-	2	3	2	2	3	-	2	3	3	-	-
Avg	3	3	-	-	1	3	2	2	3	-	1	3	3	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE11	AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the functional requirements of engine components and suitable materials
- Learn to design of cylinder and piston components
- Learn to design of connecting rod and crank shaft
- Learn to design of flywheel and valve train
- Study the Engine Testing cycles, Emission measurement technologies

UNIT-I FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS 6

Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.

UNIT-II DESIGN OF CYLINDER AND PISTON COMPONENTS 6

Design of cylinder, cylinder head, piston, piston rings and piston pin – more details in necessary

UNIT-III DESIGN OF CONNECTING ROD AND CRANK SHAFT 6

Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.

UNIT-IV DESIGN OF FLYWHEEL AND VALVE TRAIN 6

Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub - arm.

UNIT-V ENGINE TESTING 6

Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO2 - HC.-Particle counter

TOTAL : 30 PERIODS

EXPERIMENTS

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

TOTAL : 30 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Discuss the requirements of engine components and select suitable materials.
- **CO2:** Apply the concept of design to cylinder and piston components and solve problems.
- **CO3:** Apply the concept of design to Connecting rod and crank shaft and solve problems.
- **CO4:** Apply the concept of design to flywheel and valve train and solve problems.
- **CO5:** Discuss engine tests cycles, dynamometer and emission measurement technologies and instruments.

TEXT BOOKS:

1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
2. The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello | 24 December 2019

REFERENCE BOOKS:

1. Hiroshima Yamagata, "The science and technology of materials in automotive engines", Woodhead Publishing Limited, Cambridge, England
2. Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005.
3. Manufacturing Automotive Components from Sustainable Natural Fiber Composites (SpringerBriefs in Materials) by Lobna A. Elseify, Mohamad Midani, et al. | 9 August 2021
4. Mechanical and Materials Engineering of Modern Structure and Component Design (Advanced Structured Materials Book 70) by Andreas Öchsner and Holm Altenbach | 6 June 2015
5. Advanced Technology for Design and Fabrication of Composite Materials and Structures: Applications to the Automotive, Marine, Aerospace and Applications of Fracture Mechanics) by George C. Sih, Alberto Carpinteri, et al. | 15 December 2010

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/107/106/107106088/#
2. https://archive.nptel.ac.in/courses/112/107/112107217/
3. https://archive.nptel.ac.in/courses/112/104/112104122/
4. https://www.youtube.com/watch?v=9nvptpU4y3I

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	-	-	1	-	-	1	3	3	2
CO2	3	2	3	2	2	-	-	-	1	-	-	1	3	3	2
CO3	3	2	3	2	2	-	-	-	1	-	-	1	3	3	2
CO4	3	2	3	2	2	-	-	-	1	-	-	1	3	3	2
CO5	3	2	3	2	2	-	-	-	1	-	-	1	3	3	2
Avg	**3**	**2**	**3**	**2**	**2**	-	-	-	**1**	-	-	**1**	**3**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE12	CONVENTIONAL AND FUTURISTIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the advanced engine technologies
- Learn various advanced combustion technologies and its benefits
- Learn the methods of using low carbon fuels and its significance
- Learn and understand the hybrid and electric vehicle configurations
- Study the application of fuel cell technology in automotives

UNIT-I ADVANCED ENGINE TECHNOLOGY 9

Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.

UNIT-II COMBUSTION TECHNOLOGY 9

Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.

UNIT-III LOW CARBON FUEL TECHNOLOGY 9

Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward.

UNIT-IV HYBRID AND ELECTRIC VEHICLE (BATTERY POWERED) 9

Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward

UNIT-V FUEL CELL TECHNOLOGY 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Discuss the latest trends in engine technology
CO2:	Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment.
CO3:	Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals.
CO4:	Discuss the working and energy flow in various hybrid and electric configurations.
CO5:	Analyzing the need for fuel cell technology in automotive applications.

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TEXT BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6 , SPRINGER.

REFERENCE BOOKS:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
5. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/103/112103262/
2. https://archive.nptel.ac.in/courses/108/103/108103009/
3. https://www.youtube.com/watch?v=Eb7pv0oOf_k
4. https://www.youtube.com/watch?v=XT_Zk1nORk8

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	1	-	-	1	3	2	2
CO2	3	2	2	2	2	-	-	-	1	-	-	1	3	2	2
CO3	3	2	2	2	2	-	-	-	1	-	-	1	3	2	2
CO4	3	2	2	2	2	-	-	-	1	-	-	1	3	2	2
CO5	3	2	2	2	2	-	-	-	1	-	-	1	3	2	2
Avg	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**3**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE13	RENEWABLE POWERED OFF HIGHWAY VEHICLES AND EMISSION CONTROL TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the low and zero carbon fuels suitability and methods of use in off-road vehicles.
- Learn and understand the green energy production methodologies and its use in off-road vehicle categories.
- Learn various fuel cell types and its suitability in off-highway vehicles applications
- Illustrate the impact of in-cylinder technologies on engine out emissions control.
- Study the existing after-treatment technologies used in off-highway vehicle applications.

UNIT-I LOW AND ZERO CARBON FUELS POWERED OFF-HIGHWAY VEHICLES **9**

Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE), Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles.

UNIT-II GREEN ENERGY POWERED OFF-HIGHWAY VEHICLES **9**

Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles.

UNIT-III FUEL CELL POWERED OFF-HIGHWAY VEHICLES **9**

Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications.

UNIT-IV IN-CYLINDER TREATMENT TECHNOLOGIES **9**

Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed- Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies.

UNIT-V AFTER TREATMENT TECHNOLOGIES **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Evaluate the availability, suitability, and its role in off-road vehicle categories in reducing the carbon footprint on the environment.

CO2: Gain the knowledge on various green energy production methods and its impact on meeting energy demand of off-road vehicle applications.

CO3: Develop the working of fuel cell, various fuel cell types, and its design for off-road vehicle applications.

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CO4: Gain the knowledge on various in-cylinder low temperature combustion technologies and its key role in controlling the engine-out emissions.

CO5: Develop the working of various existing after treatment systems in controlling the engine out emissions.

TEXT BOOKS:

1. John Twidell, and Tony Weir. Renewable Energy Sources – 3rd Edition 2015,
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines.

REFERENCE BOOKS:

1. Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering
2. W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control.
3. Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill | 1 June 2011
4. Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. | 7 April 2022
5. The Political Economy of Low Carbon Transformation: Breaking the habits of capitalism (Routledge Studies in Low Carbon Development) by Harold Wilhite | 21 December 2017

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104033/
2. https://archive.nptel.ac.in/courses/108/106/108106182/
3. https://digimat.in/nptel/courses/video/108106182/L01.html
4. https://www.youtube.com/watch?v=5zKC_aq4ypM

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	1	-	-	1	3	1	1
CO2	3	2	1	1	1	-	-	-	1	-	-	1	3	1	1
CO3	3	2	1	1	1	-	-	-	1	-	-	1	3	1	1
CO4	3	2	1	1	1	-	-	-	1	-	-	1	3	1	1
CO5	3	2	1	1	1	-	-	-	1	-	-	1	3	1	1
Avg	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE14	VEHICLE HEALTH MONITORING, MAINTENANCE AND SAFETY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Enable the student to understand the principles, functions and practices adapted in maintenance activities of vehicles.
- Study the powertrain maintenance, fault diagnosis, maintenance of Batteries
- Develop vehicle system maintenance and service of clutch, brake.
- Study the concepts of vehicle safety and regulations.
- Study and understand the simulation of safety concepts

UNIT-I INTRODUCTION 9

Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services – service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools

UNIT-II POWER TRAIN MAINTENANCE 9

Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical -Fault Diagnosis Using Scan Tools.

UNIT-III VEHICLE SYSTEM MAINTENANCE 9

Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering

UNIT-IV VEHICLE SAFETY 9

Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers.

UNIT-V SIMULATION OF SAFETY CONCEPTS 9

Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Have the knowledge of vehicle health monitoring, maintenance and safety.
- **CO2:** Explain Maintenance of powertrain.
- **CO3:** Ability to maintenance of Vehicle system.
- **CO4:** Explain and awareness of vehicle safety.
- **CO5:** Explain the simulation of safety concepts.

TEXT BOOKS:

1. 5th Edition, "Advanced Automotive Fault Diagnosis Automotive Technology: Vehicle Maintenance and Repair" By Tom Denton
2. Safety Management System and Documentation Training Programme Handbook by S. V. Paul ISBN: 9788123923444

REFERENCE BOOKS:

1. Ed May, "Automotive Mechanics Volume One" and Two, Mc Graw Hill Publications, Tenth edition, 2018
2. Bosch Automotive Handbook, Tenth Edition, 2018
3. Jack Erjavek, "A systems approach to Automotive Technology", Cengage Learning, 5th Edition, 2012
4. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", Tata McGraw Hill, 10thEdition, 2004.
5. Vehicle Service Manuals of Reputed Indian Manufacturers.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/105/112105232/
2. https://archive.nptel.ac.in/courses/105/105/105105215/
3. https://www.youtube.com/watch?v=556-_Cs52ss

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	1	-	-	1	3	2	2
CO2	3	2	2	1	1	-	-	-	1	-	-	1	3	2	2
CO3	3	2	2	1	1	-	-	-	1	-	-	1	3	2	2
CO4	3	2	2	1	1	-	-	-	1	-	-	1	3	2	2
CO5	3	2	2	1	1	-	-	-	1	-	-	1	3	2	2
Avg	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**3**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE15	CAE AND CFD APPROACH IN FUTURE MOBILITY	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the use of computer in mobility software or mobility.
- Study the concepts computer aided design and rapid prototyping
- Introduce the basic concepts of the finite elements methods.
- Introduce basics and fundamental of the computational fluid dynamics
- Introduce Turbulence Modelling and various simulation techniques.

UNIT-I INTRODUCTION TO CAE /CFD 6

Introduction to use of computer in Mobility Product Life Cycle, Software for mobility. Introduction to design process and role of computers in the design process, use of modern computational tools used for design and analysis, Concept of modelling and simulation. CFD as a design and research tool, Applications of CFD in mobility engineering

UNIT-II CAD AND RAPID PROTOTYPING 6

Curves and Surfaces: Geometric modelling curves and surfaces, Wire frame models, Parametric representations, Parametric curves and surfaces, Solid modelling: Fundamentals of solid modelling, Different solid representation schemes, Boundary representation (B-rep), Constructive solid geometry (CSG). Mechanism design and assembly. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards. CAD Data and Programming Techniques for RP: Transformations, Solid modelling for RP, Surface modelling, STL file generation, Defects in STL files and repairing algorithms, Interface formats

UNIT-III INTRODUCTION TO FEA 6

Basic Concept of Finite Element Method, Ritz and Rayleigh Ritz methods, Method of weighed residuals, Galerkin method. Governing differential equations of one- and two dimensional problems, One Dimensional Second Order Equations – Discretization – Linear and Higher order Elements – Interpolation and shape functions, Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of static problems and case studies in stress analysis of mechanical components using 2D and 3D elements

UNIT-IV INTRODUCTION TO CFD 6

CFD vs. experimentation; continuity, navier-stokes and energy equations; modelling and discretization techniques; basic steps in CFD computation Various simplifications, Dimensionless equations and parameters, Incompressible inviscid flows, Source panel method, and Vortex panel method. Conservation form of the equations, shock fitting and shock capturing, Time marching and space marching. 3-D structured and unstructured grid generation, mesh smoothing and sensitivity checks

UNIT-V PROBLEM SOLVING USING CFD 6

Turbulence Modelling, different turbulent modelling scheme. Incompressible Viscous Flows:, Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; Simulation of Ahmed and Windsor bodies; Vorticity based grid-free simulation technique; simulation in climatic and acoustic wind tunnels; velocity vector and pressure contour simulation

TOTAL : 30 PERIODS

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BoS / Mech

CAE AND CFD LABORATORY

1. Coupled analysis of structural / thermal
2. buckling analysis
3. CFD simulation of flow analysis over a Cylinder Surface 3D
4. CFD simulation of Intermixing of Fluids in a Bent-Pipe 3D
5. CFD simulation of flow and heat transfer analysis of Double Pipe Counter Flow Heat Exchanger
6. Design & processing of Engine components by RPT

TOTAL :30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the basic concept of the CAE /CFD
CO2: Dvelop the computer aided design and rapid prototyping.
CO3: Discuss the basic concept of Finite Element methods.
CO4: Discuss the concepts of computational fluid dynamics
CO5: Solving the problem and simulation using computational fluid dynamics.

TEXT BOOKS:

1. Computational Fluid Dynamics: A Practical Approach by Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu
2. Applied Computational Fluid Dynamics by S. C. Gupta

REFERENCE BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
2. Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008
3. TirupathiR.Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.
4. Dhanaraj. R and Prabhakaran Nair. K, "Finite Element Analysis", Oxford Publications, 2015.
5. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104265/
2. https://archive.nptel.ac.in/courses/112/104/112104193/
3. https://nptel.ac.in/courses/112105045

CO's – PO's & PSO's MAPPING

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CO3	3	3	2	2	2	-	1	-	1	-	-	1	3	2	2
CO4	3	3	2	2	2	-	1	-	1	-	-	1	3	2	2
CO5	3	3	2	2	2	-	1	-	1	-	-	1	3	2	2
Avg	3	3	2	2	2	-	1	-	1	-	-	1	3	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE16	HYBRID AND ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the concept of hybrid and electric drive trains.
- Elaborate on the types and utilisation of hybrid and electric drive trains.
- Expose on different types of AC and DC drives for electric vehicles.
- Learn and utilise different types of energy storage systems
- Introduce concept of energy management strategies and drive sizing

UNIT-I INTRODUCTION 9

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT-II HYBRID ELECTRIC DRIVE TRAINS 9

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT-III CONTROL OF AC & DC DRIVES 9

Introduction to electric components used in hybrid and electric vehicles, Configuration, and control - DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch Reluctance Motor drives, drive system efficiency.

UNIT-IV ENERGY STORAGE 9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices.

UNIT-V DRIVE SIZING AND ENERGY MANAGEMENT STRATEGIES 9

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss Characterize and configure hybrid drivetrains requirement for a vehicle

CO2: Design and apply appropriate hybrid and electric drive trains in a vehicle

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CO3: Design and install suitable AC and DC drives for electric vehicles.

CO4: Discuss arrive at a suitable energy storage system for a hybrid / electric vehicle

CO5: Apply energy management strategies to ensure better economy and efficiency

TEXT BOOKS:

1. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals||, Third Edition, 2021
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998
3. Hybrid, Electric and Fuel-Cell Vehicles, International Edition by Jack Erjavec | 6 June 2012
4. Energy Management in Hybrid Electric Vehicles using Co-Simulation by Christian Paar | 11 February 2011
5. Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids (MECHANICAL ENGINEERING) by Yangsheng Xu , Jingyu Yan, et al. | 16 December 2013

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/108/103/108103009/
2. https://archive.nptel.ac.in/courses/108/102/108102121/
3. https://archive.nptel.ac.in/courses/108/106/108106170/
4. https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO2	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO3	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO4	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO5	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
Avg	**3**	**2**	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE17	THERMAL MANAGEMENT OF BATTERIES AND FUEL CELLS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the working principle of Li-ion Batteries and Battery Packs.
- Learn the thermal management system in Battery modules.
- Develop the different case studies in Battery Thermal Management System.
- Learn the working principle of Fuel Cells cooling methods.
- Learn the inside components of Thermal Management Systems in various famous Electric and Fuel Cell Electric Vehicles.

UNIT-I ADVANCED BATTERIES 9

Li-ion Batteries- chemistry, different formats, operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S- 18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Super capacitors Vs batteries. Diamond battery concepts.

UNIT-II THERMAL MANAGEMENT IN BATTERIES 9

Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications. Tesla Model-S Battery Module- bonding techniques, thermal management.

UNIT-III BATTERY THERMAL MANAGEMENT CASE STUDIES 9

EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study. Modelling Liquid Cooling of a Li-Ion Battery Pack with COMSOL Multiphysics- simulation concepts.

UNIT-IV THERMAL MANAGEMENT IN FUEL CELLS 9

Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.

UNIT-V FUEL CELL THERMAL MANAGEMENT CASE STUDIES 9

Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell Electric Vehicle Fuel economy calculations-Battery EVs Vs Fuel Cell EVs. Toyota Mirai FCV- Operating principle, High pressure hydrogen tank, Boost convertor, NiMH Battery, Internal circulation system, Hydrogen refueling- Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the different Li-ion Batteries and Fuel Cell performances.

CO2: Design a Battery Pack with appropriate PCM.

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CO3: Apply Cooling Models using Simulation.

CO4: Estimate fuel economy.

CO5: Utilize different Thermal Management System approaches during real world usage.

TEXT BOOKS:

1. Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", Wiley, 2017.
2. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles", Wiley, 2015.
3. Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.

REFERENCE BOOKS:

1. Nag.P.K, "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. "Vehicle thermal Management Systems Conference Proceedings", 1st Edition; 2013, Coventry Techno centre, UK
3. Younes Shabany, "Heat Transfer: Thermal Management of Electronics Hardcover" 2010, CRC Press.
4. T. Yomi Obidi, "Thermal Management in Automotive applications", 2015, SAE International.
5. Jerry Sergent, Al Krum, "Thermal Management Handbook: For Electronic Assemblies Hardcover", 1998, Mc Graw- Hill.

E-RESOURCES:

1. https://www.youtube.com/watch?v=9Z-FrvcPa-E
2. https://archive.nptel.ac.in/courses/103/102/103102015/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	-	1	3	2	2
CO2	3	2	2	1	1	-	-	-	-	-	-	1	3	2	2
CO3	3	2	2	1	1	-	-	-	-	-	-	1	3	2	2
CO4	3	2	2	1	1	-	-	-	-	-	-	1	3	2	2
CO5	3	2	2	1	1	-	-	-	-	-	-	1	3	2	2
Avg	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE21	VALUE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the value engineering process and able to identify its functions within the process.
- Determine the appropriate value engineering methodology for a given project and propose appropriate training to centralized and decentralized modes.
- Learn various decision-making processes and cost evaluation models and apply them in appropriately in the product development life-cycle.
- Explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing.
- Demonstrate to implement value engineering solutions and propose to perfect them.

UNIT-I VALUE ENGINEERING BASICS 9

Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis.

UNIT-II VALUE ENGINEERING JOB PLAN AND PROCESS 9

Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering.

UNIT-III VALUE ENGINEERING TECHNIQUES 9

Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC)

UNIT-IV WORKSHEETS AND GUIDELINES 9

Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects- List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.

UNIT-V VERSATILITY OF VALUE ENGINEERING 9

Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Estimate a product cost based on value engineering principles in terms of its values functions and worthiness.

CO2: Discuss the product and articulate it in various phases of value engineering

CO3: Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training

CO4: Apply querying theory and FAST to prefect a value engineering project implementation.

CO5: Develop various case studies related to value engineering project implementation.

TEXT BOOKS:

1. Iyer. S.S., "Value Engineering", New Age International (P) Limited, 9th Edition, 2009 3Ed", 2009.
2. Anil Kumar. and Mukhopadhyaya., "Value Engineering: Concepts Techniques and applications", SAGE Publications, 1st Edition, 2003.

REFERENCE BOOKS:

1. Del L. Younker., "Value Engineering: analysis and methodology", CRC Press, 2003.
2. Richard Park., "Value Engineering A Plan for Invention", CRC Press, 1998.
3. Arthur E. Mudge., "Value Engineering :A systematic approach", McGraw Hill, 1989.
4. Alphonse Dell'Isola., "Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations", R.S. Means Company, 1997.
5. Lawrence D. Miles., "Techniques of Value Analysis and Engineering", Lawrence D. Miles Value Foundation, 3rd Edition, 2015.

E-RESOURCES:

1. https://books.google.co.in/books/about/Value_Engineering_Theory_and_Practice_in.html?id=ZDFbDwAAQBAJ&redir_esc=y
2. https://www.youtube.com/watch?v=QVATa8R1kvg&list=PLLy_2iUCG87DWm2TcXTGjqppfX0Cy4O7c

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	1	-	-	1	2	1	-	3	1	1	2	1
CO2	1	-	-	1	-	-	1	2	1	-	3	1	1	2	1
CO3	1	-	-	1	-	-	1	2	1	-	3	1	1	2	1
CO4	1	-	-	1	-	-	1	2	1	-	3	1	1	2	1
CO5	1	-	-	1	-	-	1	2	1	-	3	1	1	2	1
Avg	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**1**	**-**	**3**	**1**	**1**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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E-RESOURCES:

1. https://books.google.co.in/books/about/Additive_Manufacturing_Technologies.html?id=OPGbBQAAQBAJ&redir_esc=y
2. https://www.youtube.com/watch?v=t7yv4gSnNkE&list=PLwdnzlV3ogoWI8QEu4hsT-n_r8UbWbquy
3. https://www.youtube.com/watch?v=A2deRpJAWP4&list=PLwdnzlV3ogoUqSa4Z3MAZDYucOLqTbWjl

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	3	-	-	-	-	-	-	3	2	2	-
CO2	3	2	2	-	3	-	-	-	-	-	-	3	2	2	-
CO3	3	2	2	-	3	-	-	-	-	-	-	3	2	2	-
CO4	3	2	2	-	3	-	-	-	-	-	-	3	2	2	-
CO5	3	2	2	-	3	-	-	-	-	-	-	3	2	2	-
Avg	**3**	**2**	**2**	-	**3**	-	-	-	-	-	-	**3**	**2**	**2**	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE22	ADDITIVE MANUFACTURING	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the development of Additive Manufacturing (AM), various business opportunities and applications.
- Familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- Acquainted with vat polymerization and direct energy deposition processes.
- Familiar with powder bed fusion and material extrusion processes.
- Gain knowledge on applications of binder jetting, material jetting and sheet lamination processes.

UNIT-I INTRODUCTION 6

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.

UNIT-II DESIGN FOR ADDITIVE MANUFACTURING (DfAM) 6

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.

UNIT-III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 6

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology.Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications.

UNIT-IV POWDER BED FUSION AND MATERIAL EXTRUSION 6

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials- Process - Advantages and Applications.Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT-V OTHER ADDITIVE MANUFACTURING PROCESSES 6

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications.

Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications.

Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL : 30 PERIODS

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ADDITIVE MANUFACTURING LABORATORY

Experiments

1. Modelling and converting CAD models into STL file.
2. Manipulation and error fixing of STL file.
3. Design and fabrication of parts by varying part orientation and support structures.
4. Fabrication of parts with material extrusion AM process.
5. Fabrication of parts with vat polymerization AM process.
6. Design and fabrication of topology optimized parts.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2:	Acquire knowledge on process of transforming a concept into the final product in AM technology.
CO3:	Elaborate the vat polymerization and direct energy deposition processes and its applications.
CO4:	Acquire knowledge on process and applications of powder bed fusion and material extrusion.
CO5:	Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, MahyarKhorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCE BOOKS:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN:9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. AmitBandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States,2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

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23MEE23	CAD/CAM	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce and understand the Basic of Design.
- Study the two dimensional drafting and bill of material creation.
- Learn three dimensional modelling and its advantages.
- Study the basic and purpose of assembling modeling.
- Study the basics of computer aided machining and part programming.

UNIT-I BASICS OF DESIGNS 9

Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings. Revision / ECN status of drawings – Customer Specific requirements – Drawing Grid reading

UNIT-II 2D DRAFTING 9

Projection views – Orthographic view, Axillary view, Full & Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting

UNIT-III 3D MODELING 9

Conversion of Views – 2D to 3D & 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body In White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.

UNIT-IV ASSEMBLY MODELING 9

Basics of Assembly modeling, Purpose of Assembly modeling & amp; its advantages – Top to Down & BottomUp modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stackup analysis –Cumulative effect of Tolerances in after assembly conditions.- motion analysis

UNIT-V CAM 9

Basics of CNC Machining – 3, 4 & 5 Axis machines - CNC and Part Programing, CAM programing 2D & 3D. Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation –Machining Stocks, Roughing, Re-roughing, Semi Finishing & Finishing - Tool Path Generation, Isl and Milling Programing. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time. – Post Process NC Code conversion and Setup Sheet Preparation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the basics of the design and concepts.

CO2: Develop the two dimensional drafting and projection views.

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CO3: Discuss the three dimensional modeling, parametric and Non-parametric modeling

CO4: Discuss the assembly modeling and top down, bottom up approaches.

CO5: Develop the computer aided machining and wirting part programming.

TEXT BOOKS:

1. Computer Aided Design & Manufacturing - Jacob Moses & RuchiAgarwal
2. CAD / CAM Principles & Application - J. Srinivas

REFERENCE BOOKS:

1. CAD / CAM - Ibrahim Zaid (Text & Reference Book)
2. CAD / CAM – ChandandeepGrewal
3. CAD CAM & Automation - FarazdakHaideri (Text & Reference Book)
4. Computer Aided Design & Manufacturing – AnupGoel
5. CAD / CAM – PN Rao

E-RESOURCES:

1. https://mit.primo.exlibrisgroup.com/discovery/fulldisplay?vid=01MIT_INST:MIT&search_scope=all&tab=all&docid=alma990001447790106761&lang=en&context=L&virtualBrowse=true
2. https://www.youtube.com/watch?v=EgKc9L7cbKc&list=PLSGws_74K0187XbrrYx46emEz2fmgo8F8

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	1	-	-	1	3	3	2
CO2	3	2	2	2	2	-	-	-	1	-	-	1	3	3	2
CO3	3	2	2	2	2	-	-	-	1	-	-	1	3	3	2
CO4	3	2	2	2	2	-	-	-	1	-	-	1	3	3	2
CO5	3	2	2	2	2	-	-	-	1	-	-	1	3	3	2
Avg	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**3**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE24	DESIGN FOR X	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- Learn the design consideration principles of forming in the design of extruded, stamped, and forged products
- Learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- Learn design consideration principles of welding in the design of welded products.
- Learn design consideration principles in additive manufacturing

UNIT-I INTRODUCTION 9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks.

Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.

UNIT-II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT-III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly.

UNIT-IV COMPONENT DESIGN – CASTING CONSIDERATION 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT-V DESIGN FOR ADDITIVE MANUFACTURING 9

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Elaborate the design principles for manufacturability

CO2: Discuss the factors influencing in form design

CO3: Apply the component design features of various machines.

CO4: Discuss the design consideration principles of welding in the design of welded products.

CO5: Discuss the design consideration principles of additive manufacturing.

TEXT BOOKS:

1. James G. Bralla, "Design for Manufacturability Handbook", McGraw Hill Professional, 1998.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCE BOOKS:

1. CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
5. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994

E-RESOURCES:

1. https://en.wikipedia.org/wiki/Design_for_X
2. https://books.google.co.in/books?id=CzLobLHvgglC&printsec=frontcover#v=onepage&q&f=false
3. https://www.youtube.com/watch?v=vEPpKjIdpt0

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO2	2	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO3	2	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO4	2	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO5	2	2	3	1	1	-	-	-	1	-	-	1	2	3	2
Avg	**2**	**2**	**3**	**1**	**1**	-	-	-	**1**	-	-	**1**	**2**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE25	ERGONOMICS IN DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce to industrial design based on ergonomics.
- Consider ergonomics concept in manufacturing
- Apply ergonomics in design of controls and display.
- Apply environmental factors in ergonomics design.
- Develop aesthetics applicable to manufacturing and product

UNIT-I INTRODUCTION 9

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

UNIT-II ERGONOMICS AND PRODUCTION 9

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

UNIT-III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools

UNIT-IV ENVIRONMENTAL FACTORS 9

Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munselcolour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style

UNIT-V AESTHETIC CONCEPTS 9

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout
design.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Appreciate ergonomics need in the industrial design.

CO2: Apply ergonomics in creation of manufacturing system

CO3: Discuss on design of controls and display.

CO4: Consider environmental factors in ergonomics design.

CO5: Report on importance of aesthetics to manufacturing system and product

TEXT BOOKS:

1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares , Francisco Rebelo
2. Ergonomics in Product Design by Sendpoints Publishing Co. Ltd.

REFERENCE BOOKS:

1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7thEdition, 2002
2. Brain Shakel,"Applied Ergonomics Hand Book", Butterworth Scientific London 1988.
3. Bridger, R.C., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006
5. Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.

E-RESOURCES:

1. https://www.google.co.in/books/edition/Ergonomics_In_Design/07LQEAAAQBAJ?hl=en&gbpv=
2. https://www.youtube.com/watch?v=qG_clin0Tis&list=PL819F5B524B56D0D3

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	3	-	2	-	3	-	1	-	-	1	1	3	3
CO2	-	1	3	-	2	-	3	-	1	-	-	1	1	3	3
CO3	-	1	3	-	2	-	3	-	1	-	-	1	1	3	3
CO4	-	1	3	-	2	-	3	-	1	-	-	1	1	3	3
CO5	-	1	3	-	2	-	3	-	1	-	-	1	1	3	3
Avg	**-**	**1**	**3**	**-**	**2**	**-**	**3**	**-**	**1**	**-**	**-**	**1**	**1**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE26	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the fundamental concepts of the new product development
- Develop material specifications, analysis and process.
- Learn the Feasibility Studies & reporting of new product development.
- Study the New product qualification and Market Survey on similar products of new product development
- Learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT-I FUNDAMENTALS OF NPD 9

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD.

UNIT-II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT-III ESSENTIALS OF NPD 9

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining–Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods–Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

UNIT-IV CRITERIONS OF NPD 9

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT-V REPORTING & FORWARD-THINKING OF NPD 9

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points

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generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss fundamental concepts and customer specific requirements of the New Product development

CO2: Discuss the Material specification standards, analysis and fabrication, manufacturing process.

CO3: Develop Feasibility Studies & reporting of New Product development

CO4: Analyzing the New product qualification and Market Survey on similar products of new product development

CO5: Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS:

1. Product Development – StenJonsson
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCE BOOKS:

1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
3. Toyota Product Development System – James Morgan & Jeffrey K. Liker
4. Winning at New Products – Robert Brands 3rd Edition
5. Product Design & Value Engineering – Dr. M.A. Bulsara&Dr. H.R. Thakkar

E-RESOURCES:

1. https://www.youtube.com/watch?v=HN9GtL21rb4&list=PLSGws_74K018yZOnbSaqWJZ837QyBB7vu
2. https://www.google.co.in/books/edition/New_Product_Development/YKV8KXgZnoQC?hl=en&gbpv=1

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	-	-	-	1	1	-	-	1	1	3	2
CO2	1	1	3	1	-	-	-	1	1	-	-	1	1	3	2
CO3	1	1	3	1	-	-	-	1	1	-	-	1	1	3	2
CO4	1	1	3	1	-	-	-	1	1	-	-	1	1	3	2
CO5	1	1	3	1	-	-	-	1	1	-	-	1	1	3	2
Avg	**1**	**1**	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**1**	**1**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE27	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To study about the history, concepts and terminology in PLM
- To learn the functions and features of PLM/PDM
- To develop different modules offered in commercial PLM/PDM tools
- To demonstrate PLM/PDM approaches for industrial applications
- To use PLM/PDM with legacy data bases, Coax& ERP systems

UNIT-I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM – Need for PLM – Benefits and Opportunities of PLM – Key concepts: Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm) – PLM Infrastructure: Overview of Network and Communication Systems – Fundamentals of Data Management

UNIT-II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification, Programme Management. Utility Functions – Communication and Notification, Data Interoperability (Transport and Translation), Application Integration, System Utilities.

UNIT-III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application

UNIT-IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation in key sectors – automotive, aerospace, and electronics – PLM planning and strategy: vision and roadmap – Implementation considerations: organizational readiness and change management – Evaluation of PLM impact: performance improvement and compliance – Benefits and challenges of PLM adoption

UNIT-V PLM SOFTWARE CUSTOMIZATION AND SYSTEM INTEGRATION 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Summarize the history, concepts and terminology of PLM

CO2: Develop the functions and features of PLM/PDM

CO3: Discuss different modules offered in commercial PLM/PDM tools.

CO4: Interpret the implement PLM/PDM approaches for industrial applications.

CO5: Integrate PLM/PDM with legacy data bases, CAx& ERP systems

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TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016),ISBN-10 : 3662516330
2. Product LifeCycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10 :0899303196

REFERENCE BOOKS:

1. AnttiSaaksvuori and AnselmiImmonen, "Product Lifecycle Management", Springer Publisher, 2013 (3rd Edition)
2. IvicaCrnkovic, Ulf Asklund and AnnitaPerssonDahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2015.
3. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2011
4. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation",Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

E-RESOURCES:

1. https://nptel.ac.in/courses/112107217
2. https://www.ibm.com/think/topics/product-lifecycle-management

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	-	-	-	1	1	-	-	1	1	3	3
CO2	1	1	3	1	-	-	-	1	1	-	-	1	1	3	3
CO3	1	1	3	1	-	-	-	1	1	-	-	1	1	3	3
CO4	1	1	3	1	-	-	-	1	1	-	-	1	1	3	3
CO5	1	1	3	1	-	-	-	1	1	-	-	1	1	3	3
Avg	1	1	3	1	-	-	-	1	1	-	-	1	1	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
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23MEE32	ELECTRICAL DRIVES AND ACTUATORS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Familiarize a relay and power semiconductor devices
- Get a knowledge on drive characteristics
- Obtain the knowledge on DC motors and drives.
- Obtain the knowledge on AC motors and drives.
- Obtain the knowledge on Stepper and Servo motor.

UNIT-I RELAY AND POWER SEMI-CONDUCTOR DEVICES 9

Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit- Introduction to Driver and snubber circuits

UNIT-II DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.

UNIT-III DC MOTORS AND DRIVES 9

DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT-IV AC MOTORS AND DRIVES 9

Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.

UNIT-V STEPPER AND SERVO MOTOR 9

Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation- Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Recognize the principles and working of relays, drives and motors.

CO2: Explain the working and characteristics of various drives and motors.

CO3: Apply the solid state switching circuits to operate various types of Motors and Drivers

CO4: Interpret the performance of Motors and Drives.

CO5: Suggest the Motors and Drivers for given applications.

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TEXT BOOKS:

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.

REFERENCE BOOKS:

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2012.
3. Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

E-RESOURCES:

1. https://www.google.co.in/books/edition/Control_of_Electrical_Drives/pdsF210k5ikC?hl=en&gbpv=1&dq=ELECTRICAL+DRIVES+AND+ACTUATORS+BOOKS&printsec=frontcover
2. https://www.youtube.com/watch?v=1AT1yuQ9awM&list=PLFW6lRTa1g83slfVY1p1xGqPGYUmXyahx

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	-	-	-	-	-	-	1	1	-	3
CO2	3	1	2	2	1	-	-	-	-	-	-	1	1	-	3
CO3	3	1	2	2	1	-	-	-	-	-	-	1	1	-	3
CO4	3	1	1	2	2	-	-	-	-	-	-	1	1	-	3
CO5	3	1	1	2	2	-	-	-	-	-	-	1	1	-	3
Avg	**3**	**1**	**1.4**	**2**	**1.4**	-	-	-	-	-	-	**1**	**1**	-	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE31	SENSORS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Understand the concepts of measurement technology.
- Learn the various sensors used to measure various physical parameters.
- Learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development
- Learn about the optical, pressure and temperature sensor
- Understand the signal conditioning and DAQ systems

UNIT-I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT-II MOTION, PROXIMITY AND RANGING SENSORS 9

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 8

Strain Gage, Load Cell, 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 10

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors- Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT-V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi- channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Recognize with various calibration techniques and signal types for sensors.
CO2:	Describetheworkingprincipleandcharacteristicsofforce,magnetic,heading, pressure and temperature, smart and other sensors and transducers.
CO3:	Apply the various sensors and transducers in various applications
CO4:	Select the appropriate sensor for different applications.
CO5:	Acquire the signals from different sensors using Data acquisition systems.

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TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and PuneetSawney, "A Course in Mechanical Measurements and Instrumentation and Control", DhanpatRai& Co, 12th edition New Delhi, 2013.

REFERENCE BOOKS:

1. C. SujathaDyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001.
2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
4. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

E-RESOURCES:

1. https://www.google.co.in/books/edition/Measurement_Instrumentation_and_Sensors/0oEqBgAAQBAJ?hl=en&gbpv=1&dq=sensors+and+instrumentation+google+books&printsec=frontcover
2. https://www.youtube.com/watch?v=nE1C4ghfvac&list=PLgMDNELGJ1CbufZjqWa8uoSlQWKqVwPN7

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1	-	-	-	-	-	1	2	1	3
CO2	3	2	1	2	2	1	-	-	-	-	-	1	2	1	3
CO3	3	2	1	1	2	1	-	-	-	-	-	1	2	1	3
CO4	3	2	1	3	2	1	-	-	-	-	-	1	2	1	3
CO5	3	2	1	3	2	1	-	-	-	-	-	1	2	1	3
Avg	**3**	**2**	**1**	**2.2**	**2**	**1**	-	-	-	-	-	**1**	**2**	**1**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / Mech

23MEE33	EMBEDDED SYSTEMS AND PROGRAMMING	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Familiarize the architecture and fundamental units of microcontroller.
- Know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
- Design the interface circuit and programming of I/O devices, sensors and actuators.
- Understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
- Acquaint the knowledge of real time embedded operating system for advanced system developments.

UNIT-I INTRODUCTION TO MICROCONTROLLER 6

Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.

UNIT-II PROGRAMMING AND COMMUNICATION 6

Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE-C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.

UNIT-III PERIPHERAL INTERFACING 6

I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light

UNIT-IV ARM PROCESSOR 6

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.

UNIT-V SINGLE BOARD COMPUTERS AND PROGRAMMING 6

System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages -– Python for Embedded Systems- GPIO Programming – Interfacing

TOTAL : 30 PERIODS

EMBEDDED SYSTEMS LAB

LIST OF EXPERIMENTS

1. Assembly Language Programming and Simulation of 8051.
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.

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4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051..
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
7. UART Serial and Parallel Port Programming of 8051.
8. I2C, SPI and CAN Programming of 8051.
9. Interfacing and Programming of Bluetooth and Wi-Fi with 8051
10. Programming of ARM Processor for Sensor Interface.
11. Stepper Motor and Servo Motor Control Using ARM Processor.
12. Serial Communication of ARM Processor with Computation Platform.
13. Wireless Communication of ARM Processor with Computation Platform.
14. GPIO Programming of Real Time Embedded Operating Systems.
15. IOT application using SBC.

(any 7 experiments)

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.

CO2: Recognize the role of each functional units in microcontroller, processors and system- on-chip based on the features and specifications.

CO3: Interface the sensors, actuators and other I/O's with microcontroller, processors and system on chip based interfacing

CO4: Design the circuit and write the programming microcontroller, processors and system on chip

CO5: Develop the applications using Embedded system.

TEXT BOOKS:

1. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
2. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2003.

REFERENCE BOOKS:

1. Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.
2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition,2015
3. James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003.
4. John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 2005.

E-RESOURCES:

1. https://www.google.co.in/books/edition/Programming_Embedded_Systems/NzqbAgAAQBAJ?hl=en&gbpv=1&dq=EMBEDDED+SYSTEMS+AND+PROGRAMMING&printsec=frontcover

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2. https://www.youtube.com/watch?v=0xgvINDxXJI&list=PLbRMhDVUMngcJu5oUhgpgYqtOn7DmSfuU
3. https://www.youtube.com/watch?v=hnj-7XwTYRI&list=PLPW8O6W-1chwyTzI3BHwBLbGQoPFxPAPM

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	-	-	-	-	-	1	3	1	3
CO2	3	2	1	1	2	2	-	-	-	-	-	1	3	1	3
CO3	3	2	1	1	2	2	-	-	-	-	-	1	3	1	3
CO4	3	2	1	1	2	2	-	-	-	-	-	1	3	1	3
CO5	3	2	1	1	2	2	-	-	-	-	-	1	3	1	3
Avg	**3**	**2**	**1**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE34	ROBOTICS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Learn about basics of robots and their classifications
- Understand the robot kinematics in various planar mechanisms
- Learn about the concepts in robot dynamics
- Understand the concepts in trajectory planning and programming
- Know about the various applications of robots

UNIT-I BASICS OF ROBOTICS **8**

Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution –repeatability of robot.

UNIT-II ROBOT KINMEATICS **11**

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms

UNIT-III ROBOT DYNAMICS **9**

Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT-IV TRAJECTORY, PATH PLANNING AND PROGRAMMING **8**

Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS

UNIT-V ROBOT AND ROBOT APPLICATIONS **9**

Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives. Robot end effectors & Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	State the basic concepts and terminologies of robots
CO2:	Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots
CO3:	Derive the Forward and Inverse Kinematics, Dynamics for Various Robots
CO4:	Apply the various programming techniques in industrial applications
CO5:	Analyze the use of various types of robots in different applications

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TEXT BOOKS:

1. John.J.Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.

REFERENCE BOOKS:

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2ndEdition, 2010
3. S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition, 9789332902800
4. SathyaRanjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

E-RESOURCES:

1. https://www.youtube.com/watch?v=McqDT1DMlh8&list=PLXDsvE7qtfNdt9oYEhJ_LMXDUGu6bH-L6
2. https://roboism.in/projects
3. https://www.google.co.in/books/edition/Elements_of_Robotics/itpCDwAAQBAJ?hl=en&gbpv=1&dq=ROBOTICS&printsec=frontcover

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	-	-	-	-	-	-	1	2	1	3
CO2	3	2	3	1	2	-	-	-	-	-	-	1	2	1	3
CO3	3	2	3	1	2	-	-	-	-	-	-	1	2	1	3
CO4	3	2	3	1	2	-	-	-	-	-	-	1	2	2	3
CO5	3	2	3	1	3	-	-	-	-	-	-	1	2	2	3
Avg	**3**	**2**	**3**	**1**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1.4**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE35	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
- Learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
- Learn Basic Control System Theory applied to Autonomous Automobiles.
- Produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task
- Allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

UNIT-I INTRODUCTION TO AUTOMATED,CONNECTED,AND INTELLIGENT VEHICLES 9

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Power train Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT-II SENSOR TECHNOLOGY FOR SMART MOBILITY 9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT-III CONNECTED AUTONOMOUS VEHICLE 9

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

UNIT-IV VEHICLE WIRELESS TECHNOLOGY & NETWORKING 9

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board VehicleNetworks

UNIT-V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY 9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles
CO2:	Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing
CO3:	Familiar with the concept of fully autonomous vehicles
CO4:	Apply the basic concepts of wireless communications and wireless data networks
CO5:	Analyze the concept of the connected vehicle and its role in automated vehicles

TEXT BOOKS:

1. "Intelligent Transportation Systems and Connected and Automated Vehicles", 2016, Transportation Research Board
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 2019, Springer

REFERENCE BOOKS:

1. Tom Denton, "Automobile Electrical and Electronic systems, Roultedge", Taylor & Francis Group,5th Edition,2018.

E-RESOURCES:

1. https://www.google.co.in/books/edition/Smart_Mobility_and_Intelligent_Transport/cGkWEQAAQBAJ?hl=en&gbpv=1&dq=SMART+MOBILITY+AND+INTELLIGENT+VEHICLES&printsec=frontcover
2. https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	1	-	-	-	-	-	1	2	1	1
CO2	3	2	1	1	-	1	-	-	-	-	-	1	2	1	1
CO3	3	2	1	1	-	1	-	-	-	-	-	1	2	1	1
CO4	3	2	1	1	-	1	-	-	-	-	-	1	2	1	1
CO5	3	2	1	1	-	1	-	-	-	-	-	1	2	1	1
Avg	**3**	**2**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / Mech

23MEE36	HAPTICS AND IMMERSIVE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Learn various immersive technologies of VR, AR and MR.
- Learn software related to immersive technologies.
- Learn the concepts of developing AR applications.
- Learn the concepts of developing VR and unreal engine.
- Study the haptic perception and extended reality.

UNIT-I INTRODUCTION TO IMMERSIVE TECHNOLOGIES **9**

Introduction on Virtual reality – Augmented reality – Mixed reality – Extended reality – VR Devices – AR Devices – Applications

UNIT-II SOFTWARE TOOLS **9**

Intro to Unity – Unity editor workspace – Intro to C# and visual studio - Programming in Unity – Intro to Unreal Engine – UE4 Editor workspace – Intro to Blueprint programming – Programming in Ue4

UNIT-III BUILDING AR APPLICATION WITH UNITY **9**

AR SDKs for unity and unreal engine – Working with SDKs for unity – Developing AR application in unity - Building AR application

UNIT-IV BUILDING VR APPLICATION WITH UNREAL ENGINE **9**

VR SDKs for unity and unreal engine – Developing VR application in Ue4 – Building VR application

UNIT-V HAPTIC PERCEPTION AND EXTENDED REALITY **9**

Extended Reality - Introduction to Haptics – Devices and possibilities – Custom Device development – Device Integration

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Apply detailed knowledge about immersive technology

CO2: Gaining the knowledge of different types of Tools and Devices

CO3: Acquiring the knowledge about Unity and Unreal Engine

CO4: Explain the developing application in immersive technologies

CO5: Discuss about haptics in immersive technologies

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TEXT BOOKS:

1. Immersive Multimodal Interactive Presence, by Angelika Peer (Editor), Christos D. Giachritsis (Editor), Springer; 2012th edition (13 April 2014), ISBN-10 : 1447162137
2. XR Haptics, Implementation & Design Guidelines, by Eric Vezzoli , Chris Ullrich , Gijs den Butter , Rafal Pijewski, March 13, 2022

REFERENCE BOOKS:

1. Practical Augmented Reality, by Steve Aukstakalnis, Addison-Wesley Professional; 1st edition (8 September 2016)
2. Augmented Reality - Theory, Design and Development, by Chetankumar G Shetty.
3. Strategic Communication and AI, by Simon Moore , Roland Hübscher, Routledge; 1st edition (10 September 2021), ISBN-10 : 0367627795
4. Immersive Analytics, by Kim Marriott , Falk Schreiber, Springer; 1st ed. 2018 edition (15 October 2018).
5. Immersive Analytics A Clear and Concise Reference, by Gerardus Blokdyk, 5STARCooks (5 September 2018).

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/121/106/121106013/
2. https://www.youtube.com/watch?v=bNvfbAryoEM

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	-	-	-	1	-	-	1	1	2	2
CO2	2	2	2	-	2	-	-	-	1	-	-	1	1	2	2
CO3	2	2	2	-	2	-	-	-	1	-	-	1	1	2	2
CO4	2	2	2	-	2	-	-	-	1	-	-	1	1	2	2
CO5	2	2	2	-	2	-	-	-	1	-	-	1	1	2	2
Avg	**2**	**2**	**2**	-	**2**	-	-	-	**1**	-	-	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE37	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Understand the basics of drone concepts
- Learn and understand the fundaments of design, fabrication and programming of drone
- Impart the knowledge of an flying and operation of drone
- Know about the various applications of drone
- Understand the safety risks and guidelines of fly safely

UNIT-I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT-II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT-III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications

UNIT-IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT-V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Know about a various type of drone technology, drone fabrication and programming.

CO2: Execute the suitable operating procedures for functioning a drone

CO3: Select appropriate sensors and actuators for Drones

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CO4: Develop a drone mechanism for specific applications

CO5: Create the programs for various drones

TEXT BOOKS:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCE BOOKS:

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_ae06
2. https://www.youtube.com/playlist?list=PLFW6lRTa1g82OxO_qF_Vg9xxACPhMyv5

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO2	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO3	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO4	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
CO5	1	2	3	1	3	2	-	-	-	-	-	1	2	1	3
Avg	**1**	**2**	**3**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE41	DIGITAL MANUFACTURING AND IoT	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the various aspects of digital manufacturing.
- Inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
- Formulate of smart manufacturing systems in the digital work environment.
- Interpret IoT to support the digital manufacturing.
- Elaborate the significance of digital twin.

UNIT-I INTRODUCTION 6

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing.

UNIT-II DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT 6

Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM

UNIT-III SMART FACTORY 6

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cyber security

UNIT-IV INDUSTRY 4.0 6

Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies.

UNIT-V STUDY OF DIGITAL TWIN 6

Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins.

TOTAL : 30 PERIODS

DIGITAL MANUFACTURING AND IoT LABORATORY

Experiments

1. Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino
2. Detect the Vibration of an Object Using Arduino
3. Sense a Finger When it is Placed on Board Using Arduino
4. Temperature Notification Using Arduino
5. Switch Light On and Off Based on the Input of User Using Raspberry Pi
6. Connect with the Available Wi-Fi Using Arduino.

TOTAL : 30 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Impart knowledge to use various elements in the digital manufacturing.

CO2: Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.

CO3: Select the proper procedure of validating practical work through digital validation in Factories.

CO4: Implementation the concepts of IoT and its role in digital manufacturing.

CO5: Analyse and optimize various practical manufacturing process through digital twin.

TEXT BOOKS:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

REFERENCE BOOKS:

1. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.
5. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/110/106/110106045/
2. https://archive.nptel.ac.in/courses/106/105/106105195/
3. https://www.youtube.com/watch?v=ZQj5XuJtBIo

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	1	3	3	-	1	2	2	-	2	3	2	1
CO2	3	2	3	1	3	3	2	2	2	2	-	2	3	2	3
CO3	3	-	3	1	3	3	2	-	3	2	-	2	3	2	3
CO4	3	2	2	2	3	3	2	2	2	2	2	2	3	2	3
CO5	3	-	2	-	1	3	-	2	2	2	-	2	3	2	2
Avg	**3**	**2**	**2.2**	**1.25**	**2.6**	**3**	**2**	**1.75**	**2.2**	**2**	**2**	**2**	**3**	**2**	**2.4**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE42	MODERN ROBOTICS	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce definition, history of robotics and robot anatomy.
- Learn the simulation of robot kinematics
- Study the grasping and manipulation of robots.
- Study about mobile robot and manipulation.
- Study the applications of industrial, service, domestic robots.

UNIT-I INTRODUCTION 6

Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; task space and workspace, Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, Homogeneous transformation matrices.

UNIT-II SIMULATION OF ROBOT KINEMATICS 6

Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg (D-H) transformation, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system.

UNIT-III GRASPING AND MANIPULATION OF ROBOTS 6

Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, End effectors, grippers, types of gripper, gripper force analysis, and examples of manipulation and grasping.

UNIT-IV MOBILE ROBOTS 6

Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control

UNIT-V APPLICATIONS OF ROBOTS 6

Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare

TOTAL : 30 PERIODS

MODERN ROBOTICS LABORATORY

Experiments

1. 3D modeling and motion simulation of rotational joint assembly
2. 3D modeling and motion simulation of prismatic joint assembly
3. 3D modeling and motion simulation of Cartesian robot
4. 3D modeling and motion simulation of articulated robot
5. 3D modeling and motion simulation of spherical robot
6. 3D modeling and motion simulation of cylindrical robot

TOTAL : 30 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Discuss the definition, history of robotics and robot anatomy.
- **CO2:** Develop the simulation of robot kinematics
- **CO3:** Describe the grasping and manipulation of robots.
- **CO4:** Explain about mobile robot and manipulation.
- **CO5:** Discuss the applications of industrial, service, domestic robots.

TEXT BOOKS:

1. Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park, Cambridge University Press; 1st edition (25 May 2017), ISBN-10 : 110715
2. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751

REFERENCE BOOKS:

1. Modern Robotics: Designs, Systems and Control, by Jared Kroff, Willford Press (18 June 2019)ISBN-10 : 1682856763
2. Advanced Technologies in Modern Robotic Applications, by ChenguangYang , Hongbin Ma, Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN-10 : 981109263X
3. Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition (1 August 2006), ISBN-10 : 0816057451
4. Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; Standard Edition (30 August 2018), ISBN-10 : 1788835441
5. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10 : 1639873732

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/105/112105236/
2. https://archive.nptel.ac.in/courses/112/106/112106298/
3. https://www.youtube.com/watch?v=jdj1ptkWlEg

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	2	-	-	-	1	-	-	1	1	2	3
CO2	2	1	3	1	2	-	-	-	1	-	-	1	1	2	3
CO3	2	1	3	1	2	-	-	-	1	-	-	1	1	2	3
CO4	2	1	3	1	2	-	-	-	1	-	-	1	1	2	3
CO5	2	1	3	1	2	-	-	-	1	-	-	1	1	2	3
Avg	**2**	**1**	**3**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE43	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the basics of 6 SIGMA
- Learning about the lean manufacturing tools.
- Study about the deeper understanding methodologies of Lean manufacturing.
- Study the lean concepts and its elements.
- Learn implementation and challenges of lean manufacturing.

UNIT-I BASICS OF 6 SIGMA 9

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

UNIT-II INTRODUCTION TO LEAN MANUFACTURING TOOLS 9

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.

UNIT-III DEEPER UNDERSTADING METHODOLOGIES 9

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration.

UNIT-IV LEAN ELEMENTS 9

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects

UNIT-V IMPLEMENTATION AND CHALLENGES 9

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the basics of 6 SIGMA

CO2: Elaborate the lean manufacturing tools.

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CO3: Illustrate about the deeper understanding methodologies of Lean manufacturing.

CO4: Discuss lean concepts and its elements.

CO5: Describe the implementation and challenges of lean manufacturing.

TEXT BOOKS:

1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia
3. The Toyota Way: 14 Management Principles
4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy,Masaki Imai

REFERENCE BOOKS:

1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/
3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).
4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104188/
2. https://archive.nptel.ac.in/courses/110/105/110105123/
3. https://www.youtube.com/watch?v=s2HCrhNVfak&t=32s

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO2	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO3	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO4	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
CO5	1	1	2	1	1	-	-	-	1	-	3	1	1	2	1
Avg	**1**	**1**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**3**	**1**	**1**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE44	GREEN MANUFACTURING DESIGN AND PRACTICES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the concept of environmental design and industrial ecology.
- Impart knowledge about air pollution and its effects on the environment.
- Enlighten the students with knowledge about noise and its effects on the environment.
- Enlighten the students with knowledge about water pollution and its effects on the environment.
- Introduce the concept of green co-rating and its need

UNIT-I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT 9

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle.

UNIT-II AIR POLLUTION SAMPLING AND MEASUREMENT 9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation- the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone.

UNIT-III NOISE POLLUTION AND CONTROL 9

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise- Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT-IV WATER DEMAND AND WATER QUALITY 9

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT-V GREEN CO-RATING 9

Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies Of Green Co- Rating

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Explain the environmental design and selection of eco-friendly materials.
- **CO2:** Analyse manufacturing processes towards minimization or prevention of air pollution.
- **CO3:** Analyse manufacturing processes towards minimization or prevention of noise pollution.
- **CO4:** Analyse manufacturing processes towards minimization or prevention of water pollution.
- **CO5:** Evaluate green co-rating and its benefits.

TEXT BOOKS:

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

REFERENCE BOOKS:

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.
3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
4. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
5. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
6. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/124/106/124106157/
2. https://archive.nptel.ac.in/courses/112/104/112104227/
3. https://archive.nptel.ac.in/courses/123/105/123105001/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	-	-	3	-	1	-	-	1	1	2	2
CO2	1	1	3	1	-	-	3	-	1	-	-	1	1	2	2
CO3	1	1	3	1	-	-	3	-	1	-	-	1	1	2	2
CO4	1	1	3	1	-	-	3	-	1	-	-	1	1	2	2
CO5	1	1	3	1	-	-	3	-	1	-	-	1	1	2	2
Avg	**1**	**1**	**3**	**1**	-	-	**3**	-	**1**	-	-	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE45	ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Make the students to understand the concepts of Environmental Sustainability & Impact Assessment
- Familiarize the students in environmental decision making procedure.
- Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities
- Provide information on the environmental consequences for decision making
- Promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

UNIT-I ENVIRONMENTAL IMPACT ASSESMENT 9

Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

UNIT-II ENVIRONMENTAL DECISION MAKING 9

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.

UNIT-III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION 9

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT-IV LIFE CYCLE ASSESSMENT 9

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting

UNIT-V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT 9

Spatial economics – Knowledge economy and urban regions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Explain the concepts of Environment Sustainability and trained to make decision related to Environment.
CO2:	Make decision that has an effect on our environment
CO3:	Evaluate the basics of environmental policy, planning and various legislation Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.
CO4:	Explain the Life cycle assessment of Environmental sustainability.
CO5:	Explain sustainable urban economic development.

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TEXT BOOKS:

1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter Duinker , Tony R. Walker , Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194
2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st editio (11 April 2022), ISBN-10 : 0367244470

REFERENCE BOOKS:

1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development – Edward Elgar Publishing, 2007
2. Robort B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005
3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008
4. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.
5. Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
6. John G. Rau And David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/124/107/124107160/
2. https://archive.nptel.ac.in/courses/105/105/105105157/
3. https://archive.nptel.ac.in/courses/110/103/110103093/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	-	-	-	3	-	1	-	-	1	1	2	1
CO2	1	-	2	-	-	-	3	-	1	-	-	1	1	2	1
CO3	1	-	2	-	-	-	3	-	1	-	-	1	1	2	1
CO4	1	-	2	-	-	-	3	-	1	-	-	1	1	2	1
CO5	1	-	2	-	-	-	3	-	1	-	-	1	1	2	1
Avg	**1**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE46	ENERGY SAVING MACHINERY AND COMPONENTS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the various energy saving machineries and components to the students for the purpose of conserving energy.
- Study the basics and principles of transforms, Pumps and motors.
- Impart the knowledge about the methods of energy conservation.
- Introduce the energy efficiency devices and concepts of ENCON.
- Impart the knowledge about CO2 mitigation.

UNIT-I BASICS OF ELECTRICAL ENERGY USAGE 9

Fuel to Power : Cascade Efficiency – Electricity Billing : Components and Costs – kVA – Need and Control – Determination of kVA demand and Consumption – Time of Day Tariff – Power Factor Basics – Penalty Concept for PF – PF Correction – Demand Side Management (a brief) - energy monitoring, measurement and analysis.

UNIT-II TRANSFORMERS AND MOTORS 9

Transformer – Basics and Types – AVR and OLTC Concepts – Selection of Transformers – Performance Prediction - Energy Efficient Transformers - Motors : Specification and Selection – Efficiency / Load Curve – Load Estimation – Assessment of Motor Efficiency under operating conditions – Factors affecting performance – ill effects of Rewinding and Over sizing - Energy Efficient Motors – ENCON Scope. Transmission Line Parameters – Transmission Line Losses- Kelvin's Law Performance Calculation and Analysis

UNIT-III FANS, PUMPS AND COMPRESSORS 9

Basics – Selection – Performance Evaluation – Cause for inefficient operation – scope for energy conservation – methods adopted for effecting ENCON – Economics of ENCON adoption.

UNIT-IV STUDY OF ILLUMINATION AND ENERGY EFFICIENT DEVICES 9

Specification of luminaries - Types - Efficacy - Selection and Application - ENCON Avenues and Economic Proposition - New Generation Luminaries (LED - Induction Lighting) - Soft Starters- Auto Star - Delta - Star Starters- APFC - Variable Speed and Frequency Drives - Time Sensors - Occupancy Sensors.

UNIT-V CO_2 MITIGATION AND CASE STUDIES 9

Evaluation for 3 / 4 Typical Sectors – PAT Scheme (an introduction) – CO2 Mitigation - Energy Conservation - Cost Factor. Case Studies on Industrial Energy Audit.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the various energy saving machinery and components.

CO2: Evaluate the various methods of conservation of energy.

CO3: Evaluate the performance and energy conservation of fans, pumps and

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compressors.

CO4: Discuss the various energy efficiency devices.

CO5: Explain the co2 mitigation and cost factor.

TEXT BOOKS:

1. Energy-Efficient Shutdown of Circuit Components and Computing Systems, by Ehsan Pakbazni Proquest, Umi Dissertation Publishing (1 September 2011), ISBN-10 : 1243819898
2. Handbook on Energy Efficiency, TERI, New Delhi, 2001

REFERENCE BOOKS:

1. Hamies, Energy Auditing and Conservation ; Methods Measurements, management and Case Study, Hemisphere, Washington, 1980
2. Trivedi, PR and Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997
3. Handbook on Energy Efficiency, TERI, New Delhi, 2001
4. Peters, Kraushaar and Ristenen, Sustainable Energy, beta – test – draft, Energy and Problems of a Technical Society, 1993
5. Guide book for National Certification Examination for Energy Managers and Energy Auditors (www.energymanagertraining.com)
6. Nagrath IJ and Kothari DP, Power system engineering, TMH, 2007

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/108/102/108102146/
2. https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-mm23/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	-	3	-	1	-	-	1	1	2	2
CO2	2	2	1	1	-	-	3	-	1	-	-	1	1	2	2
CO3	2	2	1	1	-	-	3	-	1	-	-	1	1	2	2
CO4	2	2	1	1	-	-	3	-	1	-	-	1	1	2	2
CO5	2	2	1	1	-	-	3	-	1	-	-	1	1	2	2
Avg	**2**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE47	GREEN SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Familiar the various standards and legislation of modern electronic manufacturing.
- Know the conventional electronic processing and lead-free electronic manufacturing techniques.
- Recognize the steps involved in assembly process and understand the need of recycle the electronics
- Implement reliability and product life cycle estimation tools in green electronic manufacturing.
- Demonstrate the green electronic manufacturing procedure in applications.

UNIT-I INTRODUCTION TO GREEN ELECTRONICS **9**

Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).

UNIT-II GREEN ELECTRONICS MATERIALS AND PRODUCTS **9**

Basics of IC manufacturing and its process – Electronics with Lead (Pb) -free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products

UNIT-III GREEN ELECTRONICS ASSEMBLY AND RECYCLING **9**

Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments - Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

UNIT-IV PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN **9**

Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry.

UNIT-V CASE STUDIES **9**

Reliability of green electronics systems , Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management – Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Get concise awareness of standards and legislation of modern electronic manufacturing for green environment.
CO2:	Explain the conventional electronic processing and lead free electronic manufacturing techniques.
CO3:	Realize the assembly process and the need of recycle of electronics
CO4:	Use reliability and product life cycle estimation tools for electronic manufacturing.
CO5:	Validate the green electronic manufacturing procedures in applications.

TEXT BOOKS:

1. Green Supply Chain Management, by Charisios Achillas , Dionysis D. Bochtis , Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10 : 1138644617
2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

REFERENCE BOOKS:

1. David Austen, Green Electronic Morning, Ingleby Gallery, 2006.
2. John Hu. Mohammed Ismail, CMOS High Efficiency on – Chip Power Management, Springer Publications 4th edition, 2011.
3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014.
4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006.
5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010.
6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/110/106/110106045/
2. www.youtube.com/playlist?list=PLbMVogVj5nJSF8ldMqvP905muWlo1r7L2

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	-	-	-	2	-	1	-	3	1	1	2	2
CO2	1	1	2	-	-	-	2	-	1	-	3	1	1	2	2
CO3	1	1	2	-	-	-	2	-	1	-	3	1	1	2	2
CO4	1	1	2	-	-	-	2	-	1	-	3	1	1	2	2
CO5	1	1	2	-	-	-	2	-	1	-	3	1	1	2	2
Avg	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**3**	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE51	DESIGN OF PRESSURE VESSELS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To introduce the Mathematical knowledge to design pressure vessels and piping
- To learn the ability to carry of stress analysis in pressure vessels and piping
- To study the design of vessels and theory of reinforcement.
- To study buckling and fracture analysis in vessels.
- To learn piping layout and flow diagram.

UNIT-I INTRODUCTION 9

Methods for determining stresses – Terminology and Ligament Efficiency – Applications

UNIT-II STRESSES IN PRESSURE VESSELS 9

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT-III DESIGN OF VESSELS 9

Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

UNIT-IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 9

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT-V PIPING 9

Introduction – Flow diagram – piping layout and piping stress Analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications
CO2:	Analyse stress in pressure vessels
CO3:	Design and analysis of pressure vessels.
CO4:	Analysis of buckling and fracture analysis in vessels
CO5:	Design and analysis piping layout and piping.

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TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001

REFERENCE BOOKS:

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.
5. Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. | 1 January 2001

E-RESOURCES:

1. https://www.routledge.com/Design-of-Pressure-Vessels/Gaddam/p/book/9780367550660
2. https://www.youtube.com/watch?v=339GQHTBk-c

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO2	3	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO3	3	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO4	3	2	3	1	1	-	-	-	1	-	-	1	2	3	2
CO5	3	2	3	1	1	-	-	-	1	-	-	1	2	3	2
Avg	**3**	**2**	**3**	**1**	**1**	-	-	-	**1**	-	-	**1**	**2**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE52	FAILURE ANALYSIS AND NDT TECHNIQUES	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce need and scope of failure analysis and fundamental sources of failures.
- Learn about non-destructive testing and basic principles of visual inspection.
- Study about magnetic testing and principles, techniques.
- Learn the principle of radiography testing and its inspection techniques and methods.
- Study the acoutistic testing principle and technique and instrumentation.

UNIT-I INTRODUCTION 6

Introduction and need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing & Assembly. Tree diagram and FMEA.

UNIT-II VISUAL INSPECTION 6

Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Sensitivity, Applications, Limitations and Standards

UNIT-III MAGNETIC TESTING 6

Magnetic Particle Testing, Eddy Current Testing: Magnetism-basic definitions and principle of. magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Sensitivity Advanced Eddy Current Test Methods, Applications, Limitations.

UNIT-IV RADIOGRAPHY TESTING 6

Radiography, Ultrasonic Testing: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for Normal Beam Inspection, Techniques for Angle Beam Inspection, Flaw characterization techniques, Ultrasonic flaw detection equipment, Modes of Display, Immersion Testing, Applications of Ultrasonic Testing, Advantages, Limitations

UNIT-V ACOUTISTIC TESTING 6

Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications, Standards. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Codes and Standards. In Situ Metallographic Examination: Approach to the Selection of Site for Metallographic examination, Replication process, Significance of Microstructure observation, Decision making, Applications, Codes and Standards.(digital signal process)

TOTAL : 30 PERIODS

NON DESTRUCTIVE TESTING LABORATORY

Experiments

1. Conducting experiment using liquid penetrant testing
2. Conducting experiment using magnetic particle testing

Chairman
BoS / Mech

3. Conducting experiment using ultrasonic testing
4. Conducting experiment using electromagnetic testing
5. Conducting experiment using acoutistic emission testing

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the need and scope of failure analysis and fundamental sources of failures

CO2: Describe about non-destructive testing and basic principles of visual inspection

CO3: Explain about magnetic testing and principles, techniques

CO4: Explain the principle of radiography testing and its inspection techniques and methods

CO5: Describe the acoutistic testing principle and technique and instrumentation

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.
2. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010

REFERENCE BOOKS:

1. ASM Metals Hand book, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1,Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4,Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7,Ultrasonic Testing
3. Charles, J. Hellier, Handbook of Non-destructive evaluation, McGraw Hill, New York 2001.
4. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition NewJersey, 2005
5. J.Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-HillEducation, 2nd edition (2011).

E-RESOURCES:

1. https://onlinecourses-archive.nptel.ac.in/noc18-me29/preview
2. https://inis.iaea.org/collection/NCLCollectionStore/_Public/31/005/31005449.pdf

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	1	-	-	1	2	1	2
CO2	2	2	1	2	2	-	-	-	1	-	-	1	2	1	2
CO3	2	2	1	2	2	-	-	-	1	-	-	1	2	1	2
CO4	2	2	1	2	2	-	-	-	1	-	-	1	2	1	2
CO5	2	2	1	2	2	-	-	-	1	-	-	1	2	1	2
Avg	**2**	**2**	**1**	**2**	**2**	-	-	-	**1**	-	-	**1**	**2**	**1**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE53	MATERIAL HANDLING AND SOLID PROCESSING EQUIPMENT	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Provide knowledge on materials handling equipment.
- Provide knowledge on Industrial Vehicles
- Provide knowledge on conveyor equipment.
- Provide knowledge on Auxiliary Equipment and Hoisting Equipment.
- Provide knowledge on Bulk Handling Equipment and Systems

UNIT-I INTRODUCTION TO MATERIALS HANDLING 9

Basic principles &objectives in material handling and its benefits - Classification of material handling equipment - selection of material handling equipments - guidelines for effective utilisation of material handling equipments -unit load concept

UNIT-II INDUSTRIAL VEHICLES 9

Introduction and types - Hand trucks - Two wheel Hand Trucks - Multiple wheel Hand Trucks - Hand Lift Trucks - Power Trucks - Fixed Platform Truck - Platform Lift Truck - Pallet Lift Truck - Walkie Truck - Straddle Carrier - Fork Lift Trucks - Specifications of FLT - FLT Attachments - Tractors - Industrial Tractor-Trailer-Self-propelled trucks and fork trucks - Automated guided vehicles Theory

UNIT-III CONVEYORS 9

Classification of conveyors- Definition - Description - General Characteristics - types and uses of belt Conveyors - Roller conveyors - Haulage Conveyors - Screw Conveyors - Bucket Conveyors - Chain Conveyors - Cable Conveyors - Pneumatic and Hydraulic conveyors - Computer controlled conveyor system.

UNIT-IV AUXILIARY EQUIPMENTAND HOISTING EQUIPMENT 9

Hoppers - Gates- Feeders- Chutes-positioners- Ball Table- Weighing and Control Equipment- Pallet loaders and unloaders -applications and advancements. - Hoisting Equipment - parts of hoisting equipment - Description and uses of hoists - Description and uses of ropes - description and purpose of crane hooks - Elevators - Cranes - Derricks - and its types

UNIT-V BULK HANDLING EQUIPMENT AND SYSTEMS 9

Storage of bulk solids - bulk handling equipment - Robotic handling - Materials handling at the workplace - Robots and their classification - Major components of a robot - classification of Robotic manipulators - Robotic handling applications

TOTAL : 45 PERIODS

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BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Discuss the basic concepts of material handling equipment
- **CO2:** Explain the basic working principles of various industrial Vehicles
- **CO3:** Develop the basic working principles of various conveyors
- **CO4:** Elabrate the basic working principles of various Auxiliary Equipment and Hoisting Equipment
- **CO5:** Explain the basic working principles of various Bulk Handling Equipment and Systems

TEXT BOOKS:

1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors,Delhi, 1987.
2. Siddharta Ray, Introduction to Materials Handling, New Age International Publishers

REFERENCE BOOKS:

1. Bolz, H. A and Hagemann, G. E (ed.), "Materials Handling Handbook", Ronald Press
2. 8005:1976, Classification of Unit Loads, Bureau of Indian Standards.
3. Apple, J.A., "Material Handling System Design", John Wiley & Sons
4. Theodore H., Allegre Sr., Material Handling Principles and Practice, CBS Publishers and Distributors
5. Immer J. R., Material Handling, Tata McGraw Hill Publication.

E-RESOURCES:

1. https://www.matconibc.com/video-resources
2. https://books.google.co.in/books?id=wWzGAff3sqkC&newbks=0&hl=en&source=newbks_fb&redir_esc=y

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	-	-	1	-	-	1	1	2	2
CO2	2	1	1	1	1	-	-	-	1	-	-	1	1	2	2
CO3	2	1	1	1	1	-	-	-	1	-	-	1	1	2	2
CO4	2	1	1	1	1	-	-	-	1	-	-	1	1	2	2
CO5	2	1	1	1	1	-	-	-	1	-	-	1	1	2	2
Avg	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE54	ROTATING MACHINERY DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Familiarize the course member with various operations of gas turbines and other driven rotating machines.
- Familiarize students with the common problems associated with the mechanical design and the lifting of the major rotating components of the gas turbine engine.
- Study the failure criteria of rotating machinery.
- Learn the design of discs, blades for rotating machinery.
- Study about blade vibrations Damage Mechanisms.

UNIT-I INTRODUCTION 9

Overview of the different operational regimes for gas turbine applications: base load, peak load, standby and backup operations, alongside their individual operational requirements. Fundamentals of Creep and Fatigue damage mechanisms. Material, design and operational parameters that affect creep and fatigue. Experimental and test procedures to characterise creep and fatigue damage.

UNIT-II DESIGNING FORCES 9

Loads/forces/stresses in gas turbine engines: loads - rotational inertia, flight, precession of shafts, pressure gradient, torsion, seizure, blade release, engine mountings and bearings-Discussion of major loadings-rotating components and pressure casing components.

UNIT-III FAILURE CRITERIA 9

Monotonic failure criteria: proof, ultimate strength. Theories of failure - bi-axial loads. Other failure mechanisms - gas turbine engines including creep and fatigue. Fatigue properties - SN and RM diagrams. Stress concentration, mean stress, Cumulative fatigue, Goodman diagram and safety factor for gas turbine components. Larson-Miller time-temperature parameter.

UNIT-IV BLADE DESIGN 9

Design of discs, blades. Illustration of magnitude stresses in conventional axial flow blades-simple desk-top method -effects of leaning the blade. Design of flanges and bolted structures. Leakages through a flanged joint and failure from fatigue.

UNIT-V BLADE VIBRATIONS AND DAMAGE MECHANISMS 9

Natural frequencies turbomachine blades. Blade twist, centrifugal stiffening, Sources of blade excitation, Stationary flow disturbance, rotating stall and flutter. Campbell diagram and troublesome resonances. Allowances for temperature, pre-twist and centrifugal stiffening. Methods for dealing with resonances.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Differentiate the operational regimes and requirements related to different gas turbine applications.
- **CO2:** Describe and distinguish the design requirements and loads encountered by gas turbine components during normal operation
- **CO3:** Analyse, evaluate and assess the loads, stresses, failure criteria and factors of safety used in gas turbine engines
- **CO4:** Evaluate impact of vibrations on design and operation of gas turbine
- **CO5:** Assess the creep and fatigue damage of gas turbine components based on design and operational parameters

TEXT BOOKS:

1. A S Rangawala, Turbomachinery Dynamics-Design and operations, McGraw-Hill, 2005, ISBN-13: 978-0071453691.
2. Design, Modeling and Reliability in Rotating Machinery, Robert X. Perez (Editor) ISBN: 978-1- 119-63169-9

REFERENCE BOOKS:

1. P.P Walsh and P. Peletcher, Gas Turbine Performance' Blackwell Science, 1998, ISBN0632047843.
2. Turbines, Compressors & Fans S. M. Yahya Tata McGraw Hill Co. Ltd 2nd edition, 2002
3. Principals of Turbo machines D. G. Shepherd The Macmillan Company 1964
4. Fluid Mechanics & Thermodynamics of Turbo machines S. L. Dixon Elsevier 2005
5. Shaft Alignment Handbook (Mechanical Engineering) by John Piotrowski | 2 November 2006

E-RESOURCES:

1. https://altair.com/resource/multiphysics-simulation-of-electrical-rotating-machines-and-next-gen-design-rotating-machinery
2. http://www.iqytechnicalcollege.com/BAE%20662 Design%20of%20Rotating%20Electrical%20Machines.pdf

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	1	-	-	1	2	3	1
CO2	3	2	3	1	-	-	-	-	1	-	-	1	2	3	1
CO3	3	2	3	1	-	-	-	-	1	-	-	1	2	3	1
CO4	3	2	3	1	-	-	-	-	1	-	-	1	2	3	1
CO5	3	2	3	1	-	-	-	-	1	-	-	1	2	3	1
Avg	**3**	**2**	**3**	**1**	-	-	-	-	**1**	-	-	**1**	**2**	**3**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE55	THERMAL AND FIRED EQUIPMENT DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the concepts of thermal and fired equipment.
- Study the basis, design and construction of boilers.
- Study of typical fuel firing systems in the boiler.
- Study of materials requirements for pressure parts.
- Study of various boiler auxiliaries system.

UNIT-I INTRODUCTION 9

Principal equipment in Thermal Power Plant, Historical developments of Boiler, Utility, Industrial boilers, Morden trends in boiler design , Basic knowledge of different types of Thermal Fired Equipment ,sub critical and super critical boilers - Coal , Oil ,Gas , Pulverised fuel cyclone, FBC, CFBC , MSW , and Stoker firing, Boiler efficiency , auxiliary power consumption , Performance data , Performance Correction Curves

UNIT-II BASIS OF BOILERS AND DESIGN 9

Codes- Design and Construction, IBR, ISO, ASME, BS, Heat balance diagram, Boiler parameters, Fuel analysis and variations, Site conditions, Furnace heat loadings, FOT, Plan area loading, Volumetric loading Balanced Draft and Pressurised Furnace, Natural / Controlled Circulation, Constant and Sliding Pressure, Boiler heat transfer surfaces, Flue gas velocities, boiler auxiliaries, Boiler schemes, Boiler Layouts

UNIT-III FIRING SYSTEM- FUEL AND MILLING 9

Coal / Oil / Natural Gas in any combination, Lignite, Blast Furnace Gas / Coke Oven Gas / Corex Gas Carbon Monoxide / Tail gas, Asphalt, Black Liquor, Bagasse, Rice Husk, Washery Rejects, Wheat / Rice straw MSW, wind box, Burner, Type of Stokers, Pulverisers - Bowl mill, Tube mill, Direct firing, Indirect firing, Wall firing (Turbulent / Vortex Burners), Tangential firing (Jet Burners), Fire Ball.

UNIT-IV PRESSURE PARTS AND DESIGN AND MATERIALS 9

Economiser, Drums , Water Walls , Headers , Links , Super Hater , Super Heaters , Reheaters, Tubes, Spiral Tubes , Surface area , Free Gas Area , Metal temperature , LMTD , Acid Due Point Temperature , Carbon steel , Low alloy steel , Titanium alloy steel

UNIT-V BOILER AUXILIARIES 9

Air preheaters (APH) – bi sector APH , Tri sector APH, Cold PA System, Hot PA System, Tubular APH, Steam coil Air preheater , FANS – Axial, Radial, Performance curves, MILLS- Tube , Vertical mills , Air quality Control systems ,DustCollection System - Mechanical Precipitator, Electrostatic Precipitator, FGD , SCR , SNCR

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the concepts of thermal and fired equipment

CO2: Discuss the basis, design and construction of boilers

CO3: Describe of typical fuel firing systems in the boiler

CO4: Discuss the materials requirements for pressure parts

CO5: Discuss of various boiler auxiliaries system

TEXT BOOKS:

1. A Course in Power Plant Engineering; Dhanapat Rai and Sons - Domkundwar
2. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar

REFERENCE BOOKS:

1. Elwakil M, Power Plant Technology, McGraw Hill, New York, 1964
2. Steam Generators and Waste Heat Boilers: For Process and Plant Engineers (Mechanical Engineering) by V. Ganapathy
3. Steam Generators: Description and Design by Donatello Annaratone
4. An Introduction to Coal and Wood Firing Steam Generators (Power Plants Engineering) by J Paul Guyer
5. Advances in Power Boilers (JSME Series in Thermal and Nuclear Power Generation) by Mamoru Ozawa and Hitoshi Asano | 28 January 2021

E-RESOURCES:

1. https://archive.nptel.ac.in/content/storage2/courses/103103027/pdf/mod1.pdf
2. https://www.youtube.com/watch?v=qh9OzgxrwJc

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	-	-	-	-	1	-	-	1	2	3	2
CO2	2	1	3	1	-	-	-	-	1	-	-	1	2	3	2
CO3	2	1	3	1	-	-	-	-	1	-	-	1	2	3	2
CO4	2	1	3	1	-	-	-	-	1	-	-	1	2	3	2
CO5	2	1	3	1	-	-	-	-	1	-	-	1	2	3	2
Avg	**2**	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE56 INDUSTRIAL LAYOUT DESIGN AND SAFETY

L	T	P	C
2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
- Learn the facilities layout design algorithms and selecting appropriate software.
- Study the facilities layout problem modelling tools and algorithms for production, warehouse, and material handling.
- Learn the safety planning and management principles in industries.
- Learn the various safety management approaches in industries.

UNIT-I INTRODUCTION 6

Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.

UNIT-II FACILITIES LAYOUT DESIGN & ALGORITHMS 6

Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP-PLANOPT, Factory CAD, Factory FLOW, Plant Simulation)

UNIT-III FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS 6

Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material-Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.

UNIT-IV SAFETY PLANNING & MANAGEMENT 6

Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety.

UNIT-V APPROACHES IN SAFETY MANAGEMENT 6

Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.

TOTAL : 30 PERIODS

INDUSTRIAL LAYOUT DESIGN LABORATORY

Experiments

1. Simulation of Manufacturing Shop
2. Simulation of Batch Production System

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3. Simulation of Multi Machine Assignment System
4. Simulation of Manufacturing and Material Handling Systems
5. Simulation of a Shop Floor
6. Simulation of Material Handling Systems

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
CO2: Discuss the facilities layout design algorithms and selecting appropriate software.
CO3: Describe the facilities layout problem modeling tools and algorithms for production, warehouse, and material handling.
CO4: Explain the safety planning and management principles in industries.
CO5: Illustrate the various safety management approaches in industries.

TEXT BOOKS:

1. Sunderesh S. Heragu, "Facilities Design", 3rd Edition, CRC Press Taylor & Francis Group, 2008.
2. L. M. Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", Tata McGraw-Hill Publishing Co. Ltd., 2005.

REFERENCE BOOKS:

1. Eric Teicholz, "Facility Design and Management Handbook", Tata McGraw-Hill Publishing Co. Ltd., 2001.
2. James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, "Facilities Planning", 4th Edition, John Wiley & Sons, 2010.
3. Matthew P. Stevens and Fred E. Meyers, "Manufacturing Facilities Design and Material Handling", 5th Edition, Purdue University Press, 2013.
4. Charles D.Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.
5. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
6. Industrial Hazard and Safety Handbook: (Revised impressionby Ralph W King and John Magid | 24 September 2013

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/110/107/110107141/
2. https://www.youtube.com/playlist?list=PLbRMhDVUMngdXebaRB59KdKwstzuAovua

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	3	3	3	2	1	1	3	2	2	2
CO2	1	2	2	2	1	3	3	3	2	1	1	3	2	2	2
CO3	1	2	2	2	1	3	3	3	2	1	1	3	2	2	2
CO4	1	2	2	2	1	3	3	3	2	1	1	3	2	2	2
CO5	1	2	2	2	1	3	3	3	2	1	1	3	2	2	2
Avg	**1**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE57	DESIGN CODES AND STANDARDS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the Codes and Standards and Need for them in the Industry
- Know the different sources and the bodies that publish Codes and Standards
- Familiarize the Government Regulations and its applicability
- Familiarize with different codes used in Different Industry
- Familiarize the Codes and Standards used in Process Industry

UNIT-I INTRODUCTION 9

Introduction to Codes and Standards. What is code? What is Standard?Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices.

UNIT-II CODES 9

Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes

UNIT-III STANDARDS 9

Sources of Codes and Standards. Who publishes Codes and Standards? International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes.

UNIT-IV REGULATIONS 9

Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers

UNIT-V DESIGN CODES 9

Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the need for codes and Standards in Industry.

CO2: Discuss the different codes and standards used in different industry.

CO3: Discuss the sources of different codes and standards and the societies that publish them and how these are evolved

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CO4: Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International

CO5: Discuss knowledge of codes and standards used in Process equipment design for Oi and Gas Industry.

TEXT BOOKS:

1. Mechanical Engg. Handbook. ASME. ASTM.API
2. Perrys Chemical Engg Handbook

REFERENCE BOOKS:

1. ASME
2. API
3. ISO, IBR, OISD
4. AWS
5. ISHRAE

E-RESOURCES:

1. https://www.youtube.com/watch?v=Uiqlu2gJu3k&t=1s
2. https://www.asme.org/codes-standards
3. https://www.iso.org/standards.html

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO2	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO3	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO4	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
CO5	2	1	3	-	-	-	-	-	1	-	-	1	1	2	2
Avg	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE61	BIOENERGY CONVERSION TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Elucidate on biomass, types, availability, and characteristics
- Study the bio-methanation process.
- Impart knowledge on combustion of biofuels
- Describe on the significance of equivalence ratio on thermochemical conversion of biomass
- Provide insight to the possibilities of producing liquid fuels from biomass

UNIT-I INTRODUCTION 9

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies

UNIT-II BIOMETHANATION 9

Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants

UNIT-III COMBUSTION 9

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

UNIT-IV GASIFICATION, PYROLYSIS AND CARBONISATION 9

Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation

UNIT-V LIQUIFIED BIOFUELS 9

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Estimate the surplus biomass availability of any given area.

CO2: Design a biogas plant for a variety of biofuels.

CO3: Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.

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CO4: Analyse the influence of process governing parameters in thermochemical conversion of biomass.

CO5: Synthesize liquid biofuels for power generation from biomass.

TEXT BOOKS:

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar , Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).

REFERENCE BOOKS:

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester,1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ch76/preview#:~:text=This%20course%20aims%20at%20providing,biomass)%20with%20emphasis%20on%20engineering
2. https://www.youtube.com/playlist?list=PLwdnzlV3ogoU_xd_1SOtPpMPis4Li8yHe

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	2	-	3	-	1	-	-	2	3	-	-
CO2	2	2	3	-	-	2	2	-	-	-	2	2	3	-	-
CO3	2	2	3	2	-	-	1	-	-	-	2	2	3	2	-
CO4	2	2	3	2	-	-	1	-	-	-	2	2	3	1	-
CO5	2	2	3	2	-	-	1	-	-	-	2	2	3	1	-
Avg	**2**	**2**	**3**	**2**	**2**	**2**	**1.6**	**-**	**1**	**-**	**2**	**2**	**3**	**1.3**	

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE62	CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce climate change and carbon footprint
- Study the principle of product life cycle and Green House Gas emissions accounting
- Study the Methodology for Carbon Footprint Calculation
- Learn emission mitigation and carbon sink
- Study the case study of carbon footprint.

UNIT-I CLIMATE CHANGE AND CARBON FOOTPRINT **9**

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations

UNIT-II PRODUCT LIFE CYCLE AND GHG EMISSIONS **9**

Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality- Allocation and Assessing Uncertainty

UNIT-III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT **9**

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes

UNIT-IV EMISSION MITIGATION AND CARBON SINK **9**

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Polcies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing.

UNIT-V CASE STUDIES **9**

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation - Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Explain the climate change and carbon footprint
- **CO2:** Discuss the principle of product life cycle and Green House Gas emissions accounting
- **CO3:** Explain the Methodology for Carbon Footprint Calculation
- **CO4:** Discuss emission mitigation and carbon sink
- **CO5:** Explain the case study of carbon footprint.

TEXT BOOKS:

1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10 : 9811011737
2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10 : 9814585742

REFERENCE BOOKS:

1. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press
2. Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers
3. World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard
4. ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation.
5. IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_ge49
2. https://www.youtube.com/playlist?list=PLLy_2iUCG87D2ixzWALTJHsf6GTgeNVej

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	-	-	-	3	-	1	-	-	1	1	1	2
CO2	1	1	2	-	-	-	3	-	1	-	-	1	1	1	2
CO3	1	1	2	-	-	-	3	-	1	-	-	1	1	1	2
CO4	1	1	2	-	-	-	3	-	1	-	-	1	1	1	2
CO5	1	1	2	-	-	-	3	-	1	-	-	1	1	1	2
Avg	**1**	**1**	**2**	**-**	**-**	**-**	**3**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE63	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Learn Quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally benign
- Analyzing factors behind energy billing and applying the concept of demand side management for lowering energy costs
- Learn Computing the stoichiometric air requirement for any given fuel and quantifying the energy losses associated with thermal utilities of industries
- Diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency
- Applying CUSUM and other financial evaluation techniques to estimating the accruable energy savings/monetary benefits for any energy efficiency project

UNIT-I INTRODUCTION 9

Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

UNIT-II ELECTRICAL SUPPLY SYSTEMS 9

Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics

UNIT-III ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES 9

Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.

UNIT-IV ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES 9

Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems

UNIT-V ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS 9

Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign

CO2: Analyse factors behind energy billing and apply the concept of demand side management for lowering energy costs

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CO3: Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries

CO4: Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency

CO5: Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project

TEXT BOOKS:

1. Guide book for National Certification Examination for "Energy Managers and Energy Auditors" (4 Volumes). Available at http://www.em-ea.org/gbook1.asp. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.
2. K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers &Dist, 2007.

REFERENCE BOOKS:

1. Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
2. Albert Thumann and Paul Mehta D, "Handbook of Energy Engineering", 7thEdition, The Fairmont Press, 2013.
3. Murphy.W.R. and McKay.G, "Energy Management", Butterworth, London 1982.
4. Paul W.O'Callaghan, Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers, Pergamon Press, 1981.
5. Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/105/112105221/
2. https://onlinecourses.swayam2.ac.in/nou23_es05/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	3	-	1	-	-	1	2	2	2
CO2	2	2	1	-	-	-	3	-	1	-	-	1	2	2	2
CO3	2	2	1	-	-	-	3	-	1	-	-	1	2	2	2
CO4	2	2	1	-	-	-	3	-	1	-	-	1	2	2	2
CO5	2	2	1	-	-	-	3	-	1	-	-	1	2	2	2
Avg	**2**	**2**	**1**	**-**	**-**	**-**	**3**	**-**	**1**	**-**	**-**	**1**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE64	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Learn the climate and buildings, building efficiency rating and standards
- Developing energy efficiency in building envelopes through alternate methods
- Study the thermal comfort, passive heating and cooling techniques
- Apply various energy saving concepts in buildings.
- Incorporate Renewable energy systems in buildings

UNIT-I INTRODUCTION 9

Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ and ECBC Standards

UNIT-II LANDSCAPE AND BUILDING ENVELOPES 9

Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools

UNIT-III THERMAL COMFORT, PASSIVE HEATING AND COOLING 9

Thermal comfort, Psychrometry, Comfort indices – ASHRAE / ISHRAE Standards on thermal Comfort – Passive heating and cooling systems - HVAC Systems for build environment – Heat Pumps, Evaporative Cooling and Radiant Cooling.

UNIT-IV ENERGY CONSERVATION IN BUILDING UTILITIES 9

Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors , Pumps, Illumination Systems, Electrical distribution systems, Cooling Towers,Refrigeration and Air Conditioning Systems, Water and Waste Management systems

UNIT-V RENEWABLE ENERGY IN BUILDINGS 9

Introduction of Renewable sources in buildings, , Stand-alone PV systems, BIPV, Solar water heating Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Familiar with climate responsive building design and basic concepts

CO2: Explain the basic terminologies related to buildings

CO3: Discuss the energy efficient air conditioning techniques

CO4: Evaluate the performance of buildings

CO5: Gets acquainted with Renewable energy systems in buildings

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TEXT BOOKS:

1. Advanced Decision Making for HVAC Engineers, by Javad Khazaii, Springer; Softcover reprint of the original 1st ed. 2016 edition (23 June 2018),ISBN-10 : 3319814869
2. Thermal Comfort and Energy-Efficient Cooling of Nonresidential Buildings, by Doreen E. Kalz, Jens Pfafferott, Springer; 2014th edition (8 April 2014), ISBN-10 : 9783319045818.

REFERENCE BOOKS:

1. ASHRAE Handbook – Fundamentals / Equipment's/ Applications – ASHRAE 2021,2020, 2019 Editions
2. Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 1998
3. Baruch Givoni: Passive Low Energy Cooling of Buildings by, John Wiley & Sons, 15-Jul-1994
4. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley & Sons, 2006.
5. Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and Cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 28-Dec-2009.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/102/105102195/
2. http://digimat.in/nptel/courses/video/105102175/L01.html

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	3	-	1	-	-	1	2	1	1
CO2	2	2	1	-	-	-	3	-	1	-	-	1	2	1	1
CO3	2	2	1	-	-	-	3	-	1	-	-	1	2	1	1
CO4	2	2	1	-	-	-	3	-	1	-	-	1	2	1	1
CO5	2	2	1	-	-	-	3	-	1	-	-	1	2	1	1
Avg	**2**	**2**	**1**	-	-	-	**3**	-	**1**	-	-	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE65	ENERGY STORAGE DEVICES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the various types of energy storage devices and technologies and them comparison.
- Learn the techniques of various energy storage devices and their performances.
- Learn the basics of batteries and hybrid systems for EVs and other mobile applications.
- Learn about the renewable energy storage systems and management systems.
- Have an insight into other energy storage devices, hydrogen, and fuel cells.

UNIT-I INTRODUCTION TO ENERGY STORAGE 9

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy torage technologies – Efficiency and Comparison.

UNIT-II ENERGY STORAGE SYSTEMS 9

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types- Charging and Discharging – Battery testing and performance.

UNIT-III MOBILE AND HYBRID ENERGY STORAGE SYSTEMS 9

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.

UNIT-IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT 9

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management

UNIT-V OTHER ENERGY DEVICES 9

Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC,MCFC and Biofuel Cells – Biogas Storage.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the need and identify the suitable energy storage devices for applications.

CO2: Explain the working of various energy storage devices and their importance.

CO3: Explain the basic characteristics of batteries for mobile and hybrid systems.

CO4: Discuss the storage of renewable energies and management systems.

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CO5: Explain the need for other energy devices and their scope for applications.

TEXT BOOKS:

1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", 2 nd Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001

REFERENCE BOOKS:

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, 2016.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & amp; Sons, 2002.
3. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4. Aulice Scibioh M. and Viswanathan B, "Fuel Cells – principles and applications', University Press(India), 2006
5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

E-RESOURCES:

1. https://www.youtube.com/playlist?list=PLB41970323E7D1E1A
2. http://172.16.0.33/web/T212TVBFZW1hVWpoTzZ3Nmc0NDJOdz/09

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO2	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO3	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO4	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
CO5	3	2	1	1	1	-	2	-	-	-	-	-	1	2	3
Avg	**3**	**2**	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE66	EQUIPMENT FOR POLLUTION CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the pollution control regulation and standards, water and wastewater.
- Study the equipment for various water pollution.
- Study the equipment for air pollution control.
- Study the equipment for solid waste processing
- Study the pollution monitoring equipment

UNIT-I POLLUTION CONTROL REGULATIONS AND STANDARDS 9

Pollutants in water and wastewater – sources and impacts- Characteristics and impacts of solid and hazardous wastes - Indian Constitution and Environmental Protection Legislations - Environmental Standards under different Environmental legislations - Water Act (1974), Air Act (1981), Environmental Protection Act (1986) and major Notifications, Municipal solid Wastes (Management and Handling) Rules -Bio Medical Wastes (Management and Handling) Rules - Hazardous Wastes (Management and Handling Rules),Environment Impact Assessment Notifications - Unit operations and unit processes in Pollution Control- - Selection criteria for Pollution Control Equipment.

UNIT-II EQUIPMENT FOR WATER POLLUTION CONTROL 9

Operational principles and Design criteria of Flash mixers, Flocculators, Clarifiers, Sand Filters, Adsorption Columns, Aerators, Air blowers, Distillation units, Centrifugal and Reciprocating Pumps, Chemical dosing systems, Motors, Pipes, valves and Fittings.- Filed visit to a wastewater treatment plant

UNIT-III EQUIPMENT FOR AIR POLLUTION CONTROL 9

Operational principles and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electrostatic precipitators, Biofilters - Filed visit to an industry with air pollution control systems

UNIT-IV EQUIPMENT FOR SOLID WASTE PROCESSING 9

Operational principles and Design criteria of Dewatering equipment – centrifuge, Vaccum Filter, Filter Press- Size Reduction equipment – shredders, grinders – Trommel and Disc Screens – Air Classifiers - bailing and briquetting – incinerators –Pyrolysis – field visit to a solid waste processing facility

UNIT-V POLLUTION MONITORING EQUIPMENT 9

Equipment's for sampling of water, solids and air- Sample preservation Equipment – incubators – Cold Storage systems- equipment for analysis of water and air samples- Ambient air and flue gas sampling and monitoring equipment

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the different types of pollution, their sources and effects.

CO2: Discuss the pollution control regulations and standards

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CO3: Design equipment for pollution control

CO4: Discuss different methods of pollution control from various sources in air, water and soil

CO5: Discuss the Conduct performance assessment of pollution control equipment.

TEXT BOOKS:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
2. Rao. C.S (2006)., "Environmental Pollution and Control Engineering", 2nd Edition, Revised, Wiley Eastern Limited, India.

REFERENCE BOOKS:

1. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford, 2001
2. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2014.
3. Noel de Nevers, "Air Pollution Control Engg", Mc Graw Hill, New York, 2016.
4. CPCB (2021), "Pollution Control Acts, Rules and Notifications issued thereunder, PCL Series- Central Pollution Control Board, Delhi
5. CPHEEO, "Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.

E-RESOURCES:

1. https://www.youtube.com/playlist?list=PLF5457B8AE71516CE
2. https://onlinecourses.nptel.ac.in/noc24_ch53/preview

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	3	-	1	-	-	1	1	2	2
CO2	2	1	1	-	-	-	3	-	1	-	-	1	1	2	2
CO3	2	1	1	-	-	-	3	-	1	-	-	1	1	2	2
CO4	2	1	1	-	-	-	3	-	1	-	-	1	1	2	2
CO5	2	1	1	-	-	-	3	-	1	-	-	1	1	2	2
Avg	**2**	**1**	**1**	-	-	-	**3**	-	**1**	-	-	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE67	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Know the Indian and global energy scenario
- Learn the various solar energy technologies and its applications.
- Educate the various wind energy technologies.
- Explore the various bio-energy technologies.
- Study the ocean and geothermal technologies.

UNIT-I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT-II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT-III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT-IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion- mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT-V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the Indian and global energy scenario.

CO2: Describe the various solar energy technologies and its applications.

CO3: Explain the various wind energy technologies.

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CO4: Explore the various bio-energy technologies.

CO5: Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCE BOOKS:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/121/106/121106014/
2. https://onlinecourses.nptel.ac.in/noc22_ch27/preview

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	3	2	2	1	1	3	2	1	2
CO2	3	2	2	1	1	1	3	1	1	1	2	3	2	1	2
CO3	3	2	3	1	2	1	3	1	1	1	1	3	1	1	2
CO4	2	2	2	1	2	1	3	1	1	1	2	3	2	2	2
CO5	2	1	2	1	2	1	3	1	1	1	1	3	2	1	2
Avg	**2.2**	**1.6**	**2**	**1**	**1.6**	**1.2**	**3**	**1.2**	**1.2**	**1**	**1.4**	**3**	**1.8**	**1.2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE71	COMPUTATIONAL SOLID MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the definition and basics on theory of elasticity
- Learn finite element method and procedure for static linear elasticity
- Study the Non Linear and History depend problems
- Study time dependent and dynamic problems of Small and large strain visco plasticity
- Study Structural Elements & Interfaces and contact using penalty method.

UNIT-I BASIC ON THEORY OF ELASTICITY 9

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium. Strain – displacement relations, Stress – strain relations, Lame's constant –cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Mohr's circle, Saint Venant's principle.

UNIT-II FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY 9

Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.

UNIT-III NON LINEAR AND HISTORY DEPEND PROBLEMS 9

Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity - Large strain visco-plasticity.

UNIT-IV TIME DEPENDENT AND DYNAMIC PROBLEMS 9

First-order systems - the diffusion equation - Explicit time integration – the Newmark method - Implicit time integration - Modal analysis and modal time integration.

UNIT-V STRUCTURAL ELEMENTS & INTERFACES AND CONTACT 9

Continuum Beams – Shells – Cohesive Zones - Enforcing constraints using penalty methods and Lagrange Multipliers - Contact elements (in two dimensions)

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the definition and basics on theory of elasticity

CO2: Derive the finite element method for static linear elasticity, solve problems.

CO3: Discuss the Non Linear and History depend problems, Solve problems.

CO4: Discuss time dependent and dynamic problems, solve problems.

CO5: Discuss Structural Elements & Interfaces and contact, solve problems.

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TEXT BOOKS:

1. L.S.Srinath, Advanced Mechanics Of Solids, 3rd Edition 2008.(0070139881 9780070139886).
2. J.N.Reddy, Introduction To Finite Element Method, 4th Edition 2020. (939038527X 9789390385270).

REFERENCE BOOKS:

1. The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution (Computational Fluid and Solid Mechanics)by Miguel Luiz Bucalem and Klaus-Jurgen Bathe | 25 February 2013
2. The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics)by Dominique Chapelle and Klaus-Jurgen Bathe | 27 January 2013
3. Inelastic Analysis of Solids and Structures (Computational Fluid and Solid Mechanics)by M. Kojic and Klaus-Jurgen Bathe | 22 October 2010
4. High-Resolution Methods for Incompressible and Low-Speed Flows (Computational Fluid and Solid Mechanics)by D. Drikakis and W. Rider | 22 October 2010
5. Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer (Computational Fluid and Solid Mechanics) by Ben Q. Li | 22 October 2010

E-RESOURCES:

1. https://ocw.mit.edu/courses/16-225-computational-mechanics-of-materials-fall-2003/
2. https://www.brown.edu/Departments/Engineering/Courses/En2340/
3. https://onlinecourses.nptel.ac.in/noc21_me121/preview

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	1	-	-	1	3	1	1
CO2	3	3	2	1	-	-	-	-	1	-	-	1	3	1	1
CO3	3	3	2	1	-	-	-	-	1	-	-	1	3	1	1
CO4	3	3	2	1	-	-	-	-	1	-	-	1	3	1	1
CO5	3	3	2	1	-	-	-	-	1	-	-	1	3	1	1
Avg	**3**	**3**	**2**	**1**	-	-	-	-	**1**	-	-	**1**	**3**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE72	COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the fluid flow simulation techniques and its mathematical behaviour
- Learn the Discretise 1D and 2D systems using finite difference and finite volume techniques
- Formulate diffusion –convection problems using finite volume method
- Study the flow field for different types of grids
- Learn the need for turbulence models and its types

UNIT-I INTRODUCTION 9

Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow – Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretisation and Numerical errors

UNIT-II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of solution, optimum step-size, Euler, Crank-Nickolson, and pure implicit methods, stability of schemes.

UNIT-III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis.

UNIT-IV FLOW FIELD ANALYSIS 9

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer.

UNIT-V TURBULENCE MODELLING 9

Turbulence model requirement and types, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Apply the fundamentals of CFD, and develop case specific governing equations.
- **CO2:** Discuss finite difference and finite volume based analysis for steady and transient diffusion problems.
- **CO3:** Implement various mathematical schemes under finite volume method for convention diffusion.
- **CO4:** Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.
- **CO5:** Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014 .
2. Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2017.

REFERENCE BOOKS:

1. John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, 2013.
2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.
3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.
4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.
5. Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2002.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104302/#:~:text=Intro-Computational%20Fluid%20Dynamics%20and%20Heat%20Transfer.%20Watch%20on.%20NPTEL%20provides
2. https://onlinecourses.nptel.ac.in/noc21_me126/preview#:~:text=Computational%20Fluid%20Dynamics.%20By%20Prof.%20Suman%20Chakraborty%20|%20IIT%20Kharagpur.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO2	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO3	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO4	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO5	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
Avg	**3**	**2**	**1**	**1**	-	-	-	-	**1**	-	-	**1**	**3**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE73	THEORY ON COMPUTATION AND VISUALIZATION	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the concepts and techniques of discrete mathematics for theoretical computer science.
- Learn different formal languages and their relationship.
- Classify and construct grammars for different languages and vice-versa.
- Study Visualization, Graphical and Quantitative Information.
- Learn Visualization design and data Ink.

UNIT-I REVIEW OF MATHEMATICAL THEORY 9

Sets, Functions, Logical statements, Proofs, Relations, Languages, Principal of Mathematical Induction, Strong Principle, Recursive Definitions, Structural Induction.

UNIT-II REGULAR LANGUAGES AND FINITE AUTOMATA 9

Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output – Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, union- intersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA, ??- Non Deterministic Finite Automata, Conversion of NFA- ? to NFA, Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.

UNIT-III CONTEXT FREE GRAMMAR (CFG) AND PUSHDOWN AUTOMATA 9

Definitions and Examples, Unions Concatenations And Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity , Unambiguous CFG and Algebraic Expressions, BacosNaur Form (BNF), Normal Form – CNF. Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.

UNIT-IV VALUE OF VISUALIZATION 9

Information Visualization, In Readings in Information Visualization, Graphical Excellence, Graphical Integrity, Sources of Graphical Integrity In The Visual Display of Quantitative Information

UNIT-V VISUALIZATION DESIGN 9

The Power of Representation, Data-Ink and Graphical Redesign, Data-Ink Maximization and Graphical Design, Data Density and Small Multiples

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Discussing the concepts and techniques of discrete mathematics for theoretical computer science.
- **CO2:** Explain the different formal languages and their relationship.
- **CO3:** Discussing to classify and construct grammars for different languages and vice-versa.
- **CO4:** Explaining the Visualization, Graphical and Quantitative Information.
- **CO5:** Appling the Visualization design and data Ink.

TEXT BOOKS:

1. Introduction to the Theory of Computation by Michael Sipser
2. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman

REFERENCE BOOKS:

1. Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill
2. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria& Sons
3. Introduction to computer theory By Deniel I. Cohen , Joh Wiley & Sons, Inc
4. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall.

E-RESOURCES:

1. https://www.youtube.com/playlist?list=PLUl4u3cNGP60_JNv2MmK3wkOt9syvfQWY
2. https://www.youtube.com/playlist?list=PL1QH9gyQXfgsUBfYUR0WirJASgif4pHVX

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO2	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO3	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO4	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
CO5	3	2	1	1	-	-	-	-	1	-	-	1	3	2	1
Avg	**3**	**2**	**1**	**1**	-	-	-	-	**1**	-	-	**1**	**3**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE74	COMPUTATIONAL BIO-MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduction of principles and concepts of bio-mechanics.
- Focuses on the studies of tissues and structure of musculoskeletal system.
- Study the mechanics of joints and human motion.
- Explain the computational approaches in biomechanics.
- Learn the quantification of forces and motion.

UNIT-I INTRODUCTION TO BIOMECHANICS 9

Perspective of biomechanics, Terminologies, Kinematic and kinetic concepts for analyzing human motion, Kinetic concepts for analyzing human motion, Linear kinetics of human movement, Equilibrium, Angular kinetics of human Movement, Mechanical properties of soft tissues, bones, and muscles

UNIT-II BIOMECHANICS OF TISSUES AND STRUCTURES OF THE MUSCULOSKELETAL SYSTEM 9

Biomechanics of Bone, Biomechanics of Articular Cartilage, Tendons and Ligaments, Peripheral Nerves and Spinal Nerve Roots, Skeletal Muscle

UNIT-III BIOMECHANICS OF JOINTS AND HUMAN MOTION 9

Knee, Hip, Foot and Ankle, Lumbar Spine, Cervical Spine, Shoulder, Elbow Wrist, and Hand, Linear kinematic and kinetic aspects of human movement, angular kinematic and kinetic aspects of human movement, equilibrium and human moment.

UNIT-IV COMPUTATIONAL APPROACHES IN BIOMECHANICS 9

Finite Element Analysis in Biomechanics, Computational modelling of Vancouver Periprosthetic Fracture in Femur, Scaffolds, artificial hip and knee joints, Aortic Valve.

UNIT-V GAIT ANALYSIS 9

Exoskeleton design, Ergonomics, Sports mechanics, Performance Analysis, Biomechanical analysis, 3D printing.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Discuss the principles of mechanics.
CO2:	Elaborate the tissues and structures of the musculoskeletal system
CO3:	Discuss of joint mechanics and human motion.
CO4:	Create Examples of computational mathematical modelling applied in biomechanics.
CO5:	Describe the analysis of human motion.

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TEXT BOOKS:

1. Susan J Hall, —Basic Biomechanics, 6th Edition, The McGraw-Hill Companies Inc., 2011
2. Jay D Humphrey and Sherry L Delange, —An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, 1st edition, Springer-Verlag, 2010

REFERENCE BOOKS:

1. Margareta Nordin and Victor H Frankel, —Basic Biomechanics of the Musculoskeletal System, 3rd Edition, Lippincott Williams and Wilkins, 2001.
2. Ozkaya, Nihat, Nordin, and Margareta, —Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, 2nd Edition, Springer, 2009.
3. Pritam Pain, Sreerup Banerjee, Goutam Kumar Bose , Advances in Computational Approaches in Biomechanics, 2022
4. Kinetics and Dynamics: From Nano- to Bio-Scale: 12 (Challenges and Advances in Computational Chemistry and Physics)by Piotr Paneth and Agnieszka Dybala-Defratyka | 12 August 2010
5. Computational Approaches to Biochemical Reactivity: 19 (Understanding Chemical Reactivity) by Gábor Náray-Szabó and Arieh Warshel | 31 March 2002

E-RESOURCES:

1. https://www.youtube.com/watch?v=3jMAtYxkbT4
2. https://www.google.co.in/books/edition/Computational_Modeling_in_Biomechanics/8Vii6lcp45EC?hl=en&gbpv=1&pg=PR8&printsec=frontcover

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	1	-	-	1	3	2	2
CO2	3	2	2	1	-	-	-	-	1	-	-	1	3	2	2
CO3	3	2	2	1	-	-	-	-	1	-	-	1	3	2	2
CO4	3	2	2	1	-	-	-	-	1	-	-	1	3	2	2
CO5	3	2	2	1	-	-	-	-	1	-	-	1	3	2	2
Avg	**3**	**2**	**2**	**1**	-	-	-	-	**1**	-	-	**1**	**3**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE75	ADVANCED STATISTICS AND DATA ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the basic concepts of linear regression and multiple regression
- Introduce exploratory data analysis
- Study logistic regression models for classification
- Develop the forecasting techniques for the predictions
- Introduce the time series analysis for the prediction of future behavior

UNIT-I REGRESSION 9

Introduction – Linear regression - Correlation analysis -Limitations, errors, and caveats of using regression and correlation analyses - Multiple regression and correlation analysis - Inferences about population parameters – Modeling techniques. - Coefficient of determination, Interpretation of regression coefficients, Categorical variables, heteroscedasticity, Multi-co linearity outliers, Ridge regression.

UNIT-II EXPLORATORY DATA ANALYSIS 9

Rise of statistics, Data Wrangling, Data Quality. Visual encoding – Mapping Data to Visual Variables, Encoding Effectiveness, Scales & Axes, Aspect Ratio, Regression Lines, Multidimensional Data, Parallel Coordinates, Dimensionality Reduction.

UNIT-III LOGISTIC AND MULTINOMIAL REGRESSION 9

Logistic function, Estimation of probability using Logistic regression, Variance, Wald Test, Hosmer Lemshow Test, Classification Table, Gini Co-efficient.

UNIT-IV FORECASTING AND CAUSAL MODELS 9

Moving average, Exponential Smoothing, Casual Models.

UNIT-V TIME SERIES ANALYSIS 9

Auto regression (AR), Moving Average(MA) Models, ARMA, ARIMA models , Multivariate Models

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Develop how to do regression fit for the given data.

CO2: Visualize the data through explanatory data analysis

CO3: Classify the given data through logistic regression

CO4: Analyzing forecasting techniques and causal inferences.

CO5: Utilize the effective time series analysis to predict/forecast the future behavior of data.

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TEXT BOOKS:

1. Douglas C Montgomery and George C Runges, "Applied Statistics and Probability for Engineers", John Wiley &Sons, 2014.
2. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulachi, "Introduction to Time Series Analysis and Forecasting" ,Wiley,2015

REFERENCE BOOKS:

1. David Forsyth, 'Probability and Statistics for Computer Science', Springer; 2018
2. Michael J. Evans, Jeffrey S. Rosenthal, 'Probability and Statistics - The Science of Uncertainty'. W H Freeman & Co, 2010
3. Max Kuhn, Kjell Johnson, "Applied Predictive Modeling", Springer, 2014.
4. Ronald E. Walpole, Raymond H. Meyers, Sharon L. Meyers, "Probability and Statistics for Engineers and Scientists", Pearson Education, 2014.
5. Daniel T. Larose, Chantal D. Larose "Data Mining and Predictive Analytics", Wiley,2015
6. Thomas W.Miller, "Modeling Techniques in Predictive Analytics with Python and R: A guide to Data Science", Pearson Education, 2014.

E-RESOURCES:

1. https://ocw.mit.edu/courses/15-075j-statistical-thinking-and-data-analysis-fall-2011/
2. https://www.coursera.org/courses?query=advanced%20statistics%20for%20data%20science

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	1	-	-	-	1	-	-	1	3	1	1
CO2	3	3	1	2	1	-	-	-	1	-	-	1	3	1	1
CO3	3	3	1	2	1	-	-	-	1	-	-	1	3	1	1
CO4	3	3	1	2	1	-	-	-	1	-	-	1	3	1	1
CO5	3	3	1	2	1	-	-	-	1	-	-	1	3	1	1
Avg	**3**	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE76	CAD AND CAE	L	T	P	C
		2	0	2	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Applying the fundamental concepts of computer graphics and its tools in a generic framework.
- Creating and manipulating geometric models using curves, surfaces, and solids.
- Applying concept of 3D modeling, visual realism,and CAD standard practices in engineering design
- Developing mathematical models for Boundary Value Problems and their numerical solution.
- Formulating solution techniques to solve non-linear problems

UNIT-I FUNDAMENTALS OF COMPUTER GRAPHICS 6

Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations - Graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation. Standards for computer graphics

UNIT-II GEOMETRIC MODELING 6

Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).

UNIT-III VISUAL REALISM and CAD STANDARDS 6

Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – coloring – computer animation.

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc.

UNIT-IV FINITE ELEMENT ANALYSIS 6

Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of Boundary Value Problems – Ritz Method – Finite Element Modelling – Element Equations – Linear and Higher order Shape functions – Bar, Beam Elements – Applications to Heat Transfer problems.

UNIT-V NON-LINEAR ANALYSIS 6

Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and visco-plasticity, stress stiffening, contact interfaces-problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate- Introduction to Analysis Software.

TOTAL : 30 PERIODS

CAD & CAE LABORATORY

Experiments

1. Design and animate Piston Cylinder assembly and motion study using CAD software.
2. Design and simulate Connecting rod and crank shaft using CAD software.
3. Design and simulate Two Cylinder Engine assembly using CAD software.

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4. Coupled Simulation of structural /thermal analysis
5. Harmonic, Transient and spectrum analysis of simple systems.
6. Buckling analysis

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the fundamental concepts of computer graphics and its tools in a generic framework.

CO2: Create and manipulate geometric models using curves, surfaces and solids.

CO3: Discuss concept of 3D modeling , visual realism and standard CAD practices in engineering design.

CO4: Develop the mathematical models for one dimensional finite element problems and their numerical solutions.

CO5: Formulate solution techniques to solve non-linear problems.

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
2. Seshu.P, "Textbook of Finite Element Analysis", PHI Learning Pvt. Ltd., NewDelhi, 2012.

REFERENCE BOOKS:

1. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc, 1992.
3. Foley, Wan Dam, Feiner and Hughes – "Computer graphics principles & practice", Pearson Education - 2003
4. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth-Heinemann,2018.
5. Reddy,J.N. "Introduction to the Finite Element Method", 4thEdition, Tata McGrawHill,2018.

E-RESOURCES:

1. https://www.youtube.com/playlist?list=PL2osCupAISlLPqpV-zQ5RNZ9dRNirWIkj

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	-	-	-	1	3	-	2	2	1	2
CO2	1	1	1	1	2	-	-	-	1	3	-	2	2	1	2
CO3	1	1	1	1	2	-	-	-	1	3	-	2	2	1	2
CO4	3	3	2	2	2	-	-	-	1	3	-	2	3	1	1
CO5	3	3	2	2	2	-	-	-	1	3	-	2	3	1	1
Avg	**1.8**	**1.8**	**1.4**	**1.4**	**2**	**-**	**-**	**-**	**1**	**3**	**-**	**2**	**2.4**	**1**	**1.6**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE77	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce basic machine learning techniques such as regression, classification
- Learn about introduction of clustering, types and segmentation methods
- Learn about fuzzy logic, fuzzification and defuzzification
- Learn about basics of neural networks and neuro fuzzy networks.
- Learn about Recurrent neural networks and Reinforcement learning.

UNIT-I INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT-II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT-III FUZZY LOGIC 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application

UNIT-IV NEURAL NETWORKS 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics

UNIT-V RNN AND REINFORCEMENT LEARNING 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand basic machine learning techniques such as regression, classification

CO2: Understand about clustering and segmentation

CO3: Model a fuzzy logic system with fuzzification and defuzzification

CO4: Understand the concepts of neural networks and neuro fuzzy networks.

CO5: Gain knowledge on Reinforcement learning.

TEXT BOOKS:

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011

REFERENCE BOOKS:

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2016 2nd Edition, Springer
2. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, delhi 2016.
3. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, Chichester, 2011, Sussex Wiley.

E-RESOURCES:

1. https://www.youtube.com/playlist?list=PLl8OlHZGYOQ7bkVbuRthEsaLr7bONzbXS

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	-	-	-	-	-	1	3	3	2	3
CO2	3	2	3	2	1	-	-	-	-	-	1	3	3	2	3
CO3	3	2	3	2	1	-	-	-	-	-	1	3	3	2	3
CO4	3	2	3	2	1	-	-	-	-	-	1	3	3	2	3
CO5	3	2	3	2	1	-	-	-	-	-	1	3	3	2	3
Avg	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**2**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE81	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the construction and working principle of various parts of an automobile.
- Study the practice for assembling and dismantling of engine parts and transmission system
- Study various transmission systems of automobile.
- Study about steering, brakes and suspension systems
- Study alternative energy sources

UNIT-I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, IC engines – components-functions and materials.

UNIT-II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system, Electronic ignition system, Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system.

UNIT-III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, propeller shaft, Differential and rear axle, Hotchkiss Drive.

UNIT-IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT-V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Electric and Hybrid Vehicles, Fuel Cell.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Recognize the various parts of the automobile and their functions and materials.

CO2: Discuss the engine auxiliary systems.

CO3: Distinguish the working of different types of transmission systems.

CO4: Explain the Steering, Brakes and Suspension Systems.

CO5: Predict possible alternate sources of energy for IC Engines.

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TEXT BOOKS:

1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 14th Edition 2019.

REFERENCE BOOKS:

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.
5. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/107/106/107106088/
2. https://onlinecourses.nptel.ac.in/noc21_de02/preview
3. https://www.youtube.com/channel/UCr9n57XbMVwDb-eLfgGB3IQ

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	-	-	-	-	1	-	-	1	1	2	1
CO2	2	1	2	1	-	-	-	-	1	-	-	1	1	2	1
CO3	2	1	2	1	-	-	-	-	1	-	-	1	1	2	1
CO4	2	1	2	1	-	-	-	-	1	-	-	1	1	2	1
CO5	2	1	2	1	-	-	-	-	1	-	-	1	1	2	1
Avg	**2**	**1**	**2**	**1**	-	-	-	-	**1**	-	-	**1**	**1**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE82	MEASUREMENTS AND CONTROLS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Identify measurement parameters and analyze errors of measurements.
- Select and apply suitable transducer for a particular measurement.
- Identify measurement parameters and select the appropriate sensor for it.
- Explain the working of various types of control systems of apply for specific applications.
- Apply the principle of automatic control systems to control various parameter(s).

UNIT-I MEASUREMENTS AND ERROR ANALYSIS 9

General concepts – Units and standards – Measuring instruments –sensitivity, readability, range, accuracy, precision – static and dynamic response – repeatability hysteresis – systematic and random errors –Statistical analysis of experimental data – Regression analysis – Curve fitting - calibration and Uncertainty.

UNIT-II INSTRUMENTS 9

Transducer, modifying (intermediate) and Terminal stages – Mechanical and electrical transducers, preamplifiers – charge amplifiers – filters – attenuators – D' Arsonval – CRO – Oscillographs – recorders – microprocessor- based data logging, processing and output

UNIT-III PARAMETERS FOR MEASUREMENT 9

Dimension, displacement, velocity, acceleration, Impact – Force, torque, power- Pressure, Temperature, Heat Flux, Heat Transfer Coefficients, Humidity – Flow – Velocity - Time, frequency and phase angle – noise and sound level.

UNIT-IV CONTROL SYSTEMS 9

Basic elements – feedback principle, implication of measurements – Error detectors – final actuating elements – Two position, multi-position, floating, proportional controls – relays – servo amplifiers – servo motors – Electrical, magnetic, electronic control systems

UNIT-V APPLICATION OF CONTROL SYSTEMS 9

Governing of speed, kinetic and process control – pressure, temperature, fluid level, flow-thrust and flight control – photo electric controls – designing of measurement and control systems for different applications

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Identify measurement parameters and analyze errors of measurements.
CO2:	Select and apply suitable transducer for a particular measurement.
CO3:	Identify measurement parameters and select the appropriate sensor for it.
CO4:	Explain the working of various types of control systems of apply for specific applications.
CO5:	Apply the principle of automatic control systems to control various parameter(s).

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TEXT BOOKS:

1. Venkateshan S P, Mechanical Measurements, 2ndEdition, John Wiley & Sons, Ltd, 2015.
2. William Bolton, Instrumentation and Control Systems, 2ndEdition, Newnes, 2015.

REFERENCE BOOKS:

1. Beckwith, Marangoni and Lienhard, Mechanical Measurements, Pearson, 2013.
2. Ernest Doebelin and DhaneshManik, Measurement Systems, McGraw Hill InternationalEdition, 2017.
3. Holman J P, "Experimental Methods for Engineers", McGraw Hill Int. Edition, 7th Ed., 2017.
4. Nagrath I J, "Control Systems Engineering", New Age International Publishers, 2018.
5. NakraB.C , and Chaudhry K.K, Instrumentation, Measurement, and Analysis, Tata McGraw Hill, 4th Edition, 2016.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107242/
2. https://archive.nptel.ac.in/courses/112/103/112103261/
3. https://www.youtube.com/playlist?list=PLm_MSClsnwm-neKtn3L0qndw95ukSfUlZ

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO2	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO3	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO4	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO5	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
Avg	**2**	**2**	**2**	**2**	-	-	-	-	**1**	-	-	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE83	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the various design requirements and get acquainted with the processes involved in product development.
- Study the design processes to develop a successful product.
- Learn scientific approaches to provide design solutions.
- Designing solution through relate the human needs and provide a solution.
- Study the principles of material selection, costing and manufacturing in design.

UNIT-I DESIGN TERMINOLOGY 9

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

UNIT-II INTRODUCTION TO DESIGN PROCESSES 9

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation

UNIT-III CREATIVITY IN DESIGN 9

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks- Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts

UNIT-IV HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT 9

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects

UNIT-V MATERIAL AND PROCESSES IN DESIGN 9

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly
(DFA).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Analyze the various design requirements and get acquainted with the processes involved ir product development.

CO2: Apply the design processes to develop a successful product.

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CO3: Apply scientific approaches to provide design solutions.

CO4: Design solution through relate the human needs and provide a solution.

CO5: Apply the principles of material selection, costing and manufacturing in design.

TEXT BOOKS:

1. Dieter. G. N., Linda C. Schmidt, "Engineering Design", McGraw Hill, 2013..
2. Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.

REFERENCE BOOKS:

1. Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co., 1998.
2. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, "Integrated Product and Process Design and Development", CRC Press, 2009.
3. James Garratt, "Design and Technology", Cambridge University Press, 1996.
4. Joseph E. Shigley, Charles R.Mische, and Richard G. Budynas, "Mechanical Engineering Design", McGraw Hill Professional, 2003.
5. Sumesh Krishnan and MukulSukla, Concepts in Engineering Design, Notion Press, 2016.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/107/103/107103002/
2. https://www.youtube.com/playlist?list=PLWsow9ACLonuM_ruYEx-J1wOjXKxF2tgH

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO2	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO3	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO4	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
CO5	2	2	2	2	-	-	-	-	1	-	-	1	2	1	1
Avg	**2**	**2**	**2**	**2**	-	-	-	-	**1**	-	-	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE84	COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the fundamentals of composite material strength and its mechanical behavior
- Study the analysis of fiber reinforced Laminate design
- Study Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
- Study and analysis for residual stresses in an isotropic layered structure such as electronic chips.
- Study the fundamentals of composite material strength

UNIT-I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 9

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes

UNIT-II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 9

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT-III LAMINA STRENGTH ANALYSIS 9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial Failure criterion. Prediction of laminate Failure

UNIT-IV THERMAL ANALYSIS 9

Assumption of Constant C.T. E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T. E's. C.T. E's for special Laminate Configurations –Unidirectional, Off- axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT-V ANALYSIS OF LAMINATED FLAT PLATES 9

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Summarize the various types of Fibers, Equations and manufacturing methods

CO2: Derive Flat plate Laminate equations

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CO3: Analyze Lamina strength

CO4: Analyze the thermal behavior of Composite laminates

CO5: Analyze Laminate flat plates

TEXT BOOKS:

1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw Hill, 1998

REFERENCE BOOKS:

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
2. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber," Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104229/
2. https://archive.nptel.ac.in/courses/112/104/112104249/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	-	2	2	-	-	-	-	2	3	-	-
CO2	2	2	2	2	-	2	2	-	-	-	-	2	3	-	-
CO3	2	2	2	2	-	2	2	-	-	-	-	2	3	-	-
CO4	2	2	2	2	-	2	2	-	-	-	-	2	3	-	-
CO5	2	2	2	2	-	2	2	-	-	-	-	2	3	-	-
Avg	**2**	**2**	**2.2**	**2.2**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / Mech

23MEE85	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Learn the basic concepts of different types of electrical machines
- Study the performance characteristics of D.C motors
- Study the methods of starting electrical motors
- Study the conventional and solid-state speed control of D.C. drives
- Study the conventional and solid-state speed control of A.C. drives

UNIT-I INTRODUCTION 9

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

UNIT-II DRIVE MOTOR CHARACTERISTICS 9

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors– Braking of Electrical motors – DC motors: Shunt, series, and compound - single phase and three phase induction motors.

UNIT-III STARTING METHODS 9

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phases quirrel cage and slip ring induction motors.

UNIT-IV CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF D.C. DRIVES 9

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

UNIT-V CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF A.C. DRIVES 9

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the basic concepts of different types of electrical machines and their performance

CO2: Explain the performance characteristics of D.C motors

CO3: Discuss the different methods of starting D.C motors and induction motors

CO4: Describe the conventional and solid-state speed control of D.C. drives

CO5: Explain the conventional and solid-state speed control of A.C. drives

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TEXT BOOKS:

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2006
2. VedamSubrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

REFERENCE BOOKS:

1. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2012
3. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.
4. Fundamentals Of Electric Drives And Controlby B.R. Gupta and V. Singhal | 1 January 2013
5. Advanced Electrical Drives - Analysis Modeling Controlby Rik De Doncker, Andre Veltman, et al. | 1 January 2014

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/108/104/108104140/
2. https://archive.nptel.ac.in/courses/108/102/108102146/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	1	-	-	1	2	1	1
CO2	2	1	1	-	-	-	-	-	1	-	-	1	2	1	1
CO3	2	1	1	-	-	-	-	-	1	-	-	1	2	1	1
CO4	2	1	1	-	-	-	-	-	1	-	-	1	2	1	1
CO5	2	1	1	-	-	-	-	-	1	-	-	1	2	1	1
Avg	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE86	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To impart the knowledge on boilers and steam power plant.
- To learn about the various components associated with steam power plant.
- To learn about the working of diesel and gas turbine power plant.
- To study the working of nuclear and Hydel power plant
- To provide the knowledge on power plants using renewable energy and economics of power plants.

UNIT-I INTRODUCTION TO POWER PLANTS AND BOILERS 9

Layout of Steam power plant - Components, Selection. Steam Boilers and Cycles - High Pressure and Super Critical Boilers, Fluidized Bed Boilers. Combined Power Cycles. Comparison and Selection.

UNIT-II STEAM POWER PLANT 9

Fuel and Ash Handling - Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, and Mechanical Collectors. Draught - different types. Surface Condenser types. Cooling Towers. Pollution controls.

UNIT-III DIESEL, GAS TURBINE POWER PLANTS 9

Layout of Diesel power plant - Components, Selection of Engine Type, applications. Gas Turbine Power Plant - Layout, Fuels, Gas Turbine Material. Open and Closed Cycles - Reheating, Regeneration and Intercooling.

UNIT-IV NUCLEAR AND HYDEL POWER PLANTS 9

Nuclear Energy - Fission, Fusion Reaction. Layout - Types of Reactors, Pressurized Water Reactor, Boiling Water Reactor, Waste Disposal and safety. Hydel Power Plant - Layout, Essential Elements, pumped storage. Selection of Turbines, Governing of Turbines.

UNIT-V OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS 9

Geo thermal power plant. Ocean thermal energy conversion (OTEC). Tidal power plant. Solar thermal power plant. Wind energy. Wind turbines. Magneto hydrodynamic generator (MHD). Cost of Electric Energy - Fixed and operating Costs, Economics of load sharing.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Apply the working principles of steam power plants and boilers towards their operational Processes.
CO2:	Analyze the functions of various systems within a steam power plant.
CO3:	Evaluate the working mechanisms of diesel and gas turbine power plants.
CO4:	Select suitable components for nuclear and hydel power plants based on their operational requirements

Chairman
BoS / Mech

CO5: Evaluate the economics of power plant operations towards the different sources of renewable energy.

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineeringby R.K. Rajput | 1 January 2016

REFERENCE BOOKS:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019
5. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

E-RESOURCES:

1. https://archive.nptel.ac.in/noc/courses/noc20/SEM1/noc20-me10/
2. https://archive.nptel.ac.in/courses/112/103/112103243/
3. https://archive.nptel.ac.in/courses/103/103/103103206/
4. https://archive.nptel.ac.in/courses/112/107/112107291/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	1	2	-	-	-	-	-	-	2	-
CO2	2	-	-	-	-	-	1	-	-	-	-	-	-	2	-
CO3	2	-	-	-	-	1	2	-	-	-	-	-	-	2	-
CO4	2	-	-	-	-	1	1	-	-	-	-	-	-	2	-
CO5	2	3	2	-	-	-	1	-	-	-	-	-	-	2	-
Avg	**2**	**2.5**	**2**	**1**	**-**	**1**	**1.4**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE87	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- Provide knowledge on design aspects of Vapour Compression Refrigeration.
- Study the Vapour absorption refrigeration systems.
- Learn the psychrometric properties and processes.
- Study the air conditioning systems and load estimation.

UNIT-I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT-II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system - problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT-III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic- Vortex and Pulse tube refrigeration systems.

UNIT-IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT-V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; calculation of summer & winter air conditioning load; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the basic concepts of Refrigeration

CO2: Explain the Vapor compression Refrigeration systems and to solve problems

CO3: Discuss the various types of Refrigeration systems

CO4: Calculate the Psychrometric properties and its use in psychrometric processes

CO5: Explain the concepts of Air conditioning and to solve problems

Chairman
BoS / Mech

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010
2. Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi | 10 February 2019

REFERENCE BOOKS:

1. ASHRAE Hand book, Fundamentals, 2010
2. JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4. Stoecker,W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.
5. A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput | 1 January 2013

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/105/112105129/
2. https://archive.nptel.ac.in/courses/112/107/112107208/
3. https://youtu.be/fcRR95Sy8_U?si=yuhpNMchG3n7kY7d

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	2	-	1	-	-	1	2	2	1
CO2	2	1	1	1	-	-	2	-	1	-	-	1	2	2	1
CO3	2	1	1	1	-	-	2	-	1	-	-	1	2	2	1
CO4	2	1	1	1	-	-	2	-	1	-	-	1	2	2	1
CO5	2	1	1	1	-	-	2	-	1	-	-	1	2	2	1
Avg	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**-**	**1**	**2**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE88	DYNAMICS OF GROUND VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Develop and utilize physical and mathematical models for predicting vehicle dynamics.
- Apply performance criteria in vehicle design to evaluate dynamic responses effectively
- Perform dynamic analyses to enhance vehicle design processes
- Evaluate and control longitudinal dynamics in automobiles, ensuring optimal performance systems
- Provide a comprehensive understanding of lateral dynamics principles in automotive

UNIT-I CONCEPT OF VIBRATION 9

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Base excitation. Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed

UNIT-II TYRES 9

Tyre axis system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance, Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tyres. Various test carried on a tyre.

UNIT-III VERTICAL DYNAMICS 9

Human response to vibration, Sources of Vibration. Suspension requirements – types. State Space Representation. Design and analysis of Passive, Semi active and Active suspension using Quarter car, Bicycle Model, half car and full car vibrating model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law. Suspension optimization techniques. Air suspension system and their properties.

UNIT-IV LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for different drive vehicles. Power limited acceleration and traction limited acceleration. Driveline dynamics. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

UNIT-V LATERAL DYNAMICS 9

Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics. Steering dynamics. Direction control of vehicles. Roll center, Roll axis. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Develop physical and mathematical models to predict the dynamic response of vehicles

CO2: Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response

CO3: Use dynamic analyses in the design of vehicles

CO4: Evaluate the longitudinal dynamics and control in an automobile

CO5: Understand the principle behind the lateral dynamics

TEXT BOOKS:

1. J. Y. Wong, "Theory of Ground Vehicles", Fourth Edition, Wiley-Interscience, 2008
2. Singiresu S. Rao, "Mechanical Vibrations," Fifth Edition, Prentice Hall, 2010

REFERENCE BOOKS:

1. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013
2. Hans B Pacejka, "Tyre and Vehicle Dynamics," Second edition, SAE International, 2005
3. John C. Dixon, "Tyres, Suspension, and Handling, " Second Edition, Society of Automotive Engineers Inc, 1996
4. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics",Elsevier Limited, 2004
5. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", Second edition, Springer, 2013

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/107/106/107106080/
2. https://www.youtube.com/watch?v=LZ82iANWBL0

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	-	2	2	3	-	3	2	2	2
CO2	3	3	3	3	3	3	-	2	2	3	-	3	2	2	2
CO3	3	3	3	3	3	3	-	2	2	3	-	3	2	3	3
CO4	3	2	2	2	2	2	-	2	1	3	-	3	2	3	3
CO5	3	3	3	3	3	3	-	2	2	3	-	3	2	3	3
Avg	**3**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**-**	**2**	**1.8**	**3**	**-**	**3**	**2**	**2.6**	**2.6**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE91	TURBO MACHINES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the energy transfer in rotor and stator parts of the turbo machines.
- Study the function of various elements of centrifugal fans and blowers.
- Evaluating the working and performance of centrifugal compressor
- Analyzing flow behavior and flow losses in axial flow compressor.
- Study the types and working of axial and radial flow turbines.

UNIT-I WORKING PRINCIPLES 9

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT-II CENTRIFUGAL FANS AND BLOWERS 9

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.

UNIT-III CENTRIFUGAL COMPRESSOR 9

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT-IV AXIAL FLOW COMPRESSOR 9

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

UNIT-V AXIAL AND RADIAL FLOW TURBINES 9

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the energy transfer in rotor and stator parts of the turbo machines.

CO2: Explain the function of various elements of centrifugal fans and blowers

CO3: Evaluate the working and performance of centrifugal compressor

CO4: Analyze flow behavior and flow losses in axial flow compressor

CO5: Explain the types and working of axial and radial flow turbines

Chairman
BoS / Mech

TEXT BOOKS:

1. Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011.
2. Yahya, S.M., "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2011.

REFERENCE BOOKS:

1. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7th Edition, Butterworth- Heinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., "Turbomachinery Performance Analysis" 1st Edition, Arnold Publisher, 1996.
4. Saravanamutto, Rogers, Cohen, Straznicky., "Gas Turbine Theory" 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104305/
2. https://www.youtube.com/watch?v=473XQrJjDZE

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO2	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO3	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO4	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
CO5	2	1	1	1	-	-	-	-	1	-	-	1	3	2	1
Avg	**2**	**1**	**1**	**1**	-	-	-	-	**1**	-	-	**1**	**3**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE92	NON-TRADITIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Classify non-traditional machining processes and describe mechanical energy based non- traditional machining processes.
- Differentiate chemical and electro chemical energy-based processes.
- Describe thermo-electric energy-based processes
- Explain nano finishing processes.
- Introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT-I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT-II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

UNIT-III THERMO-ELECTRIC ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

UNIT-IV NANO FINISHING PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.

UNIT-V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non- traditional machining processes.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.

CO2: Illustrate chemical and electro chemical energy based processes.

CO3: Evaluate thermo-electric energy based processes.

Chairman
BoS / Mech

CO4: Interpret nano finishing processes.

CO5: Analyse hybrid non-traditional machining processes and differentiate non-traditional machining processes.

TEXT BOOKS:

1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. AnandPandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCE BOOKS:

1. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. GolamKibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
4. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_me154/preview
2. https://www.youtube.com/watch?v=PaYInS9axxw&list=PLzCSUZGIUJkaSyCzPiQMWynGyxmC8hrpl

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	1	-	1	-	1	1	-	1	2	2	2
CO2	3	-	1	-	1	-	1	-	1	1	-	1	2	2	2
CO3	3	-	1	-	1	-	1	-	1	1	-	1	2	2	2
CO4	3	-	2	-	1	-	1	-	1	1	-	1	2	2	2
CO5	3	-	3	-	3	-	1	-	1	1	-	1	3	3	3
Avg	**3**	**-**	**1.6**	**-**	**1.4**	**-**	**1**	**-**	**1**	**1**	**-**	**1**	**2.2**	**2.2**	**2.2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE93	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the fundamental concept and principles of industrial safety
- Study the principles of maintenance engineering.
- Analyzing the wear and its reduction.
- Study the faults in various tools, equipments and machines.
- Study the periodic maintenance procedures in preventive maintenance.

UNIT-I INDUSTRIAL SAFETY 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II MAINTENANCE ENGINEERING 9

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

UNIT-III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V PERIODIC AND PREVENTIVE MAINTENANCE 9

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, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:i. Machine tools, ii. Pumps, iii. Air compressors,iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the fundamental concept and principles of industrial safety

CO2: Apply the principles of maintenance engineering

CO3: Analyze the wear and its reduction

CO4: Evaluate faults in various tools, equipments and machines

CO5: Apply periodic maintenance procedures in preventive maintenance

TEXT BOOKS:

1. L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005.
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

REFERENCE BOOKS:

1. Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
2. Garg, HP, Maintenance Engineering, S. Chand Publishing.
3. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia,Springer, 2017.
4. R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.
5. W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_mg43/preview
2. https://www.youtube.com/watch?v=FGa0FVkgJDA

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO2	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO3	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO4	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO5	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
Avg	**2**	**1**	**2**	-	-	**2**	**1**	-	-	-	-	**1**	**1**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEE94	THERMAL POWER ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the fuel properties and arrive at proximate and ultimate analysis of fuels.
- Study the different types of boilers and compute their performance parameters.
- Study the performance parameters of an air compressor
- Study the working principles of various refrigeration systems and perform cop calculations
- Study the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads

UNIT-I FUELS AND COMBUSTION 9

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values

UNIT-II BOILERS 9

Types and comparison, Mountings and Accessories. Performance calculations, Boiler trial.

UNIT-III AIR COMPRESSORS 9

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors

UNIT-IV REFRIGERATION SYSTEMS 9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration.

UNIT-V PSYCHROMETRY AND AIR-CONDITIONING 9

Psychrometric properties – Property calculations using Psychrometric chart. Psychrometric processes –concept of RSHF, GSHF and ESHF, Cooling loadcalculations. Cooling towers – concept and types.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Evaluate the fuel properties and arrive at proximate and ultimate analysis of fuels.
CO2:	Analyze different types of boilers and compute their performance parameters
CO3:	Evaluate the performance parameters of an air compressor
CO4:	Apply the working principles of various refrigeration systems and perform cop calculations
CO5:	Analyze the psychrometric properties and how they are utilized in arriving at

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calculations to determine heating loads

TEXT BOOKS:

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ballaney. P, " Thermal Engineering", 25th Edition, Khanna Publishers, 2017

REFERENCE BOOKS:

1. Ananthanarayanan P.N, "Basic Refrigeration and Air-Conditioning", 4th Edition, Tata McGraw Hill, 2013.
2. Arora, "Refrigeration and Air-Conditioning", 2nd Edition, Prentice Hall of India, 2010.
3. Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
4. Nag P.K, " Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill, 2010
5. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011

E-RESOURCES:

1. https://www.nitt.edu/home/academics/departments/mech/programmes/mtech/thermalpower
2. https://en.wikipedia.org/wiki/Thermal_engineering

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	-	1	-	-	1	2	1	1
CO2	3	2	1	1	-	-	-	-	1	-	-	1	2	1	1
CO3	3	1	1	1	-	-	-	-	1	-	-	1	2	1	1
CO4	3	2	1	1	-	-	-	-	1	-	-	1	2	1	1
CO5	3	1	1	1	-	-	-	-	1	-	-	1	2	1	1
Avg	**3**	**1.4**	**1**	**1**	-	-	-	-	**1**	-	-	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE95	DESIGN OF TRANSMISSION SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- Understand the standard procedure available for Design of Transmission of Mechanical elements spur gears and parallel axis helical gears.
- Learn the design bevel, worm gears of Transmission system.
- Learn the concepts of design multi and variable speed gear box for machine tool applications.
- Learn the concepts of design to cams, brakes and clutches

(Use of P S G Design Data Book permitted)

UNIT-I DESIGN OF FLEXIBLE ELEMENTS 9

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT-II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.

UNIT-III BEVEL AND WORM GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT-IV GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT-V CAMS, CLUTCHES AND BRAKES 9

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses.Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Apply the concepts of design to belts, chains and rope drives.

CO2: Apply the concepts of design to spur, helical gears

CO3: Apply the concepts of design to worm and bevel gears

CO4: Apply the concepts of design to gear boxes.

CO5: Apply the concepts of design to cams, brakes and clutches

TEXT BOOKS:

1. Bhandari V, "Design of Transmission Elements",, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCE BOOKS:.

1. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
2. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley,2005
4. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", AnuradhaPublications,Chennai, 2003.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_me71/preview
2. https://www.youtube.com/watch?v=1kWtZKvfD4&list=PL8EJqJaNKpjXm5xk16x7SzlddsFk3diRH

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1					1			1	2	3	2
CO2	3	2	3	1					1			1	2	3	2
CO3	3	2	3	1					1			1	2	3	2
CO4	3	2	3	1					1			1	2	3	2
CO5	3	2	3	1					1			1	2	3	2
Avg	**3**	**2**	**3**	**1**	-	-	-	-	**1**	-	-	**1**	**2**	**3**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEE96	DESIGN FOR MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce economic process selection principles and general design principles. Also, apply design consideration principles of casting in the design of cast products.
- Learn design consideration principles of forming in the design of extruded, stamped, and forged products.
- Learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- Learn design consideration principles of welding in the design of welded products.
- Learn design consideration principles of assembly in the design of assembled products.

UNIT-I INTRODUCTION AND CASTING 9

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.

UNIT-II FORMING 9

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts.

UNIT-III MACHINING 9

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.

UNIT-IV WELDING 9

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment& heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash &Upset weldment.

UNIT-V ASSEMBLY 9

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Discuss the economic process selection principles and general design principles. Also, apply design consideration principles of casting in the design of cast products.
CO2:	Explain design consideration principles of forming in the design of extruded, stamped, and forged products
CO3:	Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products
CO4:	Explain design consideration principles of welding in the design of welded products

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CO5: Explain design consideration principles of assembly in the design of assembled products.

TEXT BOOKS:

1. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill, 1986.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCE BOOKS:

1. CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for LowCost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Henry Peck, "Designing for Manufacture", Sir Isaac Pitman & Sons Ltd., 1973.
5. Matousek, "Engineering Design", Blackie & Sons, 1956.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/101/112101005/
2. https://www.youtube.com/watch?v=NT8o5Bo8M2E
3. https://www.youtube.com/watch?v=igWfQpxI100

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	-	-	-	-	1	2	2	1
CO2	3	3	3	1	-	-	-	-	-	-	-	1	2	2	1
CO3	3	3	3	1	-	-	-	-	-	-	-	1	2	2	1
CO4	3	3	3	1	-	-	-	-	-	-	-	1	2	2	1
CO5	3	3	3	1	-	-	-	-	-	-	-	1	2	2	1
Avg	**3**	**3**	**3**	**1**	-	-	-	-	-	-	-	**1**	**2**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
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23MEE97	POWER GENERATION EQUIPMENT DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the power generation equipments types layouts working cycles.
- Learn the fuels, combustion and burning methods of combustion system.
- Study the various boilers and its boilers parts of steam power plant.
- Study the basics of nuclear fuels and reactor classification.
- Study of techno economics and operating cost and safety of power plant.

UNIT-I INTRODUCTION 9

Introduction to types, layouts and working cycles - Layouts of diesel-electric, hydro-electric, nuclear, gas turbine, steam, cogeneration, MHD and other power plants - Site selection - Reheat and regenerative steam cycles - Binary vapour cycle - Combined cycle - Topping cycle - Power plant instrumentation and control - air flow, furnace pressure, steam temperature control system - Governing system - Steam turbine.

UNIT-II COMBUSTION SYSTEM 9

Fuels, combustion and burning methods - Fuel classification - Solid, liquid and gaseous - Compositions and heating values - Classification of coal - Combustion process, atmosphere and control - ESP Furnace construction - Stokers - suspension firing - pulverised fuel firing - oil and gas burners and systems - Fuel control - Burner management system - FSSS - Ash handling system.

UNIT-III STEAM POWER PLANT 9

Steam generators - fire tube, water tube, forced circulation, once through, super charged, super critical, Lamont, Loeffler, Schmide, Hortmen and Velox boilers, Fluidised Bed & Circulated Fluidised Bed boilers - Natural, artificial, balanced and steam jet drafts - Simple problems - Functions of super heaters, economisers, air-heaters, deaerators, feed heaters, air ejectors - Feed pumps - Injectors - Feed water control- Condensers – Jet and surface type - Simple problems - Cooling towers.

UNIT-IV NUCLEAR POWER PLANT 9

Nuclear power plant - Basics of nuclear fuels - Fission and chain reaction - Reactor classification - Boiling water, pressurised water, homogeneous, gas cooled breeding and metal cooled

UNIT-V TECHNO ECONOMICS OF POWER PLANT 9

Economics and safety - Actual load curves - Fixed and operating costs - Tariff methods for electrical energy - Peak load and variable load operations - Selection of generation type and general equipment. Introduction to safety aspects in power plants - Environmental impacts - assessment for thermal power plant.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss the power generation equipment's types layouts working cycles.

CO2: Explain the fuels, combustion and burning methods of combustion system

CO3: Discuss the various boilers and its boilers parts of steam power plant

CO4: Explain the basics of nuclear fuels and reactor classification

CO5: Discuss of techno economics and operating cost and safety of power plant.

TEXT BOOKS:

1. Power Plant Engineering - PK Nag
2. A Textbook of Power Plant Engineering - Rajput

REFERENCE BOOKS:

1. Basics of Boiler and HRSG Design - Brad Buecker
2. Steam Plant Operation-Everett B. Woodruff,Herbert B. Lammers,Thomas F. Lammers
3. Nuclear Power Plant Design and Analysis Codes Development Validation and Application 2020 Edition by Jun Wang, Xin Li, Chris Allison, Judy Hohorst , Elsevier
4. A Techno-Economic Analysis of Solar Thermal Power Plant by Malik Monu and Saini R P | 8 November 2012
5. Power Plant Engineering by DilipVairagkar | 1 January 2019

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107291/
2. https://www.youtube.com/watch?v=olpOTwq4Rz0

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	2	-	1	-	-	1	1	2	2
CO2	2	1	1	1	-	-	2	-	1	-	-	1	1	2	2
CO3	2	1	1	1	-	-	2	-	1	-	-	1	1	2	2
CO4	2	1	1	1	-	-	2	-	1	-	-	1	1	2	2
CO5	2	1	1	1	-	-	2	-	1	-	-	1	1	2	2
Avg	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEEX1	ADVANCED VEHICLE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students:

- To introduce the basic concepts of electric vehicle and their characteristics
- To introduce different types of motors and the selection of motor for vehicle applications.
- To acquaint with different sensors and systems used in autonomous and connected vehicles.
- To give an overview of networking with sensors and systems.
- To introduce the modern methods of diagnosing on-board the vehicle troubles.

UNIT-I ELECTRIC VEHICLES 9

EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.

UNIT-II ELECTRIC VEHICLE MOTORS 9

Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, Characteristics, Performance and control of Drives.

UNIT-III AUTONOMOUS AND CONNECTED VEHICLES 9

Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System.

UNIT-IV AUTOMOTIVE NETWORKING 9

Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.

UNIT-V ON-BOARD TESTING 9

Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring, Introduction to Cyber-physical system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Acquire an overview of electric vehicles and their importance in automotive.
CO2:	Discuss the characteristics and the selection of traction motor.
CO3:	Comprehend the vehicle-to-vehicle and autonomous technology.
CO4:	Explain the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
CO5:	Be familiar with on-board diagnostics systems.

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TEXT BOOKS:

1. John G Hayes and G Abaas Goodarzi, Electric Powertrain -, 1st Edition, John Wiley & Sons Ltd., 2018
2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities,CRC Press, 1st Edition, 2020.

REFERENCE BOOKS:

1. Hong Cheng, —Autonomous Intelligent Vehicles: Theory, Algorithms &
2. Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science,
3. Engineering and Technology: Congressional Policies, Practices and Procedures by Andrew M Wright and Harrison R Scott | 5 September 2012
4. Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT | 17 July 2002
5. Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey | 1 September 2011

E-RESOURCES:

1. https://nptel.ac.in/courses/108106170
2. https://www.youtube.com/watch?v=HfN5dEeUyuE

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	2	-	1	-	-	1	1	2	1
CO2	2	1	1	1	-	-	2	-	1	-	-	1	1	2	1
CO3	2	1	1	1	-	-	2	-	1	-	-	1	1	2	1
CO4	2	1	1	1	-	-	2	-	1	-	-	1	1	2	1
CO5	2	1	1	1	-	-	2	-	1	-	-	1	1	2	1
Avg	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**-**	**1**	**1**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
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23MEEX2	ADVANCED INTERNAL COMBUSTION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students:

- To study the working of Gasoline fuel injection systems and SI combustion.
- To study the working of Diesel fuel injection systems and CI combustion.
- To Identifying the source and measure it; explain the mechanism of emission formation and control methods.
- To study the Selecting alternative fuel resources and its utilization techniques in IC engines.
- To study the advanced combustion modes and future power train systems.

UNIT-I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.

UNIT-II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.

UNIT-III EMISSION FORMATION AND CONTROL 9

Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.

UNIT-IV ALTERNATIVE FUELS 9

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel -Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.

UNIT-V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM 9

Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles –- Fuel Cells.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the working of Gasoline fuel injection systems and SI combustion.

CO2: Explain the working of Diesel fuel injection systems and CI combustion.

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CO3: Identify the source and measure it; explain the mechanism of emission formation and control methods.

CO4: Select alternative fuel resources and its utilization techniques in IC engines.

CO5: Explain advanced combustion modes and future power train systems.

TEXT BOOKS:

1. V. Ganesan, "Internal Combustion Engines", V Edition, Tata McGraw Hill, 2012.
2. John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill, 1988.

REFERENCE BOOKS:

1. B.P. Pundir, "IC Engines Combustion & Emission", Narosa Publishing House, 2014.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, Inc., 2003.
3. EranSher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control,
4. K.K. Ramalingam, "Internal Combustion Engine Fundamentals", SciTech Publications, 2011.
5. R.B. Mathur and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai& Sons, 2007

E-RESOURCES:

1. https://www.iust.ac.ir/files/mech/ayatgh_c5664/files/internal_combustion_engines_heywood.pdf
2. https://www.youtube.com/watch?v=xTtiBmguhFQ

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2	3	-	1	-	-	3	3	2	2
CO2	3	2	2	1	1	2	3	-	1	-	-	3	3	2	1
CO3	3	2	2	2	2	2	3	-	1	-	-	3	2	3	1
CO4	2	1	2	1	2	2	3	-	1	-	-	3	2	3	1
CO5	3	1	1	1	2	2	2	-	1	-	-	3	2	3	1
Avg	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**-**	**1**	**-**	**-**	**3**	**2**	**3**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEEX3	CASTING AND WELDING PROCESSES	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students:

- To study the ferrous casting metallurgy and its applications.
- To study the nonferrous casting metallurgy and its applications.
- To study the ferrous welding metallurgy and its applications.
- To study the welding metallurgy of alloy steels and nonferrous metals and its applications
- To Identifying the causes and remedies of various welding defects; applying welding standards and codes.

UNIT-I FERROUS CAST ALLOYS 9

Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size- Super cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure-Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions-Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels- low alloy steels - stainless steels- composition control- slag-metal reactions-desulphurization- dephosphorization

UNIT-II NON-FERROUS CAST ALLOYS 9

Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys- problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings

UNIT-III PHYSICAL METALLURGY OF WELDING 9

Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.

UNIT-IV WELDING OF ALLOY STEELS AND NON-FERROUS METALS 9

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions

UNIT-V DEFECTS, WELDABILITY AND STANDARDS 9

Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the ferrous casting metallurgy and its applications.

CO2: Explain the non ferrous casting metallurgy and its applications.

CO3: Explain the ferrous welding metallurgy and its applications.

CO4: Explain the welding metallurgy of alloy steels and non ferrous metals and its applications.

CO5: Identify the causes and remedies of various welding defects; apply welding standards and codes.

TEXT BOOKS:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2017.
2. A.K.Chakrabarthi, 'Casting Technology and Cast Alloys,Prentice Hall, 2005.

REFERENCE BOOKS:

1. ASM International. Handbook Committee, ASM Handbook: Casting. Volume 15, ASM International, 2008.
2. Baldev Raj, Shankar V, Bhaduri A K, "Welding Technology for Engineers", Narosa Publications, 2009.
3. Beeley P, "Foundry Technology" Butterworth-Heinemann, 2001.
4. R.S.Parmar, 'Welding Engineering and Technology', Khanna Publishers, 2010
5. John Campbell, "Casting", Butterworth-Heinemann, 2003.

E-RESOURCES:

1. https://archive.org/details/principlesofmeta0000hein
2. https://www.refcoat.com/pdf/book-on-metal-casting.pdf
3. https://digimat.in/nptel/courses/video/112107215/L01.html

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	-	-	-	-	1	-	-	1	2	1	1
CO2	1	1	2	2	-	-	-	-	1	-	-	1	2	1	1
CO3	1	1	2	2	-	-	-	-	1	-	-	1	2	1	1
CO4	1	1	2	2	-	-	-	-	1	-	-	1	2	1	1
CO5	1	1	2	2	-	-	-	-	1	-	-	1	2	1	1
Avg	**1**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / Mech

23MEEX4	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Introduce the process planning concepts to make cost estimation for various products after process planning
- Learn the various Process Planning Activities
- Provide the knowledge of importance of costing and estimation.
- Provide the knowledge of estimation of production costing.
- Learn the knowledge of various Machining time calculations

UNIT-I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection

UNIT-II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT-III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation – Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges.

UNIT-IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT-V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Discuss select the process, equipment and tools for various industrial products.

CO2: Explain the prepare process planning activity chart.

CO3: Explain the concept of cost estimation.

CO4: Compute the job order cost for different type of shop floor.

CO5: Calculate the machining time for various machining operations.

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TEXT BOOKS:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, 2003.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCE BOOKS:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2025.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2017.
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 2017.

E-RESOURCES:

1. https://www.youtube.com/watch?v=Om24w_EcWlE
2. https://www.youtube.com/watch?v=ohJiTqRCaac

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	1	-	1	1	2	1	1
CO2	3	3	2	1	-	-	-	-	1	-	1	1	2	1	1
CO3	3	3	2	2	-	-	-	-	1	-	1	1	2	1	1
CO4	3	3	2	2	-	-	-	-	1	-	1	1	2	1	1
CO5	3	3	2	2	-	-	-	-	1	-	1	1	2	1	1
Avg	**3**	**3**	**2**	**2**	-	-	-	-	**1**	-	**1**	**1**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEEX5	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the fundamentals of surface features and different types of friction associated with metals and non-metals
- Study the different types of wear mechanism and its standard measurement.
- Study the different types of corrosion and its preventive measures
- Study the different types of surface properties and surface modification techniques
- Study the various types of materials used in the friction and wear applications

UNIT-I SURFACES AND FRICTION 9

Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT-II WEAR 9

Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements

UNIT-III CORROSION 9

Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors

UNIT-IV SURFACE TREATMENTS 9

Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy –Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nano- engineered coatings – Other coatings, Corrosion resistant coatings

UNIT-V ENGINEERING MATERIALS 9

Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Describe the fundamentals of surface features and different types of friction associated with metals and non-metals

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CO2: Analyze the different types of wear mechanism and its standard measurement.

CO3: Analyze the different types of corrosion and its preventive measures

CO4: Analyze the different types of surface properties and surface modification techniques

CO5: Analyze the various types of materials used in the friction and wear applications.

TEXT BOOKS:

1. G.W.Stachowiak and A.W.Batchelor, "Engineering Tribology", Butterworth-Heinemann, 2005.
2. S.K.Basu, S.N.Sengupta and B.B.Ahuja , "Fundamentals of Tribology", Prentice Hall of India, 2005.

REFERENCE BOOKS:

1. Fontana G., "Corrosion Engineering", McGraw Hill, 1985.
2. Halling, J. (Editor), "Principles of Tribology ", MacMillian, 1984.
3. Rabinowicz.E., "Friction and Wear of materials", John Willey &Sons,1995.
4. Williams J.A., "Engineering Tribology", Oxford University Press, 1994.
5. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

E-RESOURCES:

1. https://drive.google.com/file/d/1ZoGt9FZvW-XfS1z_eQWweSX92gZGuT0b/view
2. https://archive.nptel.ac.in/courses/112/107/112107248/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	-	-	2	1	-	-	2	3	2	1
CO2	2	2	2	2	2	-	-	2	1	-	-	2	3	2	1
CO3	1	2	2	2	2	-	-	2	1	-	-	2	2	3	1
CO4	1	2	2	2	3	-	-	2	1	-	-	2	2	3	1
CO5	1	1	2	2	1	-	-	2	1	-	-	3	1	2	1
Avg	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**2**	**1**	**-**	**-**	**2**	**2**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEEX6	PRECISION MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students:

- To study the need, significance and progress of precision manufacturing and the different levels of manufacturing.
- To study the principle and working of different methods of precision machining.
- To study the special construction requirements of precision machine tools.
- To study the errors involved in precision machine tools and calculate the error budgets for a given situation.
- To study the Selecting a suitable measurement solution to measure and characterize precision machined features.

UNIT-I PRECISION ENGINEERING 9

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.

UNIT-II PRECISION MACHINING 9

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro- milling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.

UNIT-III MACHINE DESIGN FOR PRECISION MANUFACTURING 9

Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.

UNIT-IV MECHANICAL AND THERMAL ERRORS 9

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

UNIT-V MEASUREMENT AND CHARACTERISATION 9

Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nano features. Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.

CO2: Explain the principle and working of different methods of precision machining.

CO3: Explain the special construction requirements of precision machine tools.

CO4: Explain the errors involved in precision machine tools and calculate the error budgets for a given situation

CO5: Select a suitable measurement solution to measure and characterize precision machined features.

TEXT BOOKS:

1. Jain, V.K., Introduction to micromachining, Narosa publishers, 2018
2. Venktesh V.C., Sudinlzman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2007.

REFERENCE BOOKS:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.
2. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
3. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
4. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
5. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107078/
2. https://download.e-bookshelf.de/download/0000/0017/12/L-G-0000001712-0002332134.pdf

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	1	-	-	1	2	2	1
CO2	2	2	2	2	2	-	-	-	1	-	-	1	2	2	1
CO3	2	2	2	2	2	-	-	-	1	-	-	1	2	2	1
CO4	2	2	2	2	2	-	-	-	1	-	-	1	2	2	1
CO5	2	2	2	2	2	-	-	-	1	-	-	1	2	2	1
Avg	**2**	**2**	**2**	**2**	**2**	-	-	-	**1**	-	-	**1**	**2**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEEX7	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Study the fundamentals of compressible flow concepts and the use of gas tables.
- Learn the compressible flow behaviour in constant area ducts.
- Study the development of shock waves and its effects.
- Study the types of jet engines and their performance parameters.
- Learn the types of rocket engines and their performance parameters.

UNIT-I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

UNIT-II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.

UNIT-III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

UNIT-IV JET PROPULSION 9

Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

UNIT-V SPACE PROPULSION 9

Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Apply the fundamentals of compressible flow concepts and the use of gas tables.
- **CO2:** Analyze the compressible flow behaviour in constant area ducts.
- **CO3:** Analyze the development of shock waves and its effects.
- **CO4:** Explain the types of jet engines and their performance parameters.
- **CO5:** Explain the types of rocket engines and their performance parameters.

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TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.
2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

REFERENCE BOOKS:

1. R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", 2nd edition, Wiley, 2011.
2. Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", Prentice-Hall of India, 2007.
3. Radhakrishnan, E., "Gas Dynamics", Printice Hall of India, 2006.
4. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965.
5. Babu, V., "Fundamentals of Compressible Flow", CRC Press, 1st Edition, 2008.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106166/
2. https://drive.google.com/file/d/1OljFuYcFl3bnCKuKyuZooB9Op_-ulas3/view

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	1	-	-	1	3	1	2
CO2	3	2	1	1	-	-	-	-	1	-	-	1	3	1	2
CO3	3	2	1	1	-	-	-	-	1	-	-	1	3	1	2
CO4	3	2	1	1	-	-	-	-	1	-	-	1	3	1	2
CO5	3	2	1	1	-	-	-	-	1	-	-	1	3	1	2
Avg	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**3**	**1**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEEX8	OPERATIONAL RESEARCH	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Learn the constraints on the availability of resources and developing a model and rendering an optimal solution for the given circumstances.
- Study the challenges in the transportation and production problems and furnishing a rational solution to maximize the benefits.
- Learn the purchase/ manufacturing policies, managing the spares/ stocks and meeting the customer demands.
- Analyzing the queue discipline and exploring the avenues for better customer service.
- Investigating the nature of the project and offering methodical assistance towards decision making in maintenance.

UNIT-I INTRODUCTION TO OPERATIONS RESEARCH AND LINEAR PROGRAMMING 9

Operation Research: Definition – Models – Steps – Important topics – Scope - Tools. Linear Programing (LP): Introduction – Concept (Problem mix, Assumption, Properties) – Development (Problem formulation) – Problems in: Graphical method, Simplex methods, Big M method.

UNIT-II TRANSPORTATION, ASSIGNMENT AND PRODUCTION SCHEDULING PROBLEMS 9

Transportation problems: Introduction, Model, Types – Problems in: Initial Basic (feasible) solution: Northwest Corner Cell method; Least Cost Cell method; Vogel's Approximation method and Optimal solution MODI (U-V) method. Assignment problems: Introduction, Types, Problems in Hungarian method. Production Scheduling problems: Introduction – Problems in Single Machine Scheduling: SPT; WSPT, EDD methods – Problems in Johnson's Algorithm: n job 2 machines, n job 3 machines.

UNIT-III INVENTORY CONTROL MODELS & SYSTEMS 9

Inventory Control: Introduction, Models – Problems in Purchase and Production (Manufacturing) models with and without shortages – Theory on types of inventory control systems: P& Q, ABC, VED, FNS, XYZ, SDE and HML.

UNIT-IV QUEUING THEORY 9

Queuing Theory: Introduction; Applications; Terminology, Poisson process and exponential distribution – Problems in Single Server and Multi Server Queuing Models –Case study on simulation using Monte Carlo technique.

UNIT-V PROJECT MANAGEMENT AND REPLACEMENT MODELS 9

Project Management: Introduction; Guidelines for Networking AOA Diagrams – Problems in Critical Path Method (CPM) & Program Evaluation Review Technique (PERT) – Differences of CPM & PERT. Replacement Problems: Types – Problems in: Determination of Economic Life of an Asset – Problems in: Individual and Group Replacement Policies , Apply OR software

TOTAL : 45 PERIODS

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BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

- **CO1:** Discuss the selection of the constraints on the availability of resources, develop a model and render an optimal solution for the given circumstances.
- **CO2:** Explain the appraise the challenges in the transportation and production problems and furnish a rational solution to maximize the benefits.
- **CO3:** Explain plan the purchase/ manufacturing policies, manage the spares/ stocks, and meet the customer demands.
- **CO4:** Analyze the queue discipline and explore the avenues for better customer service.
- **CO5:** Investigate the nature of the project and offer methodical assistance towards decision making in maintenance.

TEXT BOOKS:

1. Pannerselvam R, "Operations Research", 2nd Edition, PHI, 2009.
2. Hamdy A. Taha, "Operations Research an Introduction", 10th Edition, PHI/Pearson Education, 2017.

REFERENCE BOOKS:

1. Ravindran, Phillips and Solberg, "Operations Research Principles and Practice", 2nd Edition, Wiley India, 2007.
2. Srinivasan G, "Operations Research Principles and Applications", 3 rd Edition EEEPHI, 2017.
3. Sharma J K, "Operations Research Theory and Applications",5th Edition, Macmillan India, 2013.
4. Premkumar Gupta and D.S.Hira, "Problems in Operations Research", S.Chand,2009.
5. Wayne L. Winston, "Operations Research Applications and Algorithms", 4th Edition, Cengage Learning, 2004.

E-RESOURCES:

1. https://nptel.ac.in/courses/110106062

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO2	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO3	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO4	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO5	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
Avg	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23CEO11 **CIVIL AND INFRASTRUCTURE ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand basic of civil engineering.
- To know methods and techniques used in civil engineering.
- To examine the various components in building structures.
- To know the planning and design aspects of Infrastructure services.
- To gain knowledge about the various Infrastructure services.

UNIT-I **INTRODUCTION** **9**

Introduction to Civil Engineering – Various disciplines of Civil engineering, Importance of Civil engineering in infrastructure development of the country. Introduction to types of buildings as per NBC, Selection of site for buildings, Components of a residential building and their functions, Introduction to Industrial buildings and types. Building Planning – Basic requirements, elements, introduction to various building area terms, computation of plinth area, carpet area.

UNIT-II **METHODS AND TECHNIQUES** **9**

Surveying – Principle and objectives, Instruments used, Horizontal measurements, Ranging (direct ranging only), Instruments used for ranging, Leveling – Definition, Principles, Instruments, Preparation of level book, Modern surveying instruments – EDM, Total station, GPS (Brief discussion) Building Materials – Bricks, properties and specifications, Cement – Types, properties, grades, other types of cement and uses, Cement mortar – Constituents, Preparation, Concrete – PCC and RCC, Grades, Steel – Use of steel in buildings, types

UNIT-III **BUILDING COMPONENTS** **9**

Building Construction – Foundations, Classification, Bearing Capacity of Soil and related terms (definition only), Masonry Works – classifications, definition of different technical terms, Brick masonry – types, bonds, general principle, Roofs – functional requirements, basic technical terms, roof covering material, Floors – function, types, flooring materials (brief discussion), Plastering and Painting – objectives, types, preparation and procedure of application.

UNIT-IV **INFRASTRUCTURE SERVICES** **9**

Basic Infrastructure services – air conditioning & purpose, fire protection & materials, Ventilation, necessity & functional requirements, Lifts, Escalators. Introduction to planning and design aspects of transportation engineering, Transportation modes, Highway engineering – historical development, highway planning, classification of highway, Railway Engineering – cross section of rail track, basic terminology, geometric design parameter (brief discussion only).

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UNIT-V **OTHER INFRASTRUCTURE STUDIES** 9

Airport engineering – development, types, definition, characteristics of aircraft, basic terminology, Traffic engineering – traffic characteristics, traffic studies, traffic operations (signals, signs, markings), Urban engineering – classification of urban road. Irrigation & Water Supply Engineering – Introduction, Types of Irrigation, different types of hydraulic structures, dam and weirs, types of dam, purpose and functions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Understand basic of civil engineering

CO2 : Identify methods and techniques used in civil engineering

CO3 : Examine the various components in building structures

CO4 : Recognize the planning and design aspects of Infrastructure services

CO5 : Gain knowledge about the various Infrastructure services

TEXT BOOKS:

1. Basic Civil engineering, Gopi, S., Pearson Publication
2. Basic Civil Engineering, Bhavikatti, S. S., New Age

REFERENCE BOOKS:

1. Construction Technology, Chudley, R., Longman Group, England
2. Basic Civil and Environmental Engineering, C.P. Kausik, New Age.
3. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application

E-RESOURCES:

1. https://www.vssut.ac.in/lecture_notes/lecture1684506126.pdf
2. https://archive.nptel.ac.in/courses/105/106/105106115/

CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1												1			
CO2	1	2		2		2		3		3		3	3	2	3
CO3	1	2	2	3		2		3	1			2	3	3	3
CO4	3	2	1	3	1	1	2	3	2			3	2	3	2
CO5	1	2	2	3		2	2	3	2	3	1	3	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Civil

23CE012	ENVIRONMENTAL POLLUTION AND WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand essential attributes of environmental pollution types.
- To know about environmental resources and their pollution aspects.
- To analyze the sampling and analysis strategies for the water, air, and soil samples.
- To apply remediation techniques for various environmental pollution.
- To gain knowledge climate change and Environmental Pollution.

UNIT-I **INTRODUCTION** **9**

Introduction and basic concepts of environment, the structure of the environment, air, soil, water interactions, Interface between Environment and Development, Pollution and Environmental Ethics, pollution types (Water, Air, Noise, Land, Municipal Solid Waste), Pollution prevention strategies and processes, Sustainable Development Goals (SDGs)

UNIT-II **WATER POLLUTION** **9**

Definition and sources of water pollution, Environmental, health, and economic impacts of water pollution, Water quality standards, and regulatory Overview of regulatory agencies and their roles in enforcing compliance, Fundamentals of water quality monitoring, Techniques for determining water quality. Overview of available technologies and their application in water pollution control, Case studies. Conservation and Management of Water Resources: Groundwater Pollution and its control measures, Rainwater Harvesting and Artificial Recharge.

UNIT-III **AIR AND NOISE POLLUTION** **9**

Air Pollution: Global and regional environmental issues of air pollution: Ozone depletion, Climate change, Global warming, Acid rain. Noise Pollution Basics of acoustics- propagation of indoor and outdoor sound- noise profiling effects of noise – measurement, index, and mitigation methods- health effects of noise.

UNIT-IV **MUNICIPAL SOLID WASTE (MSW)TREATMENT AND DISPOSAL** **9**

Introduction to Solid Waste Management, Municipal Solid Waste Characteristics and Quantities, MSW Rules 2016 - E-waste: Introduction, E-waste characteristics; E-waste generation, collection, transport, recycling, and disposal methods; Plastic waste: Introduction, Plastic Waste – Sources, Production, Global and Indian Context; Plastic Waste Management Practices – Plastic management- recycling, energy production & other applications. Plastic Waste Management Rules, 2022

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UNIT-V CLIMATE CHANGE AND ENVIRONMENTAL POLLUTION 9

Introduction to Climate change and its effect on the environment, Climate Change Impacts agriculture, biodiversity, water resources (intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms), and Current examples of emerging environmental pollutants and their potential impacts.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Understand essential attributes of environmental pollution types

CO2 : Environmental resources and their pollution aspects

CO3 : Analyze the sampling and analysis strategies for the water, air, and soil samples

CO4 : Apply remediation techniques for various environmental pollution

CO5 : Gain knowledge climate change and Environmental Pollution

TEXT BOOKS:

1. C.S. Rao, (2021) Environmental Pollution Control Engineering, NEW AGE International Publishers.
2. Goel, P. K. Water pollution: causes, effects, and control. New age international, 2006.
3. Wang, Lawrence K., Norman C. Pereira, and Yung-Tse Hung, eds. Advanced air and noise pollution control. Totowa, NJ: Humana Press, 2005.
4. Peirce, J. J., Vesilind, P. A., & Weiner, R. (1998). Environmental pollution and control, Butterworth-Heinemann.

REFERENCE BOOKS:

1. Sustainable Development Goal Interactions through a climate lens: a global analysis (2023), Publisher: Stockholm Environment Institute (SEI)
2. Municipal Solid Waste Management Manual Part I: An Overview, Central Public Health and Environmental Engineering Organisation (CPHEEO), 2016
3. Municipal Solid Waste Management Manual Part II: The Manual, Central Public Health and Environmental Engineering Organization (CPHEEO), 2016
4. Climate Change 2022: Mitigation of Climate Change, IPCC.

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E-RESOURCES:

1. https://archive.nptel.ac.in/courses/123/105/123105001/
2. https://archive.nptel.ac.in/courses/103/107/103107215/

CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1												1			
CO2	1	2		2		2		3		3		3	3	2	3
CO3	1	2	2	3		2		3	1			2	3	3	3
CO4	3	2	1	3	1	1	2	3	2			3	2	3	2
CO5	1	2	2	3		2	2	3	2	3	1	3	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CEO13	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles.
- To understand various impact identification methodologies, prediction techniques and model of impacts on various environments.
- To understand relationship between social impacts and change in community due to development activities and rehabilitation methods
- To acquire knowledge on document the EIA findings and prepare environmental management and monitoring plan
- To Identify, predict and assess impacts of similar projects based on case studies

UNIT-I INTRODUCTION 9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process- screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT-II IMPACT INDENTIFICATION AND PREDICTION 9

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological -– cumulative impact assessment

UNIT-III SOCIO-ECONOMIC IMPACT ASSESSMENT 9

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT-IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

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UNIT-V **CASE STUDIES** 9

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles

CO2 : Understand various impact identification methodologies, prediction techniques and model of impacts on various environments

CO3 : Understand relationship between social impacts and change in community due to development activities and rehabilitation methods

CO4 : Document the EIA findings and prepare environmental management and monitoring plan

CO5 : Identify, predict and assess impacts of similar projects based on case studies

TEXT BOOKS:

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India
3. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003

REFERENCE BOOKS:

1. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey
2. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/124/107/124107160/
2. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ar07/

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CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1				1		2	3	3	3		1	2		
CO2	3	2	3	2	2	1		3			1	1	1	2	2
CO3		2	3	2	2			3		1	1	1	1	2	2
CO4	1		3		2	1	2	2	2	1	1	1	1	2	2
CO5	3			2				2			1	1	2	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CEO14	BUILDING SERVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inform about the principles and laws of electricity and wiring systems in buildings.
- To inform about the principles and laws of lighting systems in buildings.
- To inform about the principles and laws of acoustics in buildings..
- To give exposure to the design of electrical, lighting and
- To gain knowledge acoustic systems in buildings of small scale.

UNIT-I GENERATION OF ELECTRICITY AND DISTRIBUTION IN BUILDINGS 9

Generation of electricity. Ohms and Kirchoffs Laws. Units: watt, volt, amps. Distribution from grid to facilities. Two phase and three phase systems. Substation, transformers, generators. Wires and conduits, types and applications. Lightning conductors and earthing. Distribution boards, meters, switch boards, earthing. Energy efficient systems and renewable energy resources.

UNIT-II INTRODUCTION TO LIGHTING 9

Electromagnetic spectrum. Sources of light. Laws and terminologies of lighting. Daylight. Considerations for designing with daylight- typology, room dimensions, openings. Daylight Factor. Light from artificial sources, quantity and quality. Types of lamps and luminaires. Applications and choice of luminaires. Energy efficient systems.

UNIT-III LIGHTING DESIGN FOR BUILDINGS 9

Lighting level for different uses in outdoor and indoor environment. Lighting calculations. Lighting simulation and performance analysis using software. Design exercise involving lighting design for appropriate projects of simple scale through choice, calculations, layout, drawings, simulations, physical models

UNIT-IV FUNDAMENTALS OF ACOUSTICS 9

Fundamentals– sound waves, frequency, intensity, wave length, measure of sound, decibel scale, speech and music frequencies. NC curves. Permissible noise limits. Material property- absorption, reflection, scattering, diffusion, transmission. Absorption co-efficient, NRC, Sound Transmission Class (STC), Impact Insulation Class (IIC).

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UNIT-V **ENVIRONMENTAL ACOUSTICS** 9

Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH..

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : The principles and laws of electricity and wiring systems in buildings

CO2 : The principles and laws of lighting systems in buildings.

CO3 : The principles and laws of acoustics in buildings...

CO4 : Design of electrical, lighting.

CO5 : Gain knowledge acoustic systems in buildings of small scale

TEXT BOOKS:

1. Phillips, 'Lighting in Architectural Design', McGraw Hill. New York, 1964.
2. David Egan, Victor Olgyay 'Architectural Lighting', McGraw-Hill, 2001.
3. Gary Gordon, 'Interior Lighting for Designers', 5th Edition, John Wiley & Sons Inc., New 2015.
4. David Egan, 'Architectural Acoustics', J.Ross Publishing, 2007.
5. David Lee Smith, 'Environmental Issues for Architecture', Wiley, 2011.
6. National Building Code- Bureau of Indian Standards.

REFERENCE BOOKS:

1. 'The Lighting Handbook', IES, 2011.
2. National Lighting Code 2010.
3. Descottes, Herve and Cecilia E. Ramos, 'Architectural Lighting: Designing with Light Space', Princeton Architectural Press, Princeton, 2011. and
4. A.K.Mittal, 'Electrical and Mechanical Services in High Rise Building: Design and Estimation Manual', CBS, 2009.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/105/102/105102176/
2. https://onlinecourses.nptel.ac.in/noc22_ce40

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CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1											1	1	1	1
CO2	1	1		2		2		2		3		3	1	1	1
CO3	1	1	2	3		2		2	1			2	1	1	1
CO4	1	1	1	3	1	1	2	2	2			3	1	1	1
CO5	1	1	2	3		2	2	2	2	3	1	3	1	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CEO15	WATER, SANITATION AND HEALTH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know fundamental concepts and terms which are to be applied and understood all through the study.
- To comprehend the various factors affecting water sanitation and health through the lens of third world scenario.
- To analyse and articulate the underlying common challenges in water, sanitation and health
- To acquire knowledge on the attributes of governance and it's say on water sanitation and health.
- To Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.

UNIT-I FUNDAMENTALS WASH 9

Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT-II MANAGERIAL IMPLICATIONS AND IMPACT 9

Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases-Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality-Environment: Water Borne-Water Washed and Water Based Diseases - Economic: Wage - Water and Health Budgeting -Psychological: Non-compliance - Disease Relapse - Political: Political Will

UNIT-III CHALLENGES IN MANAGEMENT AND DEVELOPMENT 9

Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation:-Infrastructure- Service Delivery: Health services: Macro and Micro- level: Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives

UNIT-IV GOVERNANCE 9

Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)-Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance

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UNIT-V **INITIATIVES** 9

Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH..

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Capture to fundamental concepts and terms which are to be applied and understood all through the study.

CO2 : Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.

CO3 : Critically analyse and articulate the underlying common challenges in water, sanitation and health.

CO4 : Acquire knowledge on the attributes of governance and its say on water sanitation and health.

CO5 : Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects

TEXT BOOKS:

1. Bonitha R., Beaglehole R.,Kjellstorm, 2006, "Basic Epidemiology", 2nd Edition, World Health Organization.
2. Van Note Chism, N. and Bickford, D. J. (2002), Improving the environment for learning: An expanded agenda. New Directions for Teaching and Learning, 2002: 91–98. doi: 10.1002/tl.83Improving the Environment for learning: An Expanded Agenda
3. National Research Council. Global Issues in Water, Sanitation, and Health: Workshop Summary. Washington, DC: The National Academies Press, 2009.

REFERENCE BOOKS:

1. Sen, Amartya 1997. On Economic Inequality. Enlarged edition, with annex by JamesFoster and Amartya Sen, Oxford: Claredon Press, 1997.
2. Intersectoral Water Allocation Planning and Management, 2000, World Bank Publishers

E-RESOURCES:

1. Third World Network.org (www.twn.org).
2. https://onlinecourses.nptel.ac.in/noc19_ge29

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CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1												1			
CO2	1	2		2		2		3		3		3	3	2	3
CO3	1	2	2	3		2		3	1			2	3	3	3
CO4	3	2	1	3	1	1	2	3	2			3	2	3	2
CO5	1	2	2	3		2	2	3	2	3	1	3	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CSO11 **FOUNDATION OF AR/VR**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Learn the fundamentals of Virtual Reality (VR) and Augmented Reality (AR).
- Understand how to incorporate user experience efficiently.
- Identify and resolve real-life conflicts using AR/VR solutions.
- Analyze applications of AR and VR in different domains.
- Explore practical use cases in architecture, gaming, and entertainment.

UNIT-I **DESIGN , ART ACROSS DIGITAL REALITIES AND EXTENDED REALITY** **9**

How Humans Interact with Computers-Modalities Through the Ages-Types of Common HCI Modalities -The Current State of Modalities for Spatial Computing Devices - Current Controllers for Immersive Computing Systems-A Note on Hand Tracking and Hand Pose Recognition-Designing for Our Senses, Not Our Devices-Sensory Design-Five Sensory Principles. Virtual Reality for Art-3D Art Optimization-Introduction-Draw Calls- Using VR Tools for Creating 3D Art -Acquiring 3D Models Versus Making Them from Scratch.

UNIT-II **HARDWARE, SLAM, TRACKING** **9**

How the Computer Vision That Makes Augmented Reality Possible Works-A Brief History of AR- Select an AR Platform-Mapping Platforms- Apple's AR Kit- Other Development Considerations –Lighting-The AR Cloud- The Dawn of the AR Cloud-The Bigger Picture— Privacy and AR Cloud Data

UNIT-III **CREATING CROSS-PLATFORM AUGMENTED REALITY AND VIRTUAL REALITY** **9**

Virtual Reality and Augmented Reality: Cross-Platform Theory-The Role of Game Engines-Understanding 3D Graphics-Portability Lessons from Video Game Design-Simplifying the Controller Input-Virtual Reality Toolkit: Open Source Framework for the Community Three Virtual Reality and Augmented Reality Development Best Practices.

UNIT-IV **ENHANCING DATA REPRESENTATION:DATA VISUALIZATION AND ARTIFICIAL INTELLIGENCE IN SPATIAL COMPUTING** **9**

Data and Machine Learning Visualization Design and Development in Spatial Computing-Introduction-Understanding Data Visualization Principles for Data and Machine Learning Visualization-2D Data Visualizations versus 3D Data Visualization-Animation-Data Representations, Info graphics, and

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Interactions-3D Reconstruction and Direct Manipulation of Real-World Data.

UNIT-V **CHARACTER AI ,BEHAVIORS AND USE CASES IN EMBODIED REALITY** **9**

Introduction - Behaviors -Current Practice: Reactive AI-More Intelligence in the System: Deliberative AI-The Virtual and Augmented Reality Health Technology Ecosystem-VR/AR Health Technology Application Design - Standard UX Isn't Intuitive-The Fan Experience: Sports XR.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Apply the fundamentals of design ,art across digital realities and extended reality

CO2: Make use of components of hardware, slam, and tracking

CO3: Apply the concept by creating cross-platform augmented reality and virtual reality

CO4: Apply the techniques for enhancing data representation for data visualization and artificial intelligence in spatial computing

CO5: Utilize the character of AI ,behaviors and use cases in embodied reality

TEXT BOOKS:

1. Creating Augmented and Virtual Realities by Erin Pangilinan, Steve Lukas, Vasanth Mohan Released March 2019,Publisher(s): O'Reilly Media, Inc.,ISBN: 9781492044147

REFERENCE BOOKS:

1. Paul Mealy,Virtual& Augmented Reality For Dummies,ISBN: 978-1-119-48134-8 July 2018

E-RESOURCES:

https://onlinecourses.nptel.ac.in/noc25_cs87/preview

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	1	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	2	1	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	2	1	3	2	-	-	-	-	-	-	-	-	-
AVG	**3**	**2**	**2**	**1**	**3**	**2**	-	-	-	-	-	-	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CSO12	WEB DESIGNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basics of web design, including writing, mark-up, and coding.
- Get familiar with the structure and formatting of web pages using HTML.
- Apply styling and design principles with CSS for better presentation.
- Learn about web development components such as web content, web client, and scripting.
- Enhance interactivity and functionality of web pages using JavaScript.

UNIT-I **WEBSITES BASICS, HTML 5** **9**

Web Essentials: Evolution of the Internet and World Wide Web- Web Basics- Client-Side Scripting versus Server-Side Scripting- World Wide Web Consortium (W3C)-HTML5: Introduction- Editing HTML5- First HTML5 Example- Headings- Linking- Images- Special Characters and Horizontal Rules- Lists- Tables.

UNIT-II **HTML5 - FORM ELEMENTS AND CANVAS** **9**

Form- Internal Linking- meta Elements- New HTML5 Form input Types- Input and data list Elements and auto complete Attribute- Page-Structure Elements- Canvas: Introduction- Coordinate System- Rectangles- Using Paths to Draw Lines- Drawing Arcs and Circles- Shadows- Linear Gradients- Radial Gradients- Images- Transformations- Text.

UNIT-III **CASCADING STYLE SHEETS (CSS3)** **9**

Types of CSS- Inline Styles- Embedded Style Sheets- Conflicting Styles- Linking External Style Sheets- Positioning Elements- Backgrounds- Element Dimensions- Box Model and Text Flow- Media Types and Media Queries- Drop-Down Menus- Text Shadows- Rounded Corners- Color- Box Shadows- Linear Gradients- Radial Gradients- Image Borders- Transitions and Transformations.

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UNIT-IV **INTRODUCTION TO SCRIPTING LANGUAGE** **9**

JavaScript: Introduction to Java script- Modifying Your First Script - Memory Concepts- Arithmetic- Decision Making-Obtaining User Input with prompt Dialogs-Control Statements- Functions- Objects.

UNIT-V **DOCUMENT OBJECT MODEL AND EVENT HANDLING** **9**

Document Object Model: Introduction- Modeling a Document: DOM Nodes and Trees- Traversing and Modifying a DOM Tree- DOM Collections- Dynamic Styles- Using a Timer and Dynamic Styles to Create Animated Effects- **Event Handling:** Introduction- Reviewing the load Event- Event mouse move and the event Object- Rollovers with mouse over and mouse out- Form Processing with focus and blur- More Form Processing with submit and reset- Event Bubbling- Case Study: Creation of a website using express studio.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Construct a web page with essential elements using HTML5.

CO2: Plain the form and canvas elements for a given web page using HTML5.

CO3: Design the web page and specify how to apply styles using CSS3.

CO4: Develop a script for a given scenario using components of JavaScript.

CO5: Exhibit the ability to design dynamic web pages with validation using JavaScript objects and event handling mechanisms.

TEXT BOOKS:

1. Paul Deitel, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How to Program", 5th Edition, Pearson Publications, 2012.
2. Danny Goodman, Michael Morrison, Paul Novitski, and Tia GustaffRayl, "JavaScript Bible", 7th Edition , Wiley Publications, 2010.

REFERENCE BOOKS:

1. David Flanagan, "JavaScript – The Definitive Guide", 6th Edition, O'Reilly Media Publications, 2011.
2. cholas C. Zakas, "Professional JavaScript for Web Developer", 3rd Edition, Wrox Publications, 2012.
3. Ian Lloyds, "Build your own website the Right Way Using HTML & CSS", Site point publications, 2008.

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E-RESOURCES:

1. http://nptel.ac.in/courses/106105084/1, Internet Technologies,
2. http://www.w3schools.com/html/
3. www.liveweaver.com.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	2	-	2	-	-	-	-	-	-	1	-	-	-
CO2	-	3	2	-	2	-	-	-	-	-	-	1	-	-	-
CO3	-	3	2	-	2	-	-	-	-	-	-	1	-	-	-
CO4	-	3	2	-	2	-	-	-	-	-	-	1	-	-	-
CO5	-	3	2	-	2	-	-	-	-	-	-	1	-	-	-
AVG	**-**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CSO13	BLOCK CHAIN FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the concept of blockchain as a secure method of storing information.
- Recognize how blockchain ensures data integrity by preventing changes, hacking, or manipulation.
- Learn the structure of blockchain as a distributed or decentralized ledger.
- Explore how transactions are duplicated and shared across the network.
- Analyze the role of participating computers in maintaining and validating the blockchain.

UNIT-I INTRODUCTION TO BLOCKCHAIN 9

The history of blockchain -Blockchain -Definition -Generic elements of a Blockchain-How blockchain works -Benefits and limitations of blockchain.

UNIT-II BLOCKCHAIN TECHNOLOGY 9

Blockchain technology-Tiers of Blockchain technology-Features of a Blockchain-Types of Blockchain-Consensus-Types of consensus mechanisms -Consensus in Blockchain-CAP theorem and Blockchain.

UNIT-III DECENTRALIZATION AND CRYPTOGRAPHIC TECHNIQUES 9

Decentralization using blockchain - Methods of decentralization-The decentralization framework example -Cryptograpy primitives.

UNIT-IV BITCOIN 9

Bitcoin - The transaction life cycle-The transaction data structure-Types of transactions.The structure of a block-Mining-Tasks of the miners-Mining rewards-Proof of Work (PoW)-The mining algorithm-Proof of Storage-Proof of Stake (PoS)

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UNIT-V **ETHEREUM** **9**

Ethereum blockchain-Components of the Ethereum ecosystem-Types of accounts-Transactions and messages-Ether cryptocurrency / tokens (ETC and ETH)-The Ethereum Virtual Machine (EVM).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the Concepts and working of Block chain and summarize their Benefits limitations.

CO2: Explore the Features and technology behind Blockchain,Mechanism of consensus and CAP Theorem in Blockchain

CO3: Summarize the concepts of Decentralization , methods of Decentralization and cryptography primitive.

CO4: Understand the lifecycle of a Bitcoin, MiningTasks and Mining algorithm.

CO5: Explore the components of Ethereum Ecosysytem and Ethereum Virtual Machine.

TEXT BOOKS:

1.Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.

REFERENCE BOOKS:

1. Bikramaditya Singhal, Gautam Dhameja and Priyansu Sekhar Panda, "Beginning Blockchain – A Beginner's Guide to Building Blockchain Solutions",Apress Publication, 2018.

2. Michael J. Casey and Paul Vigna , "The Truth Machine – The Blockchain and the Future of Everything",St.Martin's Press,2018

E-RESOURCES:

1. https://nptel.ac.in/courses/106/104/106104220/#

2.https://www.udemy.com/course/build-your-blockchain-az

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CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	2	1	1	2	3	-	-	-	-
CO2	1	1	1	1	2	2	2	2	1	2	3	-	-	-	-
CO3	2	2	1	1	2	2	2	2	1	2	3	-	-	-	-
CO4	2	1	1	1	2	2	2	2	1	2	3	-	-	-	-
CO5	1	1	1	1	2	2	2	2	1	2	3	-	-	-	-
AVG	1.6	1.2	1	1	1.8	2	2	1.8	1	2	3	-	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CSO14	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of knowledge creation, acquisition, representation, and dissemination.
- Examine the role of knowledge in organizations and institutions, including its use and re-use.
- Learn about Knowledge Management (KM) systems and their application in knowledge generation, transfer, and organization.
- Explore processes of knowledge codification, system development, testing, and the use of KM tools and portals.
- Analyze ethical, managerial, and legal issues related to knowledge management.

UNIT-I **KNOWLEDGE MANAGEMENT** **9**

An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT-II **CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING** **9**

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT-III **KNOWLEDGE MANAGEMENT-THE TOOLS** **9**

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval -Information Coding in the Internet Environment - Repackaging Information

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UNIT-IV **KNOWLEDGE MANAGEMENT-APPLICATION** **9**

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT-V **FUTURE TRENDS AND CASE STUDIES** **9**

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the evolution of knowledge management, challenges, ethical and legal issues and corporate social responsibilities of KM in organizations.

CO2: Determine the quality of organizational knowledge, knowledge sharing using knowledge market approach.

CO3: Use KM tools and portals to develop a quality knowledge bank/ repository.

CO4: Analyze KM applications to identify the key components for a successful management.

CO5: Use current trends and develop enterprise knowledge management applications for a business plan.

TEXT BOOKS:

1. Srikantaiah.T. K., Koenig, M., "Knowledge Management for the Information Professional" Information Today, Inc., 2000.

REFERENCE BOOKS:

1. Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995

E-RESOURCES:

1. http://nptel.ac.in/courses/110105076/
2. http://study.com/academy/lesson/knowledge-management-theory-strategies.html.

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CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	1	-	3	3	1	-	2	1	-	-	-
CO2	-	-	-	-	1	-	3	1	1	-	2	1	-	-	-
CO3	-	-	-	-	3	-	3	1	1	-	2	1	-	-	-
CO4	-	-	-	-	1	-	3	1	1	-	2	1	-	-	-
CO5	-	-	-	-	1	-	3	1	1	-	2	1	-	-	-
AVG	-	-	-	-	1.4	-	3	1.4	1	-	2	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CSO15	CLOUD COMPUTING ESSENTIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the concept of cloud computing as delivery of services over the internet.
- Explore different cloud services, including software, analytics, storage, and networking.
- Examine the key advantages of cloud computing such as cost reduction, flexibility, and business continuity.
- Analyze the migration of legacy systems to cloud platforms and the growing demand.
- Recognize the future trend of hosting all web and mobile applications on the cloud.

UNIT-I INTRODUCTION 9

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing

UNIT-II VIRTUALIZATION 9

Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.

UNIT-III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT-IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

InterCloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security and Software Protection Techniques – Virtual Machine Security.

UNIT-V CASE STUDIES 9

Google App Engine (GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services (AWS) – Microsoft Azure – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Summarize The Main Concepts, Key Technologies, Strengths, And Limitations Of Cloud Computing And Identify Suitable Scenarios For Moving To The Cloud Platform

CO2: Interpret The Role Of Virtualization As The Key Enabling Technology That Helped In The Development Of The Cloud Platform

CO3: Develop The Ability To Understand And Use The Architecture Of Compute Cloud And Storage Cloud Services And Delivery Models

CO4: Examine The Core Issues Of Cloud Computing Architecture Namely Resource Management And Security

CO5: Experiment With Several Public Cloud Offerings And Cloud Development Tools To Choose The Appropriate Service Provider For One's Requirements

TEXT BOOKS:

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", 1st Edition, John Wiley & Sons, 2011. (For Unit I)

2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2017. (For Units II,III,IV,V)

REFERENCE BOOKS:

1.Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.

2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013.

E-RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105223/,"Google Cloud Computing Foundation Course", Prof. SoumyaKantiGhosh, IIT Kharagpur.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	3	3	3	2	2	3	-	-	-	-
CO2	3	2	1	1	2	3	3	3	2	2	3	-	-	-	-
CO3	3	2	1	1	2	3	3	3	2	2	3	-	-	-	-
CO4	3	2	1	1	2	3	3	3	2	2	3	-	-	-	-
CO5	3	2	1	1	2	3	3	3	2	2	3	-	-	-	-
AVG	**3**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ECO11	BASICS OF ELECTRONICS IN AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To define and explain the fundamental electronic components and instruments used in automation systems.
- To describe the architecture, types, and significance of industrial automation systems including PLC, SCADA, HMI, and DCS..
- To apply basic PLC programming instructions such as timers, counters, and data handling to solve simple automation tasks.
- To analyze different types of automation systems and evaluate components like I/O modules, CPUs, and power supplies in PLC design.
- Design and evaluate SCADA systems and their integration with PLCs for real-time monitoring and control applications.

UNIT-I BASICS OF ELECTRONICS **9**

Evolution and impacts of Electronics in industries and societies-Familiarization of Resistors, Capacitors, Inductors, PN junction Diode, Zener Diode-Electronic Instrumentation:Digital Multimeter-Digital Storage Oscilloscope-Function Generator.

UNIT-II INTRODUCTION TO INDUSTRIAL AUTOMATION **9**

Need and benefits of industrial Automation-Automation Hierarchy, Basic components of Automation systems-Types of Automation systems: Fixed, Programmable and Flexible-Different systems for industrial Automation: PLC, SCADA, HMI,DCS and Drives.

UNIT-III PLC FUNDAMENTALS **9**

Building blocks of PLC: CPU, Memory organization, Input-Output modules (discrete and analog), special I/O Modules, power supply-Fixed and Modular PLC and their types, Redundancy in PLC module-I/O Module selection criteria.

UNIT-IV PLC PROGRAMMING AND ITS APPLICATIONS **9**

PLC I/O addressing-PLC Programming instructions: Relay type instructions, timer type instructions: On delay, Off delay, retentive, Counter instructions, up ,down, High speed, logical instructions-Comparison instructions- Data Handling instructions-Arithmetic instructions.

UNIT-V SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM **9**

Introduction to SCADA, typical SCADA, architectural /block diagram, benefits of SCADA-Various editors of SCADA-Interfacing SCADA system with PLC-Typical connection diagram, Object linking embedding for process control architecture-Applications of SCADA: Traffic light control, water distribution pipeline control.

TOTAL: 45 PERIODS

COURSE OUTCOME:

CO1: Understand the basic electronic components and instruments used in automation systems.

CO2: Analyze the concept, need, and components of industrial automation systems.

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CO3: Demonstrate the architecture and operational principles of PLCs used in industrial automation.

CO4: Apply PLC programming techniques to automate basic industrial control processes.

CO5: Evalute the structure and applications of SCADA systems integrated with PLCs..

TEXT BOOKS:

1. PLC Scada for Beginners: Understanding and Implementing Industrial Automation Systems by Ashraf Said AlMadhoun (2025).
2. Industrial Automation and Robotics: An Introduction, 2nd Edition by Jean Westcott, A.K. Gupta & S.K. Arora (2023).

REFERENCE BOOKS:

1. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.
2. Industrial Automation and Robotics: An Introduction, 2nd Edition by Jean Westcott, A.K. Gupta & S.K. Arora (2023) Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7th Edition, 2014.

E-RESOURCES:

1. NPTEL-Online Courses and Video lectures: https://archive.nptel.ac.in/courses/108/108/108108111/

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	-	-	-	-	-	1	2	1	1
CO2	3	2	2	3	2	2	-	-	-	-	-	1	2	1	1
CO3	3	3	3	2	1	2	-	-	-	-	-	1	2	1	1
CO4	3	3	2	3	2	2	-	-	-	-	-	1	2	1	1
CO5	3	2	3	2	2	1	-	-	-	-	-	1	2	1	1
AVG	3	3	3	3	2	2	-	-	-	-	-	1	2	1	1

1 -low,2-medium,3-high,'-'-nocorrelation

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23ECO12	WIRELESS OPTICAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To recognize the concepts of wireless communication
- To identify the losses in optical fiber
- To learn the principles of signaling design.
- To interpret the fundamental concepts and influencing factors of optical channel capacity
- To enrich the Knowledge about the Multielement techniques.

UNIT-I FUNDAMENTALS OF WIRELESS COMMUNICATION **9**

Introduction – Brief history of wireless optical communication–Wireless Optical Channels: Atmospheric channel, underwater and interstellar medium – Wireless optical intensity channels –Optoelectronic components-noise – Channel topologies.

UNIT-II – SIGNAL DEGRADATION OF OPTICAL FIBER **9**

Attenuation-absorption –scattering losses-bending losses-core and cladding losses-signal dispersion –inter symbol interference and bandwidth-intra model dispersion-material dispersion- waveguide dispersion-polarization mode dispersion-intermodal dispersion

UNIT-III SIGNALING DESIGN **9**

Optical intensity signal space model: Signal space model – Admissible region– Peak optical power bounding region – Peak optical power per symbol – Peak-symmetric signalling schemes, Example and geometric properties – Atmospheric turbulence channel modeling.

UNIT-IV OPTICAL CHANNEL CAPACITY **9**

Systems of Separated Components – Focal lengths of two component systems – The Optical Invariant – Matrix Optics – The y-y bar diagram – The Scheimpflug Condition – Summary of sign conventions.

UNIT-V MUTIELEMENT TECHNIQUES **9**

MIMO wireless optical channel – Experimental prototype, MIMO optical channel model– Pixel Matched Systems – Pixelated wireless optical channel coded MIMO FSO communication –Buffering – Optical routers – Optical switching technologies – Lattice codes.

TOTAL: 45 PERIODS

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

CO1	Identify the fundamentals of Wireless Communication
CO2	Infer the losses in optical fiber.
CO3	Comprehend the concept of Signaling design technique for optical system design
CO4	Interpret the Optical Channel Capacity for optical systems.
CO5	Apply the concepts of Multielement techniques for design of optical channel model.

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TEXT BOOKS:

1. Theodore S. Rappaport, "wireless communications", II Edition, Cambridge University,2024
2. Govind P. Agrawal, "Fiber- Optic Communication Systems", V Edition, Wiley,2021

REFERENCE BOOKS:

1. Andreas F. Molisch, "Wireless Communications: From Fundamentals to Beyond 5G", III Edition, Wiley,2022
2. Govind P. Agrawal, "Fiber- Optic Communication Systems",V Edition,Wiley,2021

E-RESOURCE:

Online Resource: https://onlinecourses.nptel.ac.in/noc23_ee61/preview

CO's – PO's & PSO's MAPPING

CO\PO \PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	1	-	2	1	1	-
CO2	3	3	2	2	1	-	-	-	-	1	-	2	1	1	-
CO3	2	3	3	2	1	-	-	-	-	1	-	2	1	1	-
CO4	2	3	2	3	1	-	-	-	-	1	-	2	1	1	-
CO5	3	3	3	2	2	-	-	-	-	2	-	3	1	1	-
AVG	3	3	2	2	1	-	-	-	-	1	-	2	1	1	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ECO13	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To recall and describe the basic principles and key components of soft computing techniques.
- To understand and analyze the structure, operation, and limitations of various neural network models.
- To apply fuzzy logic models and reasoning to control and model complex nonlinear systems.
- To develop genetic algorithms and compare metaheuristic techniques for solving real-world optimization problems.
- To design and simulate hybrid systems using combinations of ANN, fuzzy logic, and GA for intelligent control.

UNIT-I INTRODUCTION TO SOFT COMPUTING 9

Introduction of soft computing - soft computing vs. hard computing- various types of soft computing techniques- applications of soft computing-Neuron- Nerve structure and synapse Artificial Neuron and its model- activation functions- Neural network architecture- single layer and multilayer feed forward networks- McCullochPitts neuron model- perceptron model- Adaline and Madaline Nerwork.

UNIT-II ARTIFICIAL NEURAL NETWORKS 9

Counter propagation network- architecture- functioning & characteristics of counter Propagation network-Hopfield/ Recurrent network- configuration- stability constraintsassociative memory and characteristics- limitations and applications- Hopfield v/s Boltzman machine- Adaptive Resonance Theory- Architecture- classifications-Implementation and training-Associative Memory.

UNIT-III FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximatereasoning. Introduction to fuzzy logic modeling and control- Fuzzification- inferencing and defuzzification Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.

UNIT-IV GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

UNIT-V HYBRID SYSTEMS 9

Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms, GA Based Back Propagation Networks, Fuzzy Back Propagation Networks, Fuzzy Associative Memories, Simplified Fuzzy ARTMAP. Soft computing based hybrid fuzzy controllers.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

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

- **CO1:** Understand the basic concepts and models in soft computing and neural networks.
- **CO2:** Analyze the architecture and functioning of different artificial neural networks.
- **CO3:** Apply the concepts of Fuzzy Logic, Various fuzzy systems and their functions
- **CO4:** Develop genetic algorithms and related metaheuristics to solve optimization problems.
- **CO5:** Design and implement hybrid intelligent systems combining soft computing techniques.

TEXT BOOKS:

1. Soft Computing: Recent Advances and Applications in Engineering and Mathematical Sciences (2023),Edited by Pradip Debnath, Oscar Castillo & Poom Kumam.
2. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2020.

REFERENCE BOOKS:

1. Applied Soft Computing: Techniques and Applications (2022),Edited by Samarjeet Borah & Ranjit Panigrahi.
2. H.J. Zimmermann, Fuzzy Set Theory and Its Applications, 4th Edition, Kluwer Academic Publishers, London, 2019(Reprint).

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_ma54/preview
2. https://onlinecourses.swayam2.ac.in/ntr25_ed63/preview

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	1	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	1	-	-	-	-	-	-	-	2	-	-
CO3	3	2	2	-	1	-	-	-	-	-	-	-	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3
CO5	3	2	2	-	1	-	-	-	-	-	-	-	3	2	-
AVG	3	2	2	-	1	-	-	-	-	-	-	-	2	2	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ECO14	CONSUMER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the theory and operation of basic electronic devices.
- To understand the working principles of audio, video, and recording systems.
- To introduce and apply the concepts of sensors and voice controls in practical systems.
- To provide knowledge that enables students to design or conceptualize smart home devices.
- To gain knowledge on current communication technology and analyze its applications.

UNIT-I CONSUMER ELECTRONICS FUNDAMENTALS 9

History of Electronic Devices- Vacuum Tubes, Transistors, Integrated Circuits- Semiconductor Devices, PN junction diode,BJT ,FET, Rectifiers and Regulators .

UNIT-II ENTERTAINMENT ELECTRONICS 9

Audio systems: Microphones, Loudspeaker, Loudspeaker systems, CD player, CD-ROM, Audio compact discs. Video Systems: Record and playback, Remote control DVD and Blue RAY. Recording Systems: Digital Cameras and Camcorders.

UNIT-III SMART HOME - SENSORS 9

Technology involved in Smart home, Home Virtual Assistants- Alexa and Google Home. Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT-IV HOME APPLIANCES 9

Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave, Induction Stoves, Smart Refrigerators, Smart alarms, Smart locks.

UNIT-V INTRODUCTION TO SMART OS AND COMMUNICATION 9

Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, Li-Fi, GPS and Tracking Systems, Smart Phones and Smart Watches.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the basic electronic devices such as PN junction diode, BJT and FET
CO2: Apply the concept of entertainment electronics
CO3: Analyze the working principles of common sensors and control mechanisms.
CO4: Evaluate the current technology and apply on home applications.
CO5: Emphasize the need for communication systems

TEXT BOOKS:

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1. Dr. B.R. Gupta, V. Singhal "Consumer Electronics" 6th 2013 · Reprint: 2023
2. Bali, "Consumer Electronics" Pearson Education India 2005. ISBN, 8131717593, 9788131717592.
3. Bali S. P, Consumer Electronics, Pearson India, 2007.

REFERENCE BOOKS:

1. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2018.
2. Jordan Frith, "Smartphones as Locative Media ", Wiley. 2014.
3. Dennis C Brewer, "Home Automation", Que Publishing 2013.
4. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2012.
5. Nick vandome, Smart homes in easy steps, - Master smart technology for your home 2018.

E-RESOURCES:

1. https://nptel.ac.in/courses/117105149/
2. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO's – PO's & PSO's MAPPING

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3	-	-	-	-	1	-	-	3	2	1
CO2	3	2	3	1	2	-	-	-	-	1	-	-	2	2	1
CO3	3	2	3	1	2	-	-	-	-	1	-	-	3	2	1
CO4	2	2	3	1	3	-	-	-	-	1	-	-	2	-	1
CO5	2	2	3	1	2	-	-	-	-	1	-	-	3	2	1
AVG	3	2	3	1	2	-	-	-	-	1	-	-	3	2	1

1 - Low, 2 - medium, 3 - high, '-' - no correlation

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23ECO15	PRINCIPLES OF COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of modulation and its necessity in communication systems.
- To explore amplitude and angle modulation techniques along with their comparison.
- To understand the process of sampling, quantization and pulse code modulation.
- To analyze various digital modulation schemes and their spectrum analysis.
- To learn the fundamentals of antenna design and wave propagation mechanisms.

UNIT-I AMPLITUDE MODULATION 9

Introduction to Modulation: Definition- Need for modulation- types of modulation - Frequency spectrum - Amplitude modulation: Definition - Simple signal diagram for amplitude modulation, Expression for amplitude modulation, expression for modulation.

UNIT-II ANGLE MODULATION 9

Basic definitions of Frequency modulation and Phase modulation-Simple signal diagram-Relation between FM and PM, FM Transmitter: Types of transmitters: Direct FM transmitter, Indirect FM transmitter - FM Receiver: stereophonic FM receiver-AFC.

UNIT-III SAMPLING AND QUANTIZATION 9

Introduction, The Quantization Random Process, Quantization Noise, Pulse-Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation.

UNIT-IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, PCM, BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis.

UNIT-V ANTENNA AND WAVE PROPAGATION 9

Antennas: Definition-types of antenna: Mono pole and dipole antenna, directional Dipole arrays, Yagi antenna, parabolic antenna- Antenna parameters: directive gain, directivity, radiation pattern and polarization-applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Comprehend knowledge in amplitude modulation techniques
- **CO2:** Illustrate different angle modulation schemes with generation and detection methods
- **CO3:** Interpret knowledge in sampling and quantization
- **CO4:** Evaluate the digital modulation techniques
- **CO5:** Design different types of Antenna

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TEXT BOOKS:

1. Simon R. Saunders , Alejandro A. Aragon-Zavala, "Antennas and Propagation for Wireless Communication Systems", 3rd Edition, Wiley,2024.
2. Ifiok Otung, Communication Engineering Principles, 2nd Edition, Wiley, 2021.
3. M.L. Anand, Principles of Communication Engineering, 1st Edition, CRC Press, 2021.

REFERENCE BOOKS:

1. M. A. Bhagyaveni , R. Kalidoss , K. S. Vishvaksenan , "Introduction to Analog and Digital Communication, River Publishers, 1st Edition,2024.
2. Louis E. Frenzel, Principles of Electronic Communication Systems, 5th Edition, McGraw Hill, 2022.

E-RESOURCES:

1. https://elearn.nptel.ac.in/shop/nptel/principles-of-communication-systems-i/?v=c86ee0d9d7ed.
2. https://library.nitrkl.ac.in/libguide/subjects/guide.php?subject=EC

CO's – PO's & PSO's MAPPING

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	0	0	0	1	0	0	1	2	3	2	3
CO2	3	3	2	0	0	0	0	1	0	0	1	2	2	2	1
CO3	2	2	3	1	0	0	0	0	0	0	1	2	2	2	1
CO4	3	3	3	2	1	0	0	0	0	0	1	2	2	2	1
CO5	2	2	2	2	0	0	0	1	0	0	1	2	1	1	1
AVG	3	2	2	1	0	0	0	1	0	0	1	2	2	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23EEO11	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

Course Objectives:

- Awareness about renewable Energy Sources and technologies.
- To learn about harnessing of wind energy and grid integrated issue.
- To learn about the solar energy harnessing and tracking techniques.
- To know about biomass, hydro and geothermal energy sources.
- Recognize current and possible future role of other renewable energy sources

UNIT-I RENEWABLE ENERGY (RE) SOURCES 9

Introduction - Principles of renewable energy - energy and sustainable development - Environmental consequences of fossil fuel use, Importance of renewable sources of energy - Types of RE sources - Limitations of RE sources - Present Indian and international energy scenario of conventional and RE sources.

UNIT-II WIND ENERGY 9

Power in the Wind –Components of WPPs- Types of Wind Power Plants (WPPs) – Vertical & Horizontal axis wind turbine - Site selection of WPPs-Grid integration issues of WPPs.

UNIT-III SOLAR PV AND THERMAL SYSTEMS 9

Solar Radiation, Radiation Measurement - Pyrheliometers, Pyrometer - Solar Thermal systems - Flat plate collector , Solar pond electric power plant. Solar Photovoltaic systems: Basic Principle of SPV conversion – Types of PV Systems- maximum power point tracking.

UNIT-IV BIOMASS ,HYDRO AND GEOTHERMAL ENERGY 9

Introduction-Bio mass resources –Energy from Bio mass: conversion processes- Digesters Biomass Cogeneration-Environmental Benefits. Hydro power - Essential components of hydroelectric system - environmental issues. Geothermal energy – dry steam plant.

UNIT-V OTHER ENERGY SOURCES 9

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production - Fuel cell : Principle of working- - construction and applications. Hybrid Energy Systems.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1 Ability to create awareness about renewable Energy Sources and technologies

CO2 Ability to acquire knowledge about wind energy

CO3 Ability to acquire knowledge about solar and thermal energy

CO4 Ability to understand basics about biomass, hydro and geothermal energy.

CO5 Knowledge in capturing and applying other forms of energy sources

TEXT BOOKS:

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2023.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2023.

REFERENCES:

1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2022
2. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2020
3. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi,
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies",

Online Sources

1. NPTEL-Online Courses and Video lectures: https://nptel.ac.in/

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	2	3	2	-
CO2	3	3	3	3	2	-	-	-	-	-	-	2	3	2	-
CO3	3	2	3	3	2	-	-	-	-	-	-	2	3	1	-
CO4	3	2	3	3	3	-	-	-	-	-	-	2	3	1	-
CO5	3	3	3	3	2	-	-	-	-	-	-	2	3	1	-
Avg	**3**	**2.6**	**3**	**2.8**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**1.4**	**-**

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23EEO12	ELECTRIC VEHICLE	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn the structure of Electric Vehicle.
- To study about the Electric drive Trains components.
- To know about the details Electric drive Trains Controls.
- To understand the concepts of Energy Storage.
- To know about the details of Energy Management.

UNIT-I INTRODUCTION TO ELECTRIC VEHICLES 9

History of electric vehicles, social and environmental importance of electric vehicles, impact of modern drive-trains on energy supplies.

UNIT-II ELECTRIC DRIVE-TRAINS 9

Basic concept of electric traction, Introduction to various electric drive-train topologies, Power flow control in electric drive-train topologies.

UNIT-III ELECTRIC DRIVES & CONTROL 9

Introduction to electric components used in electric vehicles, Control of Induction Motor Drive, Permanent Magnet (PM) motor Drive & Switched Reluctance Motor (SRM) Drive.

UNIT-IV ENERGY STORAGE 9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its modeling, SOC, Different Types of Batteries, Super Capacitor based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT-V ENERGY MANAGEMENT STRATEGIES & CHARGING INFRASTRUCTURE 9

Introduction to energy management strategies used in electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies, Types of EV charging Infrastructure & Standardized Communication protocols for EV charging.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1 Illustrate electric vehicles.

CO2 Understand drive-train topologies.

CO3 Classify various electrical drives.

CO4 Classify energy storage technologies.

CO5 Classify different energy management strategies.

TEXT BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2 nd Edition, 2017. (Unit-I, II)
2. Ali Emadi, "Advanced Electric Drive Vehicles (Energy, Power Electronics, and Machines)", CRC Press, 2015. (Unit-III)
3. John G. Hayes and A. Goodarzi, "Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles", Wiley, 2018. (Unit-IV & V)

REFERENCES:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2 nd Edition 2012.

Online Sources

1. https://nptel.ac.in/courses/108106170
2. https://onlinecourses.nptel.ac.in/noc22_ee53
3. https://onlinecourses.nptel.ac.in/noc21_ee112

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	1	-	-	-	2	3	3	-
CO2	3	-	3	-	-	-	-	1	-	-	-	2	3	-	3
CO3	3	-	2	-	-	-	-	1	-	-	-	2	3	3	-
CO4	3	-	3	-	-	-	-	1	-	-	-	2	3	-	3
CO5	3	-	3	-	-	-	-	1	-	-	-	2	3	-	-
Avg	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**3**	**3**

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BoS / EEE

23EEO13	ENERGY AUDITING AND CONSERVATION	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand energy scenario and general aspects of energy audit.
- Learn about methods and concept of energy audit.
- Understand the energy utilization pattern including wastage and its management.

UNIT-I **GENERAL ASPECTS** **9**

Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries.

UNIT-II **ENERGY AUDIT CONCEPTS** **9**

Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies.

UNIT-III **PRINCIPLES AND OBJECTIVES OF ENERGY MANAGEMENT** **9**

Design of Energy Management Programmes - Development of energy management systems – Importance - Indian needof Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting.

UNIT-IV **THERMAL ENERGY MANAGEMENT** **9**

Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery - Thermal insulation - Heat exchangers and heat pumps – HVC industries-Building Energy Management.

UNIT-V **ELECTRICAL ENERGY MANAGEMENT** **9**

Supply side Methods to minimize supply-demand gap -Renovation and modernization of power plants - Reactive power management – HVDC - FACTS .

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Understand the basic concepts of energy audit, energy management.
CO2	Ability to acquire knowledge about audit procedures, techniques and usage of energy audit instruments.
CO3	Apply the knowledge to identify energy saving potential of thermal and electrical systems for maximizing and optimizing system efficiency
CO4	Analyze energy management systems, prepare and present energy audit reports.
CO5	Knowledge in capturing and applying other forms of energy management.

TEXT BOOKS:

1. Murphy, W. R. (2007), Energy Management (1st edition), Elsevier India Private Limited.
2. De, B. K., (2010), Energy Management audit & Conservation, (2nd Edition), Vrinda Publication.

REFERENCES:

1. Turner, W. C., Doty, S. and Truner, W. C., (2009), Energy Management Hand book, (7thedition), Fairmont Press.
2. L.C. Witte, P.S. Schmidt, D.R. Brown, (1988) Industrial Energy Management and Utilisation, (1stedition) Hemisphere Publication, Washington.

Online Sources

1. https://nptel.ac.in/courses/108106170
2. https://onlinecourses.nptel.ac.in/noc22_ee53
3. https://onlinecourses.nptel.ac.in/noc21_ee112

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	1	-	-	-	-	-	3	2	-
CO2	3	3	3	-	-	-	1	-	-	-	-	-	3	2	-
CO3	3	2	3	-	-	-	1	-	-	-	-	-	3	2	-
CO4	3	2	3	-	-	-	1	-	-	-	-	-	3	2	-
CO5	3	3	3	-	-	-	1	-	-	-	-	-	3	2	-
Avg	**3**	**2.6**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**

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23EEO14	DOMESTIC AND INDUSTRIAL ELECTRICAL INSTALLATIONS	L	T	P	C
		3	0	0	3

Course Objectives:

- Emphasize the estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost Availability.
- Exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design.
- These techniques should help the students to successfully estimate costing of the products/projects that are part of our everyday usage.
- A basic knowledge on methods and types of estimation and its merits and demerits
- To prepare the schedule of materials with specifications and estimates for different types of electrical installations

UNIT-I DESIGN CONSIDERATIONS OF ELECTRICAL INSTALLATIONS 9

Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of Electrical Installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections, Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches.

UNIT-II ELECTRICAL INSTALLATION OF BUILDINGS AND SMALL INDUSTRIES 9

Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries – Safety Procedures- Safety Precautions- Safety equipments.

UNIT-III OVERHEAD AND UNDERGROUND TRANSMISSION AND DISTRIBUTION LINES 9

Supports for Transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.

UNIT-IV SUBSTATIONS 9

Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substation, Floor mounted type.

UNIT-V DESIGN OF ILLUMINATION SCHEMES 9

Introduction, Terminology in Illumination, laws of illumination, various types of light sources, Practical lighting schemes.

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	The estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost viability..
CO2	Exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design.
CO3	To design illumination systems.
CO4	Understand types of substations and their ratings.
CO5	These techniques should help the students to successfully estimate costing of the products/projects that are part of our everyday usage and apply the above concepts to real- world electrical and electronics problems and applications. .

TEXT BOOKS:

1. Electrical Design Estimating and Costing, K.B. Raina, S.K. Bhattacharya, New Age InternationalPublisher.
2. Design of Electrical Installations, Dr. V.K. Jain, Dr. Amitabh Bajaj, University Science Press.
3. Electricity pricing Engineering Principles and Methodologies, Lawrence J. Vogt, P.E., CRCPress.

REFERENCES:

1. Guide for Electrical Layout in residential buildings, Indian Standard Institution, IS:4648-1968
2. Electrical Installation buildings Indian Standard Institution, IS:2032.

Online Sources

1. https://alison.com/tag/electrical-wiring
2. https://www.se.com/ww/en/work/products/product-launch/electrical-installation-guide/
3. https://www.equans-digital.com/en/industrial-electrical-installation

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	2	-	-	3	3	-
CO2	3	3	2	2	3	-	-	-	-	2	-	-	2	3	-
CO3	3	3	2	2	3	-	-	-	-	2	-	-	3	3	-
CO4	3	3	2	2	3	-	-	-	-	2	-	-	3	3	-
CO5	3	3	2	2	3	-	-	-	-	2	-	-	3	3	-
Avg	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2.8**	**3**	**-**

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23EEO15	EMBEDDED SYSTEM DESIGN AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide with a solid foundation in microcontroller architecture, programming, and basic peripherals.
- Understand the basic components of a microcontroller (CPU, memory, I/O).
- Learn about different microcontroller architectures (8-bit, 16-bit, 32-bit).
- Understand the concept of assembly language programming.

UNIT-I **EMBEDDED SYSTEMS** **9**

Introduction to embedded systems – hardware and software components –types- examples characteristics –system on chip-challenges in embedded computing system design – embedded system design process.

UNIT-II **EMBEDDED SYSTEM INTERFACING** **9**

Serial and parallel communication devices-wireless devices – timer & counting devices-Watch dog timer – Serial communication using I2C- CAN USB buses –Parallel Communication using ISA- PCI- PCI/X buses-wireless and mobile system protocol

UNIT-III **ARM PROCESSOR-7** **9**

MSP430 architecture-addressing modes-constant generator and emulsion instructions-instruction set, functions- interrupts low power modes.

UNIT-IV **PIC CONTROLLER** **9**

PIC microcontrollers: History and features –Architecture – memory organization – addressing modes – instruction set – PIC progrmming –I/O port, Data Conversion, RAM & ROM Allocation.

UNIT-V **INTERFACING – CASE STUDY** **9**

Interfacing PIC to LCD – Keyboard– parallel and serial ADC, DAC– Stepper motor interfacing

TOTAL : 45 PERIODS

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COURSE OUTCOMES

The students will be able to:

CO1	Understand the basics of embedded system.
CO2	Understand about Hardware/software co-design aspects and analyse the requirements for interfacing.
CO3	Understand concepts of ARM Processor and programming them.
CO4	Understand concepts of PIC controller and programming them.
CO5	Analyse and implement various interfacing circuits necessary for various applications.

TEXT BOOKS:

1. Sriram. V.Iyer & Pankaj Gupta, "Embedded real time systems Programming", Tata McGraw-Hill, 2007.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey „ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education 2008.
3. John Iovine, „PIC Microcontroller Project Book ", McGraw Hill 2000

REFERENCES:

1. Rajkamal, "Embedded system-Architecture, Programming and Design", 2nd edition Tata McGraw-Hill, 2003.
2. John H. Davies, "MSP430 Microcontroller Basics", Newnes publishers, First edition, 2008.
3. Rafiquzzaman.M, "Microcontroller Theory and Applications with the PIC18F", Wiley 2011

Online Sources

1.http://nptel.ac.in/courses/Webcoursecontents/IITKANPUR/microcontrollers/micro/ui/Course_home1_1.html

CO, PO & PSO MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	2	-	2	-	-	2	-	-	-	2	2	3	-
CO2	2	-	2	-	2	-	-	2	-	-	-	2	2	2	3
CO3	2	-	2	-	2	-	-	2	-	-	-	2	2	3	-
CO4	2	-	2	-	2	-	-	2	-	-	-	2	2	2	3
CO5	2	-	2	-	2	-	-	2	-	-	-	2	2	2	-
Avg	**2**	**-**	**2**	**-**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**2.4**	**3**

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23MEO11	INDUSTRIAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Understand the basic concepts of pressure measurement and study simple pressure measuring instruments used in industries.
- Learn the basic methods of temperature measurement using common instruments such as thermometers, RTDs, thermocouples, and pyrometers.
- Understand the basics of acceleration, vibration, density, and viscosity measurement using simple industrial instruments.
- Learn the basic techniques of level measurement using commonly used level measuring devices.
- Understand the basic principles of flow measurement using standard flow measuring instruments.

UNIT-I PRESSURE MEASUREMENT DEVICES 9

Pressure measurement basics, Units & Standards - Simple Manometers (U-tube and differential) – Elastic elements: Bourdon tube, diaphragm, bellows.

Electrical methods using strain gauge - High pressure measurement - Vacuum gauges – Mcleod gauge – Selection and Application – Calibration of Pressure gauge using dead weight tester.

UNIT-II TEMPERATURE MEASUREMENT DEVICES 9

Definitions and standards – Primary and secondary fixed points – Liquid filled system thermometer – Bimetallic thermometers - Sources of errors in temperature measurement.

RTD: principle, characteristics, applications - Thermocouples – Laws of thermocouple – Types of industrial thermocouples – Cold junction compensation – Radiation methods of temperature measurement – Optical pyrometer.

UNIT-III ACCELERATION, VIBRATION, DENSITY AND VISCOSITY MEASUREMENT DEVICES 9

Introduction to acceleration and vibration - Basic principle of Accelerometers – Piezoelectric – Seismic instrument – Mechanical type Vibration instruments - Applications of vibration measurement.

Definition & Units of density, specific gravity and viscosity used in industries – Pressure head type densitometer – Float type densitometer– Say bolt viscometer.

UNIT-IV LEVEL MEASUREMENT INSTRUMENTS 9

Introduction to level measurement - Visual level indicators - Float level devices- Displacer level detectors- differential pressure detectors.

Resistance and Capacitance type level measurement - Conductivity type level sensors - Ultrasonic level measurement - Sensor selection - Application.

UNIT-V FLOW MEASUREMENTS 9

Flow measurement: Introduction - Definitions and Units - Classification of flow meters - Pitot tubes - orifice meters- Venturi tubes.

Positive displacement flow meters - Rotameter - Anemometers - Electromagnetic flow meter - Ultrasonic flow meters - Flow meter selection- Application.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Explain the basic concepts of pressure measurement and identify simple pressure measuring instruments.

CO2: Describe the basic methods of temperature measurement using thermometers, RTDs, thermocouples, and pyrometers.

CO3: Explain the basic principles of acceleration, vibration, density, and viscosity measurement using common industrial instruments.

CO4: Describe the working principles of basic level measurement instruments used in industrial applications.

CO5: Explain the basic principles and applications of common flow measurement devices.

TEXT BOOKS:

1. E.O. Doebelin and D.N. Manik, 'Measurement Systems – Application and Design', Tata McGraw Hill Publishing Company, 6th Edition, 2011.
2. Raghuwanshi & R.K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 5th Edition, 2018.

REFERENCE BOOKS:

1. D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw Hill Publishing Company Ltd, 3rd Edition, 2019.
2. B.C. Nakra and K.K. Chaudhary, 'Instrumentation, Measurement and Analysis', McGraw Hill Education (India) Pvt. Ltd., 5th Edition, 2017.
3. S.K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill Education, 4th Edition, 2016.

E-RESOURCES:

1. http://nptel.ac.in/courses/108105064/
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
3. https://ocw.mit.edu

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	-	2	1	-	-	-	-	1	1	2	1
CO2	3	1	3	-	-	2	1	-	-	-	-	1	1	2	1
CO3	3	1	3	-	-	2	1	-	-	-	-	1	1	2	1
CO4	3	1	3	-	-	2	1	-	-	-	-	1	1	2	1
CO5	3	1	3	-	-	2	1	-	-	-	-	1	1	2	1
Avg	3	**1**	3	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
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23ME012	ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- Understand the principles of renewable energy, its environmental and economic impacts, and how it contrasts with conventional fossil fuels.
- Gain knowledge of various renewable energy sources, emphasizing sustainability, innovation, and practical applications.
- Evaluate renewable energy technologies based on local environmental, economic, and social conditions to support informed decision-making.
- Understand bioenergy systems, including conversion methods, system design, efficiency optimization, and practical implementation strategies.
- Understand energy conservation techniques in chemical process plants and battery technologies, including performance evaluation, safety aspects, and applications in modern energy systems.

UNIT-I INTRODUCTION **8**

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.

UNIT-II CONVENTIONAL ENERGY **8**

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT-III NON-CONVENTIONAL ENERGY **10**

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT-IV BIOMASS ENERGY **10**

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT-V ENERGY CONSERVATION AND BATTERY TECHNOLOGY **9**

Energy conservation in chemical process plants, energy audit basics, and energy-saving techniques in heat exchangers, distillation columns, dryers, furnaces, boilers, and steam economy.

Fundamentals of battery technology including performance parameters, charging and discharging characteristics, energy and storage density, safety issues, and an overview of

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batteries such as Lead Acid, Nickel–Cadmium, Zinc–Manganese Dioxide, Zinc–Air, Nickel Metal Hydride, and Lithium batteries.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Describe the fundamentals, classification, and main characteristics of renewable and non-renewable energy sources, and differentiate them with respect to fossil fuels in terms of availability, environmental impact, and sustainability.

CO2: Understand the working and performance of conventional power plants such as thermal, hydel, and nuclear.

CO3: Analyze and compare various renewable energy technologies including solar, wind, ocean, and geothermal systems, and select appropriate technologies based on local environmental, economic, and social conditions

CO4: Explain the technological principles and conversion processes involved in harnessing bioenergy resources, fuel cells, advanced power generation methods, and energy storage systems.

CO5: Identify and critically evaluate current developments in energy conservation practices and battery technologies, and develop an in-depth technical understanding of energy efficiency and storage-related problems at an advanced level.

TEXT BOOKS:

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCE BOOKS:

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_me138/preview
2. https://www.youtube.com/watch?v=HNjwoe4mSkE&list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&index=1

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	1	3	-	-	1	-	1	3	3	1
CO2	3	1	2	1	-	1	3	-	-	1	-	1	3	3	1
CO3	3	1	2	1	1	1	3	-	-	1	-	1	3	3	1
CO4	3	1	2	1	1	1	3	-	-	1	-	1	3	3	1
CO5	3	3	2	1	2	1	3	-	-	1	-	1	3	3	1
Avg	**3**	**1.4**	**2**	**1**	**1.3**	**1**	**3**	-	-	**1**	-	**1**	**3**	**3**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS / Mech

23MEO13	REVERSE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare students for:

- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- To familiarize students with reverse engineering hardware, software tools, methods, and fundamental operations used in data acquisition and reconstruction.
- To enable students to understand the criteria and methodologies for selecting appropriate reverse engineering systems based on accuracy, application, and manufacturing needs.
- To impart knowledge on integrating reverse engineering with rapid prototyping and solid freeform manufacturing for layer-based model generation.
- To expose students to industrial applications of reverse engineering and create awareness of the legal and ethical aspects involved.

UNIT-I INTRODUCTION TO REVERSE ENGINEERING **9**

Introduction to Reverse Engineering – The Generic Process – Phase 1: Scanning: Contact Scanners and Noncontact Scanners – Phase 2: Point Processing – Phase 3: Application Geometric Model Development – Computer-aided Reverse Engineering – Computer Vision and Reverse Engineering – Structured-light Range Imaging – Scanner Pipeline.

UNIT-II REVERSE ENGINEERING HARDWARE & SOFTWARE **9**

Reverse Engineering Hardware – Contact Methods – Noncontact Methods – Destructive Method – Reverse Engineering Software – Reverse Engineering Software Classification – Reverse Engineering Phases – Fundamental Reverse Engineering Operations.

UNIT-III SELECTION OF A REVERSE ENGINEERING SYSTEM **9**

The Selection Process – Point Capture Devices – Triangulation Approaches – Time-of-flight or Ranging Systems – Structured-light and Stereoscopic Imaging Systems – Issues with Light-based Approaches - Tracking Systems – Internal Measurement Systems – Destructive Systems – Some Comments on Accuracy – Positioning the Probe – Post processing the Captured Data – Handling Data Points – Curve and Surface Creation – Inspection Applications – Manufacturing Approaches.

UNIT-IV REVERSE ENGINEERING & SOLID FREE-FROM MANUFACTURING **9**

Introduction to Rapid Prototyping (Solid Freeform Manufacturing) – Brief on Current Techniques, Materials & Applications – Modeling Cloud Data in Reverse Engineering – Data Processing for Rapid Prototyping – Integration of RE and RP (SFM) for Layer-based Model Generation – Adaptive Slicing Approach for Cloud Data Modeling – Planar Polygon Curve Construction for a Layer – Determination of Adaptive Layer Thickness.

UNIT-V REVERSE ENGINEERING APPLICATIONS & LEGAL ASPECTS **9**

Reverse Engineering Applications in – Automotive Industry – Aerospace Industry – Medical Device Industry – Legal Aspects of Reverse Engineering.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

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

CO1: Apply the fundamental concepts and principles of reverse engineering for product design and development.

CO2: Apply the principles of hardware and software in reverse engineering for product design and development.

CO3: Select the appropriate reverse engineering system for product design and development.

CO4: Apply the relations between rapid prototyping (solid free-form manufacturing) and reverse engineering for product design and development.

CO5: Apply reverse engineering principles in various fields of engineering along with the various legal aspect and in product design and development

TEXT BOOKS:

1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011

REFERENCE BOOKS:

1. Scott J. Lawrence, Principles of Reverse Engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001
3. Kathryn, A. Ingle, "Reverse Engineering", McGraw-Hill, 1994.
4. Linda Wills, "Reverse Engineering", Kluver Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, "Reverse Engineering: An Industrial Perspective", Springer- Verlag London Limited 2008

E-RESOURCES:

1. https://ftp.idu.ac.id/wp-ontent/uploads/ebook/tdg/MILITARY%20REFERENCE% 20AND% 20REVERSE%20ENGINEERING/epdf.pub_reverse-engineering-technology-of-reinvention.pdf
2. https://www.youtube.com/watch?v=9dd3M2a4LKI

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	-	-	-	1	-	1	2	1	1	1
CO2	3	1	2	3	2	1	1	-	1	-	2	2	2	1	1
CO3	3	3	2	3	3	-	-	-	1	-	2	2	2	1	1
CO4	3	2	3	3	3	-	-	-	1	-	3	3	1	1	1
CO5	3	1	2	1	2	1	1	-	1	-	2	2	2	1	1
Avg	**3**	**1**	**2**	**3**	**2**	**1**	**1**	**-**	**1**	**-**	**2**	**2**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23MEO14	FIRE SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To enable the students to acquire knowledge of Fire and Safety Studies
- To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance
- To learn about fire area, fire stopped areas and different types of fire-resistant doors
- To learn about the method of fire protection of structural members and their repair due to fire damage.
- To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT-I INHERENT SAFETY CONCEPTS 9

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials, Behavior of non-structural materials

UNIT-II PLANT LOCATIONS 9

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements standard heating condition, Indian standard test method

UNIT-III WORKING CONDITIONS 9

Fire separation between building- principles of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures

UNIT-IV FIRE SEVERITY AND REPAIR TECHNIQUES 9

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs

UNIT-V WORKING AT HEIGHTS 9

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies

TOTAL : 45 PERIODS

Chairman
BoS / Mech

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1:	Understand the effect of fire on materials used for construction
CO2:	Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
CO3:	To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
CO4:	To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.
CO5:	Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS:

1. Roytman, M. Y,||Principles of fire safety standards for building construction||. Amerind Publishing Co. Pvt. Ltd., New Delhi,1975
2. John A. Purkiss,||Fire safety engineering design of structures|| (2nd edn.), Butterworth Heinemann, Oxford, UK,2009.

REFERENCE BOOKS:

1. Smith, E.E. and Harmathy, T.Z. (Editors),||Design of buildings for fire safety||. ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
2. Butcher, E. G. and Parnell, A. C, ||Designing of fire safety||. JohnWiley and Sons Ltd., New York, U.S.A.1983.
3. Jain, V.K,||Fire safety in buildings|| (2nd edn.). New Age International(P) Ltd., New Delhi,2010. 4. Hazop&Hazan,||Identifying and Assessing Process Industry Hazards||, Fourth Edition ,1999
4. Frank R. Spellman, Nancy E. Whiting,||The Handbook of Safety Engineering: Principles and Applications||, 2009

E-RESOURCES:

1. https://www.youtube.com/watch?v=izGdVqh0icM

2. https://www.youtube.com/watch?v=ka8oOirP7B8

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	2	-	-	-	3	-	-	1	-	-	-	-	-
CO4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO5	2	-	1	-	-	1	1	1	-	1	-	1	-	-	-
Avg	1.3	-	1.75	-	-	1	1.3	1		1	-	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23MEO15	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students:

- To identify different types of entrepreneurs and analyze factors influencing their success in economic growth.
- To assess key motivational factors and apply strategies from Entrepreneurship Development Programs (EDPs) to enhance entrepreneurial skills.
- To develop a business plan by identifying viable opportunities and conducting market and feasibility research.
- To evaluate sources of finance and apply principles of working capital management and taxation in small businesses.
- To analyze the causes of small business failure and explore government and institutional support for business recovery and growth.

UNIT-I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth

UNIT-II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT-III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT-IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT-V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To understand different types of entrepreneurs and factors influencing entrepreneurial growth.

CO2: To assess key motivational factors and apply strategies from entrepreneurship development programs.

CO3: To formulate a business plan by identifying opportunities and conducting market research.

CO4: To evaluate financial sources, manage working capital, and understand taxation for small businesses.

CO5: To analyze causes of business failure and explore support systems for small businesses.

TEXT BOOKS:

1. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
2. Khanka. S.S., "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi, 2013.

REFERENCE BOOKS:

1. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
2. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.

E-RESOURCES:

1. http://117.240.231.117:8081/jspui/bitstream/123456789/568/1/Entrepreneurship%20%20theory%2C%20process%2C%20practice.pdf
2. https://books.google.co.in/books/about/Entrepreneurial_Development.html?id=uUdLAgAAQBAJ&redir_esc=y

CO's – PO's& PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	-	-	-	-	1	-	1	1	1	1	1
CO2	1	1	1	2	-	-	-	-	1	-	2	2	2	1	1
CO3	1	1	1	2	-	-	-	-	1	-	2	2	2	1	1
CO4	1	2	1	2	2	-	-	-	1	-	3	3	1	1	1
CO5	1	1	1	2	-	-	-	-	1	-	2	2	2	1	1
Avg	**1**	**1**	**1**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**2**	**2**	**2**	**1**	**1**

1 - low, 2 - medium, 3 - high, '-' - no correlation

Chairman
BoS / Mech

23ADO11	INTRODUCTION TO BIG DATA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the competitive advantages of big data analytics.
- To understand the big data frameworks.
- To learn data analysis methods.
- To learn stream computing.
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

UNIT-I INTRODUCTION TO BIG DATA 7

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT-II HADOOP FRAMEWORK 9

Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN.

UNIT-III DATA ANALYSIS 13

Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT-IV MINING DATA STREAMS 7

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT-V BIG DATA FRAMEWORKS 9

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to	
CO1 :	Understand how to leverage the insights from big data analytics
CO2 :	Analyze data by utilizing various statistical and data mining approaches
CO3 :	Perform analytics on real-time streaming data.
CO4 :	Understand the various NoSql alternative database models.
CO5 :	Understand and gain knowledge on Hadoop related tools.

REFERENCE BOOKS:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, —Intelligent Data Analysis‖, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012. 6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.

E-RESOURCES:

1. https://www.google.com/search?q=Cloudera&rlz=1C1CHBD_enIN1109IN1119&oq

CO's – PO's & PSO's MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-
CO2	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-
CO4	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-
CO5	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-
AVG	3	2	2	2	1	-	-	-	-	-	-	-	3	2	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ADO12	PRINCIPLES OF DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Will gain knowledge in the basic concepts of Data Analysis
- To acquire skills in data preparatory and preprocessing steps
- To understand the mathematical skills in statistics
- To learn the tools and packages in Python for data science
- To gain understanding in classification and Regression Model
- To acquire knowledge in data interpretation and visualization techniques

UNIT-I **INTRODUCTION** **9**

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

SUGGESTED ACTIVITIES

Developing a framework for cleansing, integrating, and transforming data

Simple program exploratory data analysis

SUGGESTED EVALUATION METHODS

Quizzes on data science process.

Assignments on data analysis.

UNIT-II **DESCRIBING DATA ANALYSIS I** **9**

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions –frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – interquartile range – variability for qualitative and ranked data.

SUGGESTED ACTIVITIES

Developing a framework for basic statistics

Simple program on interquartile range

SUGGESTED EVALUATION METHODS

Quizzes on basic statistics.

Assignments on Variability.

UNIT-III **PYTHON FOR DATA HANDLING** **9**

Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping –pivot tables.

SUGGESTED ACTIVITIES

Developing simple programs on structured array

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Programs on hierarchical indexing Simple programs on numpy

SUGGESTED EVALUATION METHODS

Quizzes on algorithms and basic python.

Assignments on hierarchical indexing.

Quizzes on simple python programs.

UNIT-IV **DESCRIBING DATA ANALYSIS II** **9**

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – Population – Analysis of variance.

SUGGESTED ACTIVITIES

Developing simple programs on Normal distributions

Simple programs on regression

SUGGESTED EVALUATION METHODS

Quizzes on Normal distributions.

Assignments on regression.

UNIT-V **PYTHON FOR DATA VISUALIZATION** **9**

Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three dimensional plotting – geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh.

SUGGESTED ACTIVITIES

Developing a visualization framework using matplotlib

Developing programs for data analysis using statmodels and seaborn

SUGGESTED EVALUATION METHODS

Quizzes on matplotlib.

Assignments on data analysis using statmodels and seaborn.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Apply the skills of data inspecting and cleansing

CO2 : Determine the relationship between data dependencies using statistics

CO3 : Can handle data using primary tools used for data science in Python

CO4 : Represent the useful information using mathematical skills

CO5 : Can apply the knowledge for data describing and visualization using tools

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TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, —Introducing Data Science‖, Manning Publications, 2016. (first two chapters for Unit I)
2. Robert S. Witte and John S. Witte, —Statistics‖, Eleventh Edition, Wiley Publications, 2017. (Chapters 1–7 for Units II and IV)
3. Jake VanderPlas, —Python Data Science Handbook‖, O'Reilly, 2016. (Parts of chapters 2–4 for Units III and V)

REFERENCE BOOKS:

1. Allen B. Downey, —Think Stats: Exploratory Data Analysis in Python‖, Green Tea Press, 2014.

E-RESOURCES:

https://nptel.ac.in/courses/106106179

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	1	-	1	1	-	-	-
CO2	3	3	2	2	2	1	-	-	1	-	2	1	-	-	-
CO3	3	3	2	2	2	1	-	-	1	-	2	1	-	-	-
CO4	3	3	2	2	3	1	-	-	2	-	3	1	-	-	-
CO5	3	3	2	2	3	1	-	-	2	-	3	1	-	-	-
AVG	3	3	2	2	2.4	1	-	-	1.4		2.2	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23AD013	DATA VISUALIZATION AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of data visualization.
- To know the working principles of various information visualization depth tools.
- To acquire knowledge about the issues in data representation.
- To visualize the Data using tools Tableau.
- To gain skill in designing real time interactive information visualization system.

UNIT-I INTRODUCTION 9

Context of data visualization – Definition, Methodology, Visualization design objectives.Key Factors – Purpose, visualization function and tone, visualization design options –Data representation, Data Presentation, Seven stages of data visualization, widgets,data visualization tools. Mapping - Time Series - Connections and Correlations -Scatterplot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs

UNIT-II VISUALIZATION TECHNIQUES FOR TIME-SERIES, TREES & GRAPHS 9

Mapping - Time series - Connections and correlations – Indicator-Area chart-Pivot tableScatter charts, Scatter maps - Tree maps, Space filling and non-space filling methodsHierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node linkgraph-Matrix representation for graphs- Info graphics.

UNIT-III TEXT AND DOCUMENT VISUALIZATION 9

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, LocatingFiles for Use with Processing, Loading Text Data, Dealing with Files and Folders, ListingFiles in a Folder ,Asynchronous Image Downloads, Web Techniques, Parsing data -Levels of Effort, Tools for Gathering Clues, Text Markup Languages, RegularExpressions, Grammars and BNF Notation, Compressed Data, Vectors and Geometry,Binary Data Formats, Advanced Detective Work.

UNIT-IV INTERACTIVE DATA VISUALIZATION 9

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity -Layouts – Geomapping – Exporting, Framework – D3.js, TableauDashboards.

UNIT-V SECURITY IN DATA VISUALIZATION 9

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating secured visualization system.

TOTAL : 45 PERIODS

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JRSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Apply mathematics and basic science knowledge for designing information visualizing System.

CO2 : Collect data ethically and solve engineering problem in visualizing the information.

CO3 : Implement algorithms and techniques for interactive information visualization.

CO4 : Conduct experiments by applying various modern visualization tool and solve the space layout problem.

CO5 : Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams

REFERENCE BOOKS:

1 Robert Spence, "Information Visualization An Introduction", Third Edition, Pearson Education, 2014.

2 Colin Ware, "Information Visualization Perception for Design", Third edition, MargonKaufmann Publishers, 2012.

3 Benjamin B. Bederson and Ben shneiderman, "The Craft of Information Visualization", Morgan Kaufmann Publishers, 2003.

4 Thomas strothotte, "Computational Visualization: Graphics, Abstraction and Interactivity", Springer, 1998.

5 Matthew O. Ward, George Grinstein, Daniel Keim, "Interactive Data Visualization: Foundation, Techniques and Applications", Second Edition, A. K. Peters/CRC Press, 2015.

6 JoergOsarek, "Virtual Reality Analytics", Gordon's Arcade, 2016.

E-RESOURCES:

1. https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/data-visualization

CO's – PO's & PSO's MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	3	-	-	-	-	2	3	3	3	2	2	2
CO2	2	2	2	1	1	-	-	-	3	2	3	1	3	1	3
CO3	2	1	2	1	1	-	-	-	3	2	1	2	2	2	1
CO4	2	2	2	1	-	-	-	-	1	2	1	3	1	3	2
CO5	3	1	1	2	1	-	-	-	3	2	1	2	2	2	3
AVG	**2**	**1**	**2**	**2**	**1**	-	-	-	**2**	**2**	**2**	**2**	**2**	**2**	**2**

1-low,2-medium,3-high,'-'-nocorrelation

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23ADO14	DATA WAREHOUSING AND MINING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand data warehouse concepts, architecture, business analysis and tools.
- To understand data pre-processing and data visualization techniques
- To study algorithms for finding hidden and interesting patterns in data
- To understand and apply various classification and clustering techniques using tools.

UNIT-I **DATA WAREHOUSING, BUSINESS ANALYSIS AND ON-LINE ANALYTICAL PROCESSING (OLAP)** **9**

Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model - Data Warehouse Schemas for Decision Support, Concept Hierarchies -Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

UNIT-II **DATA MINING – INTRODUCTION** **9**

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures

UNIT-III **DATA MINING - FREQUENT PATTERN ANALYSIS** **9**

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns.

UNIT-IV **CLASSIFICATION AND CLUSTERING** **9**

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines –- Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy.

Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods.

UNIT-V **WEKA TOOL** **9**

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Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database

Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners.

TOTAL : 45 PERIODS

At the end of the course the students will be able to

CO1 : Design a Data warehouse system and perform business analysis with OLAP tools.

CO2 : Apply suitable pre-processing and visualization techniques for data analysis.

CO3 : Apply frequent pattern and association rule mining techniques for data analysis.

CO4 : Apply appropriate classification and clustering techniques for data analysis.

CO5 : Apply and understanding the WEKA tool.

(T BOOKS:

1. Jiawei Han and MichelineKamber, —Data Mining Concepts and Techniques||, Third Edition, Elsevier, 2012.

REFERENCE BOOKS:

1. Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP||, Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, ShyamDiwakar and V. Ajay, —Insight into Data Mining Theory and Practice||, Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten and Eibe Frank, —Data Mining: Practical Machine Learning Tools and Techniques||, Elsevier, Second Edition.

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_cs06

s – PO's & PSO's MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	1	-	-	-	-	2	1	-	-	-
CO2	3	2	2	2	1	1	-	-	-	-	2	1	-	-	-
CO3	3	2	2	2	1	1	-	-	-	-	2	1	-	-	-
CO4	3	2	2	2	1	1	-	-	-	-	2	1	-	-	-
CO5	3	2	2	2	1	1	-	-	-	-	2	1	-	-	-
AVG	3	2	2	2	1	1	-	-	-	-	2	1	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ADO15	PRINCIPLES OF CYBER SECURITY	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To learn cybercrime and cyberlaw.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber attack

UNIT-I INTRODUCTION 9

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need forCyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A GlobalPerspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT-II ATTACKS AND COUNTERMEASURES 9

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types ofMalicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – WirelessNetwork Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT-III RECONNAISSANCE 9

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mailServers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning andVulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN– Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing andOS Finger printing Techniques.

UNIT-IV INTRUSION DETECTION 9

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid IntrusionDetection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT-V INTRUSION PREVENTION 9

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy –Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems –Example Unified Threat Management Products.

TOTAL:45PERIODS

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COURSEOUTCOMES:

Attheendofthecoursethestudentswillbeableto

CO1 Explain the basics of cyber security, cybercrime and cyber law

CO2 Classify various types of attacks and learn the tools to launch the attacks.

CO3 Apply various tools to perform information gathering.

CO4 Apply intrusion techniques to detect intrusion.

CO5 Apply intrusion prevention techniques to prevent intrusion

TEXTBOOKS:

1. Anand Shinde, "Introduction to Cyber Security Guide to the World ofCyber Security", NotionPress,2021 (Unit 1)
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, ComputerForensicsand Legal Perspectives", Wiley Publishers, 2011

REFERENCEBOOKS:

1. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones &BartlettLearning Publishers, 2013
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking andPenetrationTesting Made easy", Elsevier, 2011
3. Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers,2007
4. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition,PearsonEducation, 2015
5. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No StarchPress,2014 (Lab)

E-RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview,<CyberSecurityandPrivacy=, Prof.SajiK Mathew, IIT Madras.
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview,<IntroductiontoCyberSecurity=,Dr.Jeetendra Pande,UttarakhandOpenUniversity,Haldwani.

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CO's – PO's & PSO's MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	1	-	-	-	2	3	-	-
CO2	3	3	3	-	-	-	-	1	-	-	-	2	3	-	-
CO3	3	3	3	-	-	-	-	1	-	-	-	2	3	-	-
CO4	3	2	3	-	-	-	-	1	-	-	-	2	3	-	-
CO5	3	2	3	-	-	-	-	1	-	-	-	2	3	-	-
AVG	3	2.6	3	-	-	-	-	1	-	-	-	2	3	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ITO11	BASICS OF JAVA PROGRAMMING (for B.Tech. -IT)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand basic OOP concepts and apply them using Java.
- To develop programs using classes, objects, constructors, arrays, and inheritance.
- To use interfaces, packages, and exception handling for modular programming.
- To perform input/output operations and create multithreaded applications.
- To handle events and build simple interactive applets in Jav

UNIT-I **OBJECT ORIENTED PROGRAMMING CONCEPT** **9**

Object Oriented Paradigm - Objects and classes - Data abstraction and Encapsulation - Inheritance - Polymorphism — Dynamic Binding — Message Communication-Java Evolution — Overview of Java- Constants, Variables and Data types - Operators & Expressions — Decision making: Branching and Looping.

UNIT-II **CLASSES AND OBJECTS** **9**

Arrays - Classes, Objects and Methods — Constructor -Method Overloading — Inheritance — Method Overriding — static —this — Garbage collection —final.

UNIT-III **PACKAGES AND EXCEPTION HANDLING** **9**

Abstract Classes - Interfaces — Defining, Extending and Implementing Interfaces — Accessing Interface Variables. Packages — Managing Errors and Exceptions.

UNIT-IV **IO PACKAGE AND MULTITHREADING** **9**

String- Managing Input and Output — Input Stream Classes — Output Stream Classes — Character Stream Classes-Multithreaded Programming.

UNIT-V **EVENT HANDLING AND APPLET** **9**

Event Handling - Delegation Event Model - Event classes - Key event class - Sources of Events - Event Listener Interfaces - Handling Mouse and Keyboard events - Adapter Classes. Applet Class - Applet Initialization and Termination - Applet display and repaint methods - Passing parameters to applet.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Demonstrate the knowledge of Object Oriented design principles in solving real world problems.

CO2 : Write object oriented programs using classes and objects.

CO3 : Implement the concept of reusability using interfaces and packages and handle runtime errors using exception handling.

CO4 : Develop concurrent applications using IO packages and multithreading.

CO5 : Design and Implement event driven applications using java applets.

TEXT BOOKS:

1. E. Balagurusamy, "Programming with Java A Primer", Tata McGrawHill, Fifth Edition, 2014.
2. Herbert Schildt, "Java the Complete Reference", McGraw Hill Education, Ninth Edition, 2014.

REFERENCE BOOKS:

1. Paul Deitel, Harvey Deitel, "Java How to Program", Prentice Hall, Tenth Edition, 2014.
2. Daniel Liang, "Introduction to Java Programming, Comprehensive Version", Pearson Education, Ninth Edition, 2014.
3. Cay S.Horstmann and Gary Cornell, "Core Java- Volume I Fundamentals", Pearson Education, Ninth Edition, 2012.

E-RESOURCES:

1. http://nptel.ac.in/courses/106106147/, "Java Basics", Prof. Pushpendra Singh, IIT — Madras.
2. http://nptel.ac.in/courses/106105084/28, "Java — Applets Part:1", Prof. Indranil Sengupta, IIT — Kharagpur.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	3	-	-	-	-	-	-	-	1	3	3	3
CO2	1	3	2	3	-	-	-	-	-	-	-	1	3	3	3
CO3	1	3	2	3	-	-	-	-	-	-	-	1	3	3	3
CO4	1	3	2	3	-	-	-	-	-	-	-	1	3	3	3
CO5	1	3	2	3	-	-	-	-	-	-	-	1	3	3	3
AVG	-	3	2	-	-	-	-	-	-	-	-	1	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ITO12	ETHICAL HACKING (for B.Tech. -IT)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of hacking, penetration testing methodologies, and vulnerability assessment frameworks.
- To learn information-gathering and scanning techniques for identifying targets, services, and network vulnerabilities.
- To analyze network-based attacks, sniffing techniques, spoofing, brute-force methods, and exploitation of common network weaknesses.
- To explore exploitation tools such as Metasploit, and apply techniques for payload delivery, post-exploitation, and password cracking.
- To study wireless and web application hacking techniques, including authentication bypass, session attacks, SQL injection, XSS, CSRF, and related vulnerabilities.

UNIT-I **INTRODUCTION TO HACKING** **9**

Introduction to Hacking — Penetration Test — Vulnerability Assessments versus Penetration Test — Rules of Engagement — Penetration Testing Methodologies — OSSTMM — NIST — OWASP — Categories and Types of Penetration Tests — Vulnerability Assessment Reports. Case study: Use security tools in Kali Linux to assess the vulnerabilities.

UNIT-II **INFORMATION GATHERING AND SCANNING** **9**

Information Gathering Techniques — Active and Passive Information Gathering —Traceroute — ICMP Traceroute — TCP Traceroute — UDP Traceroute — Enumerating and Fingerprinting the Webservers — DNS, SNMP, SMTP Enumeration — Target Enumeration and Port Scanning Techniques. Case Study: Understand the network protocols and port scanning techniques using Kali Linux.

UNIT-III **NETWORK ATTACKS** **9**

Vulnerability Data Resources — Network Sniffing — Types of Sniffing — MITM Attacks — ARP Attacks — Denial of Service Attacks —DNS Spoofing — ARP Spoofing Attack — DHCP Spoofing — Remote Exploitation —Traditional Brute Force — Attacking SMTP — Attacking SQL Servers — Testing for Weak Authentication. Case study: Demonstrating the MITM attack using ARP Poisoning using Kali Linux.

UNIT-IV **EXPLOITATION** **9**

Introduction to Metasploit — Reconnaissance, Port Scanning with Metasploit — E—Mails with Malicious Attachments — Browser Exploitation — Post—Exploitation — Hashing Algorithms

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— Windows Hashing Methods — Cracking the Hashes — Brute force Dictionary Attacks — Password Salts — Rainbow Tables — John the Ripper. Case studies: Understand the Metasploit and Exploitations.

UNIT-V **WIRELESS AND WEB HACKING** **9**

Wireless Hacking — Aircrack— Cracking the WEP — Emil Twin Attack — Web Hacking — Brute Force and Dictionary Attacks — Types of Authentication — Captcha Validation Flaw — Captcha RESET Flaw — Authentication Bypass Attacks — Session Attacks — SQL Injection Attacks — XSS (Cross-Site Scripting) — CSRF — SSRF Attacks.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Discuss the vulnerabilities across any computing system using penetration testing.

CO2 : Explain the Foot printing, scanning and Enumeration method of reconnaissance about the target systems in a network.

CO3 : Analyze active and passive sniffing,DNS, ARP, DHCP spoofing techniques in the network systems.

CO4 : Analyze the Metasploit, Browser and post Exploitationsfor hacking the information from a system.

CO5 : Identify vulnerabilities/threats/attacks in system, wireless and web services.

TEXT BOOKS:

1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2017.
2. Kevin Beaver, "Ethical Hacking for Dummies", Sixth Edition, Wiley, 2018.

REFERENCE BOOKS:

1. Jon Erickson , "Hacking: The Art of Exploitation", Second Edition, Rogunix, 2008.
2. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", 1StEdition, 2014.
3. DafyddStuttard, Marcus Pinto,"The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", 2nd Edition, 2011.

E-RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105217/, "Ethical Hacking", Prof. Indranil Sengupta, IIT Kharagpur.

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2. https://www.edureka.co/blog/ethical-hacking-tutoria1/, "Introduction to Cyber security and Ethical Hacking".

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	1	1	-	3	-	1	-	-	2	3	3
CO2	2	2	2	3	-	1	-	3	-	1	-	-	2	3	3
CO3	2	2	2	3	1	1	-	3	-	-	-	-	2	3	3
CO4	2	2	2	3	1	1	-	3	-	-	-	-	2	3	3
CO5	2	2	2	3	-	1	-	3	-	-	-	-	2	3	3
AVG	**2**	**2**	**2**	3	**1**	**1**	-	**3**	-	**1**	-	-	**2**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ITO13	E-COMMERCE AND APPLICATIONS (for B.Tech. –IT)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of E-Commerce, its models, technologies, and their impact on business operations.
- To examine E-Commerce infrastructure including internet technologies, web platforms, mobile applications, and the process of building an online presence.
- To analyze E-Commerce security requirements, threats, technological solutions, policies, and electronic payment systems.
- To explore digital marketing concepts, consumer behaviour, online advertising strategies, and emerging mobile and social marketing techniques.
- To study ethical, legal, and social issues related to E-Commerce, and understand B2B, supply chain management, and sector-specific online business applications.

UNIT-I **INTRODUCTION** **9**

E-Commerce — Difference between E-Commerce and E-Business - Features of E-Commerce technology — types of E-commerce — Growth of the Internet, Web and Mobile platform — Understanding E-commerce: organizing themes - E-Commerce business models - major Business —to-Consumer (B2C) business models — Major Business— to-Business (B2B) business models — E-Commerce enablers — how ecommerce changes business. Case Study: Identify Key components, strategy, B2B, B2C Models of E-commerce Business model of any e-commerce website.

UNIT-II **E-COMMERCE INFRASTRUCTURE** **9**

The internet — internet today — future internet infrastructure — web- internet and web — mobile applications — building an E-Commerce presence — choosing software and hardware — other E-Commerce site tools — developing a mobile web site and building mobile applications.

UNIT-III **E-COMMERCE SECURITY AND PAYMENT SYSTEMS** **9**

E-Commerce security environment — security threats in E-Commerce environment — technology solutions — management policies, business procedures and public laws — E-Commerce payment systems — electronic billing presentment and payment.

UNIT-IV **E-COMMERCE BUSINESS CONCEPTS** **9**

Consumers online — Digital commerce marketing and advertising strategies and tools — internet marketing technologies — understanding the costs and benefits of online marketing communications — social marketing — mobile marketing — local and location-based marketing.

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UNIT-V **SCM, LEGAL AND ETHICAL ISSUES** **9**

Understanding ethical, social and political issues in ecommerce — privacy and information rights — intellectual property rights — governance — public safety and welfare — E-commerce in action: E-tailing business models — service sector: offline and online — online publishing industry — B2B ecommerce and supply chain management. Case study: Present and Future of E- commerce Industry in India.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Examine the concepts of E-Commerce and E-Business and develop B2C and B2B business models for a e-commerce website.

CO2 : Select appropriate infrastructure to develop a mobile website and mobile applications using E-Commerce site tools.

CO3 : Apply the technology solutions, management policies and laws for securing the E-Commerce environment.

CO4 : Analyze the impact of digital commerce marketing and advertising strategies in E-Commerce platform.

CO5 : Explain ethical, social and political issues of E-Commerce and interpret the present and future of E-commerce industry in India.

TEXT BOOKS:

1. Kenneth C.Laudon, Carol Guercio Traver, "E-commerce business Technology society", 10°edition, Pearson Education, 2016.
2. P.T.JosephS.J, "E-Commerce An Indian Perspective", 5*edition, PHI Learning Pvt. Ltd., 2015.
3. Ravi Kalakota, Andrew B. Whinston, "Frontiers of Electronic Commerce", Pearson Education, 1996.

REFERENCE BOOKS:

1. Dave Chaffey, "E-Business and E-Commerce Management: Strategy, Implementation and Practice", 5th edition, Prentice Hall, 2013.
2. IsitaLahiri, Sujit Kumar Ghosh, "Principles of Marketing and E — Commerce", Pearson Education, 2012.
3. AdeshK.Pandey, "Introduction to E-Commerce and ERP", KatsonBooks , 2012.

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E-RESOURCES:

1. http://www.npte1.ac.in/courses/106105084/35, "Electronic Commerce", Prof. Indranil Sengupta, IIT- Kharagpur.
2. http://onlinevideolecture.com/?course_id=1295, "E-Commerce", Prof.Saadat Nisar
3. https://e-commerce2018.com/TOC.html

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	-	1	-	1	-	1	-	-	3	3	3
CO2	2	3	2	3	-	1	-	1	-	1	-	-	3	3	3
CO3	2	3	2	3	-	1	2	1	-	1	-	-	3	3	3
CO4	2	3	2	3	-	1	2	1	-	1	-	-	3	3	3
CO5	2	3	2	3	-	1	2	1	-	1	-	-	3	3	3
AVG	**2**	**3**	**2**	3	-	**1**	**2**	**1**	-	**1**	-	-	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ITO14	BASICS OF ANDROID APPLICATION DEVELOPMENT (for B.Tech. -IT)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Java programming including variables, data types, control statements, classes, objects, arrays, inheritance, interfaces, and exception handling
- To learn XML fundamentals for structuring data using namespaces, DTD, XML Schema, XSL, XPath, and XSLT.
- To understand the Android ecosystem, architecture, tools, and environment setup, and to create basic Android applications.
- To design Android user interfaces using various layouts and UI components.
- To work with Android activities, intents, menus, notifications, and to get introduced to Firebase integration.

UNIT-I **BASICS OF JAVA** **9**

Overview of java— Constants, Variables and Data types —Operators & Expressions — Decision making: Branching and Looping — Classes, Objects and Methods — Arrays—Inheritance — Interface — Exception handling.

UNIT-II **INTRODUCTION TO XML** **9**

XML Introduction — Structuring data —XML namespaces — DTDs — XML Schema documents - XML vocabularies — XSL — XPath — XSLT

UNIT-III **INTRODUCTION TO ANDROID** **9**

Introduction to Android Operating System: Android Ecosystem — Android versions — Android Activity — Features of Android — Android Architecture—Configuration of Android Environment: Android SDK — Android Development Tools (ADT) —Android Virtual Devices (AVDs)— Emulators — Dalvik Virtual Machine —Steps To Install and Configure Eclipse and SDK— Create the First Android Application— Directory Structure

UNIT-IV **ANDROID USER INTERFACE** **9**

Linear Layout —Absolute Layout —Frame Layout —Relative Layout— Table Layout —View: Text View — Button —Image Button —Edit Text —Check Box —Toggle Button —Radio Button and Radio Group —Progress Bar —Auto complete Text View —Spinner —List View —Grid View Card View—Custom Toast Alert —Date Picker.

UNIT-V **ACTIVITY, MENU AND DATABASE** **9**

Activity: Intent — Activity life cycle — Broadcast Life cycle — Service —Menus —Option Menu — Adding and Updating menu items — Handling menu items. Android Notification — Introduction to

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Firebase.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Identify and explain the fundamentals of object oriented programming concepts and decision making statements of programming.

CO2 : Explain XML framework.

CO3 : Analyze architecture, features and configuration of Android operating system.

CO4 : Identify the layouts, views, button and notifications of android user interface.

CO5 : Demonstrate the knowledge on Android Mobile Operating Systems, database and application.

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", llthEdition, McGraw Hill Education, 2019.
2. Jeffrey C. Jackson, "Web Technologies- A Computer Science Perspective", Eleventh Impression, Pearson Education in South Asia, 2012.
3. Prasanna Kumar Dixit, "Android", 1" Edition ,Vikas Publishing House, 2014

REFERENCE BOOKS:

1. B.M. Harwani, "Android Programming Unleashed", 1st Edition, Pearson Education, 2013
2. Ronan Schwarz, Phil Dutson, James Steele, Nelson To,"The Android Developer's Cookbook: Building Applications with the Android SDK", Second Edition, Pearson Education,2013

E-RESOURCES:

1. https://npte1.ac.in/courses/106106147/, "Mobile Computing — Starting Android Programming", Prof. Pushpendra Singh, Prof.SridharIyer, IIT-Madras.
2. https://npte1.ac.in/courses/106106156/, "Introduction to Modern Application Development", Prof. Gaurav Raina, MrTanmai Gopal, IIT-Madras

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	-	1	-	-	-	-	-	1	3	3	3
CO2	2	3	3	2	-	1	-	-	-	-	-	1	3	3	3
CO3	2	3	2	2	-	1	-	-	-	-	-	1	3	3	3
CO4	2	3	3	2	-	1	-	-	-	-	-	1	3	3	3
CO5	1	3	3	2	-	1	-	-	-	-	-	1	3	3	3
AVG	2	3	2	2	-	1	-	-	-	-	-	1	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23ITO15	INTRODUCTION TO WEB DESIGN (for B.Tech. –IT)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of the Internet, web protocols, and website functioning.
- To design structured and responsive web pages using HTML and CSS3.
- To apply JavaScript for client-side scripting, validation, and event handling.
- To develop server-side applications using PHP with database connectivity.
- To use Servlets and JDBC to build interactive and database-driven web applications.

UNIT-I **WEBSITE BASICS** **9**

Internet Overview - Fundamental computer network concepts - Web Protocols - URL — Domain Name- Web Browsers and Web Servers- Working principle of a Website —Creating a Website - Client-side and server-side scripting.

UNIT-II **WEB DESIGNING** **9**

HTML — Form Elements - Input types and Media elements - CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.

UNIT-III **CLIENT-SIDE PROCESSING AND SCRIPTING** **9**

JavaScript Introduction — Variables and Data Types-Statements — Operators - Literals-FunctionsObjects- Arrays-Built-in Objects- Regular Expression, Exceptions, Event handling, Validation - JavaScript Debuggers.

UNIT-IV **SERVER SIDE PROCESSING AND SCRIPTING - PHP** **9**

PHP - Working principle of PHP - PHP Variables - Constants - Operators — Flow Control and Looping - Arrays - Strings - Functions - File Handling - File Uploading — Email Basics - Email with attachments - PHP and HTML - Simple PHP scripts - Databases with PHP.

UNIT-V **SERVLETS AND DATABASE CONNECTIVITY** **9**

Servlets: Java Servlet Architecture — Servlet Life cycle- Form GET and POST actions -Sessions — Cookies — Database connectivity - JDBC Creation of simple interactive applications - Case Study : Creation of information retrieval system using web, PHP and MySQL.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites.

CO2 : Create simple PHP scripts for designing a web application.

CO3 : Design and deploy simple web-applications with client side scripting.

CO4 : Create simple database applications using PHP with server side scripting.

CO5 : Create a web page dynamically using the database connectivity.

TEXT BOOKS:

1. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTMLS" Third Edition, O'Reilly publishers, 2014.
2. Paul Deitel, Harvey Deitel, Abbey Deitel, "Internet & World Wide Web - How to Program", 5th edition, Pearson Education, 2012.

REFERENCE BOOKS:

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education 2006.
2. James F. Kurose, "Computer Networking: A Top-Down Approach", Sixth Edition, Pearson Education, 2012.
3. Steven Holzener , "PHP — The Complete Reference", 1st Edition, Me-Graw Hill, 2017

E-RESOURCES:

1. http://www.npte1.ac.in/courses/106105084/, "Internet Technology", Prof. Indranil Sengupta, IIT- Kharagpur.
2. https://npte1.ac.in/courses/106101163/45/, "Testing of Web Applications and Web Services", Prof. Meenakshi D'Souza, IIT- Bombay.

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	-	-	-	-	-	3	3	3	3
CO2	3	3	3	3	3	2	-	-	-	-	-	3	3	3	3
CO3	3	3	3	2	3	2	-	-	-	-	-	3	3	3	3
CO4	3	3	3	3	3	1	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	1	-	-	-	-	-	3	3	3	3
AVG	**3**	**3**	**3**	2	**3**	**1**	-	-	-	-	-	**3**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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OPEN ELECTIVES - OFFERED BY DEPARTMENT OF PHARMACEUTICAL TECHNOLOGY

		L	T	P	C
23PTO11	NUTRACEUTICALS	3	0	0	3

COURSE OBJECTIVES:

The objective of the course is to

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease

UNIT-I INTRODUCTION AND SIGNIFICANCE 9

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes

UNIT-II ANALYSIS OF PHYTOCHEMICALS 9

Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; falavnols, polyphenols, tannins, saponins, lignans, Chitin; Caratenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

UNIT-III ASSESSMENT OF ANTIOXIDANT ACTIVITY 9

In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources

UNIT-IV ROLE IN HEALTH AND DISEASE 9

Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT-V SAFETY ISSUES 9

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues-International and national.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Discuss about Nutraceuticals in different food sources

CO2 : Illustrate about their significances in treating the infectious diseases.

CO3 : Demonstrate about the adverse effects of antioxidants

CO4 : Examine the mechanism of action of some important phytochemicals and zoochemicals as nutraceuticals and their role in health and diseases.

CO5 : Develop the compounds with pharmacological, toxicological properties and regulatory requirements.

TEXT BOOKS:

1. Bisset, Normal Grainger and Max WichH "Herbal Drugs and Phytopharmaceuticals", 2nd Edition, CRC, 2001.
2. Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC , Publications. 2006
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006
4. Ikan, Raphael "Natural Products : A Laboratory Guide", 2nd Edition, Academic Press / Elsevier, 2005.
5. Tipnis, H.P. "Bioavailability and Bioequivalence : An Update" New Age International.

REFERENCE BOOKS:

1. Asian Functional Foods (Nutraceutical Science and Technology] by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor], CRC Publications, Taylor & Francis, 2007
2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watso (Author), Blackwell Publishing, 2007
3. Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink (Author).
4. Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Woodhead Publ., 2000
5. Hanson, James R. "Natural Products :-The Secondary Metabolites", Royal Society of Chemistry, 2003.

E-RESOURCES:

1. https://nptel.ac.in/courses/103556100
2. http://digimat.in/nptel/courses/video/10410875

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CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	2	-	-	3	-	-	-	-	-	-	-	-	-
CO4	1	2	1	-	-	-	-	-	2	-	-	-	-	-	-	-
CO5	1	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-

1 - Low, 2 - Medium, 3 - high, '-' - no correlation

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23PT012	IPR FOR PHARMA INDUSTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objective of the course is to

- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry

UNIT-I INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS 9

Introduction, Types of Intellectual Property Rights -patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT-II PATENTS 9

Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Nonobviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT-III PLANT VARIETY-TRADITIONAL KNOWLEDGE –GEOGRAPHICAL INDICATIONS 9

Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under IntellectualProperty frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT-IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing, licensing of basic types of IPR, licensing clauses of IPR. Case studies of patent infringement, compulsory licensing, simple patent license agreements.

UNIT-V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT).

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Understand the basic fundamental of Intellectual Property Rights.

CO2 : Assess and critique for Patents and Copyrights

CO3 : Understand the basic theoretical justifications for the protection of traditional Plant varieties.

CO4 : Analyse the laws and enforcement in practical aspects of IPR.

CO5 : Analyse the effects of intellectual property rights on International society.

TEXT BOOKS:

1. N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, "Intellectual Property Rights" Edu creation Publishing, New Delhi, 2017.
2. The Patents Act, 1970 [Bare Act with Short Notes] (New Delhi: Universal Law Publishing Company Pvt. Ltd. 2012.
3. B.S. Rao, P.V. Appaji, "Intellectual Property Rights in Pharmaceutical Industry: Theory and Practice", 2015.

REFERENCE BOOKS:

1. Patents for Chemicals, Pharmaceuticals, & Biotechnology-Fundamentals of Global Law, Practice and Strategy. Philip W. Grubb, Oxford University Press, 2004.
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
3. S. Lakshmana Prabu, TNK. Suriyaprakash, "Intellectual Property Rights", 1st ed., In Tech open access, Croatia, 2017.

E-RESOURCES:

https://nptel.ac.in/courses/10578429
http://digimat.in/nptel/courses/video/1074983/

CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2	2	2	3	2	2	1	2	2	1	2	3	2	3	-
CO2	3	3	2	3	3	3	2	1	2	2	1	3	2	3	3	-
CO3	3	2	3	3	3	3	3	2	2	2	1	2	3	3	2	-
CO4	3	3	3	3	3	3	3	2	3	2	2	3	3	3	3	-
CO5	2	3	3	3	2	3	3	2	2	2	2	3	3	3	3	-

1 - Low, 2 - Medium, 3 - high, '-' - no correlation

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23PT013	PHARMACEUTICAL NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objective of the course is to

- The goal of this course is to provide an insight into the fundamentals of nanotechnology in biomedical and Pharmaceutical research.
- It will also guide the students to understand how nanomaterials can be used for a diversity of analytical and medicinal rationales

UNIT-I NANOSTRUCTURES 9

Preparation, properties and characterization - Self-assembling nanostructure - vesicular and micellar polymerization-nanofilms - Metal Nanoparticles- lipid nanoparticles- nanoemulsion - Molecular nanomaterials: dendrimers, etc.,

UNIT-II NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY 9

Reconstructive Intervention and Surgery- Nanomaterials in bone substitutes and dentistry – Implants and Prosthesis -in vivo imaging- genetic defects and other disease states –Nanorobotics in Surgery –Nanocarriers: sustained, controlled, targeted drug delivery systems

UNIT-III NANOTECHNOLOGY IN CANCER THERAPY 9

Cancer Cell Targeting and Detection, Polymeric Nanoparticles for cancer treatment - mechanism of drug delivery to tumors -advantages and limitations - Multifunctional Agents - Cancer Imaging – Magnetic Resonance Imaging- Cancer Immunotherapy.

UNIT-IV NANOTECHNOLOGY IN COSMETICS 9

Polymers in cosmetics: Film Formers – Thickeners – Hair Colouring - Conditioning Polymers: conditioning, Cleansing – Silicons – Emulsions – Stimuli Responsive Polymeric Systems - Formulation of Nano Gels, Shampoos, Hair-conditioners -Micellar self-assembly Sun-screen dispersions for UV protection – Color cosmetics

UNIT-V NANOTOXICITY 9

NanoToxicology- introduction, dose relationship- Hazard Classification-Risk assessment and management - factors affecting nano toxicity- Dermal Effects of Nanomaterials, Pulmonary, Neuro and Cardiovascular effects of Nanoparticles - Gene–Cellular and molecular Interactions of Nanomaterials

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Comprehend the structural and functional principles of Pharmaceutical nanotechnology.

CO2 : Apprehend the biomedical applications of nanotechnology

CO3 : Recognize nanomaterials for analysis and sensing techniques along with therapy in Cancer

CO4 : Familiarize the use of nanotechnology in cosmetics

CO5 : Analyse the effects of nanomaterials and their toxicity.

TEXT BOOKS:

1. Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag 2004
2. Nanobiotechnology: Concepts, Applications and Perspectives,. CM.Niemeyer C A. Mirkin, (Eds) , Wiley, 2004
3. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, Second Edition, CRC Press, 2013
4. Sarah E. Morgan, Kathleen O. Havelka, Robert Y. Lochhead "Cosmetic Nanotechnology:Polymers and Colloids in Cosmetics", American Chemical Society, 2006.

REFERENCE BOOKS:

1. Nanotechnology in Biology and Medicine: Methods, Devices and Applications, Tuan VoDinh, CRC Press, 2007
2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag 2004
3. Nanotechnology: Environmental Health and safety, Risks, Regulation and Management, Matthew Hull and Diana Bowman, Elsevier, 2010

E-RESOURCES:

1. https://nptel.ac.in/courses/10898100
2. http://digimat.in/nptel/courses/video/156964001

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23PTO14	BASICS OF HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objective of the course is to

- To develop understanding about the structure (gross and histology) and functions of various organs of the human body;
- describe the various homeostatic mechanisms and their imbalances of various systems;
- identify the various tissues and organs of the different systems of the human body and appreciate coordinated working pattern of different organs of each system

UNIT-I FOUNDATIONS OF PHYSIOLOGY, HOMEOSTASIS 9

Organization of the Human Body , Chemical Foundations – Atoms, Ions, Molecules, Bonds, Solutions, Classes of organic molecules; Physical Foundations – Morphology of the cell (plasma membrane, nucleus, cell organelles) Elementary tissues of the human body: epithelial, connective, Muscular and nervous tissues-their sub-types and characteristics, Cellular Transport – Intracellular movement, Intercellular movement, Movement of molecules across the plasma membrane, intercellular communication.

UNIT-II NERVOUS AND MUSCULO-SKELETON SYSTEM 9

Anatomy and physiology of brain, blood-brain barrier, spinal cord, structure and types of the neuron, synapses neurotransmitters, organization of spinal and cranial nerves, central and peripheral nervous system, autonomic nervous system, receptors membrane potentials – graded potentials and action potentials, physiology of vision, audition, olfaction, taste and skin; anatomy and physiology of muscular system, types of muscle tissue – skeletal, smooth, cardiac, contraction, muscle fibre regulation, Osseous system - structure, composition and functions of the Skeleton, classification of joints, types of movements of joints and their disorders

UNIT-III GASTROINTESTINAL AND RENAL SYSTEM 9

Anatomy and physiology of the gastrointestinal tract (secretion, motility, digestion and absorption), structure and function of the liver, spleen, gall bladder, pancreas; the renal system structure – Anatomy and physiology kidney; structure of the nephron and network of blood capillaries urinary tract, formation of urine, concentration of urine; regulation of acidbase balance; the chemical acid-base buffer systems of body fluids and disease conditions

UNIT-IV CARDIOVASCULAR AND PULMONARY SYSTEM 9

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Anatomy and physiology of the heart, lungs, cardiac cycle; circulation of blood, heart rate, blood pressure, ECG and heart sounds, lymphatic vessel, systemic and portal circulation; vascular system – arteries, arterioles, capillaries, venules. Anatomy of respiratory tract, mechanism and dynamics of respiration, lung volumes, transport of oxygen and carbon dioxide, disorders like cyanosis

UNIT-V ENDOCRINE AND REPRODUCTIVE SYSTEM 9

Anatomy and physiology of Pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands, endocrine control of growth and metabolism; pineal, thymus, testes, ovaries, structure and physiology of reproductive systems, sex hormones, physiology of fertilization, menstruation, menopause, spermatogenesis and oogenesis, pregnancy and parturition and clinical disorders

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Define various blood cells and its importance.

CO2 : Demonstrate the functions of central, peripheral and autonomic nervous system andsense organs.

CO3 : Recognize the process of digestion excretion and urine formation.

CO4 : Explain mechanism of blood circulation by heart and respiration by lungs.

CO5 : Understand significance of endocrine glands & its hormones.

TEXT BOOKS:

1. Guyton, A.C. and Hall,J.E. "Textbook of Medical Physiology", 11th Edition, Saunders, 2006.
2. Ganong, W.F. "Review of Medical Physiology", 22nd Edition (A Lange Medical book series) McGraw – Hill (International Ed.) 2005.
3. Khurana, Indu "A Textbook of Medical Physiology" Elsevier, 2006.
4. Johnson, L.R. "Essential Medical Physiology", 3rd Edition, Academic Press / Elsevier), 2003.

REFERENCE BOOKS:

1. Waugh, Anne and Allison Grant "Ross and Wilson Anatomy and Physiology in Health and Illness", 10th Edition, Churchill – Livingstone / Elsevier), 2006.
2. Carola, R., J.P. Harley and C.R. Noback. "Human Anatomy & Physiology", 2nd Edition, McGraw – Hill, 1992.
3. Vander, A.J., J.H. Sherman and D.S. Luciano "Human Physiology: The Mechanisms of Body Function", 5th Edition, McGraw – Hill, 1990.

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23BMO11	BIOSENSORS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Understand the principles and purposes of measurement, methods used, and errors involved.
- To Learn the types, working principles, and classifications of biosensors used in biomedical applications.
- To Analyze the characteristics of biosignals and understand their physiological origins.
- To Comprehend the configurations and functions of electrodes used in biopotential measurements.
- To Understand the design and functioning of bio-amplifiers for signal acquisition and conditioning.

UNIT-I FUNDAMENTALS OF MEASUREMENTS **9**

Measurement System – Instrumentation - Classification and Characteristics of Transducers – Static and Dynamic - Errors in Measurements and their statistical analysis- methods of error analysis-Calibration - Primary and secondary standards.

UNIT-II BIOSENSORS **9**

Biosensors: transduction mechanism in a biosensor and Classification -Electronic nose. Biological Sensors- baro receptors-Hemo receptors-Sensory receptors for smell-vision-Taste, and Olfactory-Bio chemical Sensors for medicine-Fiber optic sensors-Light sensors in medicine-Bio mechanical sensor.

UNIT-III BIOPOTENTIAL MEASUREMENT **9**

Bio signals characteristics – Origin of bio potential and its propagation- Frequency and amplitude ranges- Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes- Unipolar and bipolar configuration, classification of electrodes.

UNIT-IV ELECTRODE CONFIGURATIONS **9**

ECG Electrode system - Einthoven's triangle, standard 12 lead system. EEG –10-20 electrode system, unipolar, bipolar and average mode- EMG–unipolar and bipolar mode- EMG - Electrode configuration-unipolar and bipolar mode.

UNIT-V BIO AMPLIFIERS **9**

Need for bio-amplifier- Differential bio-amplifier– Single ended amplifier- Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier- Power line interference.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze and interpret various electrical measurement parameters such as accuracy, precision, and resolution.

CO2: Select and utilize appropriate measurement tools including multimeters, CROs, and data recorders for biomedical applications.

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CO3: Explain the origin and characteristics of biosignals and apply appropriate methods for biopotential measurement.

CO4: Demonstrate understanding of different electrode configurations used in ECG, EEG, and EMG recordings.

CO5: Design and analyze bio-amplifier circuits for effective acquisition and transmission of biosignals in medical instrumentation.

TEXT BOOKS:

1. Uma Mukherjee, "Biomedical Instrumentation: Technology and Applications", 1st Edition, CRC Press, 2023.
2. John G. Webster, Amit J. Nimunkar, Medical Instrumentation: Application and Design, 5th Edition, Wiley, 2023.

REFERENCE BOOKS:

1. R.S. Khandpur, Biomedical Instrumentation: Technology and Applications, 3rd Edition, McGraw Hill, 2023.
2. C.R. Mahapatra, Biomedical Instrumentation and Measurements, 2nd Edition, PHI Learning, 2022..

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/105/112105249/
2. https://onlinecourses.nptel.ac.in/noc20_me03/preview
3. https://www.jove.com/librarians/resources

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	1	1	-
AVG	3	2	1	1	1	-	-	-	-	-	-	-	1	1	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

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BoS/BME

23BMO12	MEDICAL ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Get introduced to the fundamental of robotics and position analysis.
- To study the kinematics, dynamics, motion planning and control of robotics.
- To understand the concepts of robotics of surgery.
- To understand the concept of robotics for neurosurgery.
- To compare the various future technologies being proposed.

UNIT-I INTRODUCTION TO ROBOTICS AND AUTOMATION **9**

Introduction Automation and Robots, Classification, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation, Four-axis robot.

UNIT-II ROBOT KINEMATICS AND DYNAMICS **9**

Kinematics of manipulators - Rotational, Translation and transformation, Homogeneous transformations, Denavat – Hartenberg representation - Inverse kinematics - Linearization of Robot Dynamics – State variable continuous and discrete models.

UNIT-III ROBOT IN SURGERY **9**

Minimally invasive surgery and robotics integrations, Surgical robotic sub systems, synergistic control, Control modes, Orthopedic surgery.

UNIT-IV ROBOTICS FOR NEUROSURGERY **9**

Introduction to neurosurgical progression-Evolution of neurosurgical robots-Maintaining operator Control – Human machine interface-Future trends: informatics surgery.

UNIT-V ROBOTIC SYSTEMS FOR CARDIOVASCULAR INTERVENTIONS **9**

Introduction-Heart conditions and evolving role of cardiac surgeons and cardiologist- Surgical robot requirements and availability for cardiovascular interventions-Future trends.

TOTAL: 45 PERIODS

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

- **CO1:** Have an understanding of the basics of robotics.
- **CO2:** Understand the kinematics and dynamic involved in design of robotic systems.
- **CO3:** Outline the concepts of robotics of surgery.
- **CO4:** Identify the robotic system used for neurosurgery.
- **CO5:** Compare robotic systems used for cardiovascular interventions.

TEXT BOOKS:

1. Douglas P. Murphy, Robotics in Physical Medicine and Rehabilitation, Elsevier - Health Sciences Division, 2023.
2. Guang-Zhong Yang (Editor), Medical Robotics: Fundamentals, Applications and Challenges, 1st Edition, Springer, 2022.
3. S. B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020.

REFERENCE BOOKS:

1. Moustapha Hamdi, Surgical Robotics: Systems, Applications, and Visions, 2nd Edition, Springer, 2023.

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2. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, Robotics: Modelling, Planning and Control, 2nd Edition, Springer, 2023.

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/105/112105249/
2. https://onlinecourses.nptel.ac.in/noc20_me03/preview

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1
CO5	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1
AVG	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23BM013	BIOMETRIC TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the technologies of fingerprint, iris, face.
- To understand the general principles of design of biometric systems and the underlying trade-offs.
- To recognize personal privacy and security implications of biometrics based identification technology.
- To identify issues in the realistic evaluation of biometrics based systems.
- To interpret the technologies of face recognition.

UNIT-I INTRODUCTION TO BIOMETRICS 9

Biometric technologies – passive biometrics – active biometrics –Biometric systems – Enrollment – templates – algorithm – verification – Biometric applications –biometric characteristics– Protecting privacy and biometrics and policy-Biometric systems.

UNIT-II FINGERPRINT TECHNOLOGY 9

Finger print feature processing techniques – fingerprint sensors using RF imaging techniques – fingerprint quality assessment – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching.

UNIT-III FACE RECOGNITION AND HAND GEOMETRY 9

Face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction – Adaptive Classifiers -Visual- Based Feature Extraction and Pattern Classification – feature extraction – types of algorithm.

UNIT-IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION 9

Behavioral 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.

UNIT-V BIOMETRICS AND ITS APPLICATION 9

Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. -. Expectation- Maximization theory – Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location.

TOTAL: 45 PERIODS

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BoS/BME

COURSE OUTCOMES:

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

CO1: Distinguish the authentication mechanism of the biometric systems

CO2: Illustrate the various methodologies involved in fingerprint technology

CO3: Develop techniques for face recognition and hand geometry biometrics

CO4: Demonstrate the multimodal biometrics and the methods for evaluating the performance

CO5: Implement the concept of Biometrics and its applications

TEXT BOOKS:

1. Raghavendra Ramachandra, Christoph Busch, Biometric Systems: Design, Performance, and Applications, 1st Edition, Elsevier, 2023.
2. Nalini K. Ratha, Ruud M. Bolle, Automatic Fingerprint Recognition Systems, 2nd Edition, Springer, 2022.
3. Marina Gavrilova, Maruf Monwar, Multimodal Biometrics and Intelligent Image Processing for Security Systems, 1st Edition, IGI Global, 2021.

REFERENCE BOOKS:

1. Karthik Nandakumar, Anil K. Jain,Biometric Systems: Technology, Design and Performance Evaluation, 1st Edition, Springer, 2023.
2. Arun A. Ross, Anil K. Jain, Karthik Nandakumar,Handbook of Multibiometrics, 2nd Edition, Springer, 2022.

E-RESOURCES:

1. https://nptel.ac.in/courses/106104119/

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	-	-	3	2	1
CO2	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1
CO3	3	2	2	1	-	-	-	-	-	-	-	-	-	2	1
CO4	3	2	2	1	1	-	-	-	-	-	-	-	3	2	1
CO5	3	2	2	1	1	-	-	-	-	-	-	-	-	2	1
AVG	3	2	2	1	1	-	-	-	-	-	-	-	3	2	1

1 -low,2-medium,3-high,'-'-nocorrelation

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23BM014	HEALTHCARE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To Provide foundational knowledge about various healthcare systems at national, state, and local levels.
2. To Introduce students to national health policies and their importance in public health.
3. To Develop skills in biomedical equipment maintenance and management.
4. To Foster understanding of sustainable human resource strategies in healthcare environments.
5. To Enable students to interpret healthcare data through relevant case studies and investigative methods.

UNIT-I INTRODUCTION HEALTH SYSTEM **9**

Health Organization of the Country, the State and Cities, Health Financial System, Teaching cum Research Hospitals, General Hospital, PHC Reference System, Ambulatory Care.

UNIT-II NATIONAL HEALTH POLICY **9**

Need for Evaluating a Health Policy, Need for providing Primary Health Care, Health Education, Health Insurance, Health Legislation, Inter Sectoral Co-operation.

UNIT-III EQUIPMENT MAINTENANCE MANAGEMENT **9**

Organizing the Maintenance Operation, Biomedical Equipment Procurement Procedure, Proper Selection, Compatibility, Testing and Installation, Purchase and Contract Procedure, Trained Medical Staff, Proper use of Equipment and Operating Instructions. Maintenance Job Planning, Preventive Maintenance, Maintenance Budgeting, Contract Maintenance.

UNIT-IV PERSPECTIVES OF HUMAN RESOURCE MANAGEMENT **9**

Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.

UNIT-V CASE STUDIES **9**

Case Studies: Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the structure and functioning of healthcare systems and organizations.

CO2: Analyze the need for and components of national health policy, including insurance,

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education, and legislation.

CO3: Demonstrate knowledge of biomedical equipment procurement, maintenance planning, and budgeting.

CO4: Analyze human resource strategies and performance indicators in clinical engineering management.

CO5: Interpret case studies involving epidemiological data, imaging systems, and diagnostic tools like ECG and respiratory data.

TEXT BOOKS:

1. Bodenheimer, Understanding Health Policy: A Clinical Approach, 9th Edition, McGraw Hill, 2023.
2. Ryan J, Biomedical Equipment Maintenance and Safety, 1st Edition, 2023.
3. Susan E. Skochelak, Health Systems Science, 2nd Edition, Elsevier, 2020.

REFERENCE BOOKS:

1. Elisabeth Thames Askin, Nathan Moore, "The Health Care Handbook, Third Edition, LWW, 2023.
2. Paul Cerrato, John Halamka, Digital Reconstruction of Healthcare: Patient Safety, Risk Management, and Human Factors Engineering, 1st Edition, Academic Press, 2023.

E-RESOURCES:

1. 1.https://www.eresourcescheduler.com/blog/top-9-resource-management-software-in healthcare
2. https://multiviewcorp.com/blog/different-types-healthcare-software
3. https://www.avanttec.net/hospital-management-system/

CO's – PO's & PSO's MAPPING

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

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23BMO15 **IoT IN HEALTHCARE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide foundational knowledge of the Internet of Things (IoT) with a focus on physical and logical design principles.
- To enable students to analyse communication models and protocols for developing cost-effective IoT applications.
- To introduce core technologies and architectures that drive IoT systems.
- To teach each programming skills for IoT using open platforms such as Arduino and Raspberry Pi.
- To explore real-world case studies highlighting the role of IoT in healthcare applications.

UNIT-I INTRODUCTION TO INTERNET OF THINGS **9**

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack–Fog, Edge and Cloud in IoT.

UNIT-II COMPONENTS IN INTERNET OF THINGS **9**

Functional Blocks of an IoT Ecosystem–Sensors, Actuators, and Smart Objects–Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

UNIT-III PROTOCOLS AND TECHNOLOGIES BEHIND IoT **9**

IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT-IV OPEN PLATFORMS AND PROGRAMMING **9**

IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT-V CASE STUDY/HEALTHCARE **9**

IOT in Emergency and Healthcare services, Components of IoT healthcare, Remote health care, Real time monitoring, Preventive care, Preventive Cardiological Monitoring, Health care systems- Activity Monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the evolution, architecture, and enabling technologies of IoT.

CO2: Identify the key components of IoT ecosystems including sensors, actuators, and communication modules.

CO3: Evaluate the protocols and technologies behind IoT systems such as MQTT, CoAP, and 6LoWPAN.

CO4: Develop and implement basic IoT applications using Arduino/Raspberry Pi platforms and integrate with cloud services.

CO5: Apply IoT solutions to healthcare scenarios involving real-time monitoring, preventive care, and remote diagnostics.

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TEXT BOOKS:

1. Alex Khang,AI and IoT Technology and Applications for Smart Healthcare Systems',1st Edition, 2024.
2. IoT in Healthcare Systems: Applications, Benefits, Challenges, and Case Studies," 1st Edition,CRC Press, 2023.
3. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, 2nd Edition, VPT, 2023.

REFERENCE BOOKS:

1. Ovidiu Vermesan, Peter Friess (Editors), Internet of Things–The Call of Edge: Everything Intelligent Everywhere, 1st Edition, River Publishers, 2022.
2. D Jeya Mala ,"Integrating AI in IoT Analytics on the Cloud for Healthcare Applications ", 1st Edition, Engineering Science Reference, 2021.
3. Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, 1st Edition, Elsevier/Morgan Kaufmann, 2021.

E-RESOURCES:

1. https://archive.nptel.ac.in.
2. https://www.jove.com/

CO's – PO's & PSO's MAPPING

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	-	1	1	1	-
CO2	3	2	2	1	1	-	-	-	-	-	-	1	1	1	-
CO3	3	2	2	1	1	-	-	-	-	-	-	1	1	1	-
CO4	3	2	2	1	1	-	-	-	-	-	-	1	1	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	1	1	1	-
AVG	3	2	1	1	1	-	-	-	-	-	-	1	1	1	-

1 -low,2-medium,3-high,'-'-nocorrelation

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23CRO11 **MOBILE DEVICE SECURITY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide a strong foundation in mobile communication concepts and security issues across different generations of wireless networks.
- To develop knowledge of device, network, server, and application-level security mechanisms in mobile and wireless environments.
- To enable students to apply authentication and access control techniques for securing mobile devices and applications.
- To train students in analyzing vulnerabilities, threats, and security testing reports for identifying and mitigating risks in wireless systems.
- To expose students to security challenges in MANETs, ubiquitous computing, and mobile commerce, and explore existing and emerging solutions

UNIT-I **SECURITY ISSUES IN MOBILE COMMUNICATION** **9**

Mobile Communication History - Security – Wired Vs Wireless, Security Issues in Wireless and Mobile Communications, Security Requirements in Wireless and Mobile Communications, Security for Mobile Applications, Advantages and Disadvantages of Application-level Security.

UNIT-II **SECURITY OF DEVICE, NETWORK, AND SERVER LEVELS** **9**

Mobile Devices Security Requirements - Mobile Wireless network level Security, Server Level Security; Application - Level Security in Wireless Networks - Application of WLANs, Wireless Threats, Some Vulnerabilities and Attach Methods over WLANs, Security for 1G Wi-Fi Applications, Security for GWi- Fi Applications, Recent Security Schemes for Wi-Fi Applications.

UNIT-III **APPLICATION-LEVEL SECURITY IN CELLULAR NETWORKS** **9**

Generations of Cellular Networks - Security Issues and attacks in cellular networks - GSM Security for applications - GPRS Security for applications - UMTS security for applications - 3G security for applications -Some of Security and authentication Solutions.

UNIT-IV **APPLICATION-LEVEL SECURITY IN MANETS** **9**

MANETs-Applications of MANETs, MANET Features, Security Challenges in MANETs; Security Attacks on MANETs - External Threats for MANET applications, Internal threats for MANET Applications, Some of the Security Solutions; Ubiquitous Computing - Need for Novel Security Schemes for UC Security Challenges for UC, Security Attacks on UC networks, Some of the security solutions for UC.

UNIT-V **SECURITY FOR MOBILE COMMERCE APPLICATION** **9**

M-commerce Applications - M-commerce Initiatives - Security Challenges in Mobile E-commerce -

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Types of Attacks on Mobile E-commerce - A Secure M-commerce Model Based on Wireless Local Area Network – Some of M - Commerce Security Solutions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Apply theoretical knowledge to solve real-world security problems and scenarios related to mobile communication.

CO2 : Apply access control mechanisms and user authentication techniques to ensure that only authorized individuals can access device resources.

CO3 : Analyze security testing results and vulnerability reports to prioritize and address application-level security issues.

CO4 : List the various types of threats for MANET applications.

CO5 : Discuss security challenges and attacks over mobile commerce services.

TEXT BOOKS:

1. Pallapa Venkata ram, Satish Babu, "Wireless and Mobile Network Security", 1st Edition, Tata McGraw Hill,2010.
2. Man Ho Au, Raymond Choo," Mobile Security and Privacy",1st Edition, Syngress Publisher,2016

REFERENCE BOOKS:

1. Frank Adelstein, K.S.Gupta , "Fundamentals of Mobile and Pervasive Computing", 1st Edition, Tata McGraw Hill 2005.
2. Randall k. Nichols, Panos C. Lekkas, "Wireless Security Models, Threats and Solutions", 1st Edition, Tata McGraw Hill, 2006.
3. Bruce Potter and Bob Fleck, "802.11 Security", 1st Edition, SPD O'REILLY 2005.
4. James Kempf, "Guide to Wireless Network Security, Springer. Wireless Internet Security - Architecture and Protocols", 1st Edition, Cambridge University Press, 2008.

E-RESOURCES:

https://nptel.ac.in/courses/117104099

https://www.cisco.com/site/us/en/learn/topics/small-business/mobile-device-security.html

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	3	3	3	-	-	-	3	-	-	3	3	3
CO2	3	3	3	3	3	3	-	-	-	3	-	-	3	3	3
CO3	3	-	3	3	3	-	-	-	-	3	-	-	3	3	3
CO4	3	-	3	3	3	-	-	-	-	3	-	-	3	3	3
CO5	3	3	3	3	3	3	-	-	-	3	-	-	3	3	3
AVG	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CRO12 **MALWARE ANALYSIS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide an understanding of malware concepts, types, and behaviors in real-world applications.
- To equip students with techniques and tools required for malware analysis at different levels.
- To develop the ability to analyze malware behavior across multiple platforms, particularly Windows and Android.
- To enable students to design detection signatures and Indicators of Compromise (IOCs) for effective malware detection and response.
- To develop students in static and dynamic analysis methods for identifying and extracting critical information from malware samples.

UNIT-I **MALWARE ANALYSIS** **9**

Malware Components and Distribution – Malware Packers – Persistence Mechanisms - Network Communication- Code Injection - Process Hollowing and API Hooking - Stealth and Rootkits

UNIT-II **MALWARE CLASSIFICATION** **9**

Static Analysis – Dynamic Analysis – Memory Forensics with Volatility -Malware Pay load Dissection and Classification.

UNIT-III **MALWARE REVERSE ENGINEERING** **9**

Debuggers and Assembly Language – Debugging Tricks for Unpacking Malware- Debugging Code Injection-Armoring and Evasion: The Anti-Techniques-Fileless, Macros, and Other Malware Trends.

UNIT-IV **DETECTION ENGINEERING** **9**

Antivirus Engines - IDS/IPS and Snort / Suricata Rule Writing – Malware Sand box Internals – Binary Instrumentation For Reversing Automation

UNIT-V **ANALYZING MALICIOUS WINDOWS PROGRAMS** **9**

Analyzing Malicious Windows Programs – The Windows API -Types and Hungarian Notation-File System Functions-Shared Files-Files Accessible via Namespaces - Alternate Data Streams - The Windows Registry.

TOTAL : 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Identify various malwares the behavior of malwares in real world applications.

CO2 : Implement different malware analysis techniques.

CO3 : Analyze the malware behavior in windows and android.

CO4 : Create detection signatures and Indicators of Compromise (IOCs) to identify malware detection engineering.

CO5 : Conduct static analysis on Windows executables and DLLs to extract meaningful information without execution.

TEXT BOOKS:

1. Malware Analysis and Detection Engineering, A Comprehensive Approach to Detect and Analyze Modern Malware by Abhijit Mohanta,Anoop Saldanha, 2020,Publisher(s): Apress, ISBN: 9781484261934
2. Michael Sikorski and Andrew Honig,"PracticalMalwareAnalysis"byNoStarchPress,2012,ISBN: 9781593272906

REFERENCE BOOKS:

1. Jamie Butler and Greg Hoglund, "Rootkits: Subverting the Windows Kernel" by 2005, AddisonWesley Professional.
2. Bruce Dang, Alexandre Gazet, Elias Bacchanalian, Sebastien Josse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.

E-RESOURCES:

https://www.geeksforgeeks.org/software-engineering/introduction-to-malware-analysis/

https://tryhackme.com/module/malware-analysis

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	-	-	-	-	-	-	-	3	3	3
CO2	-	-	-	3	-	-	-	-	-	-	-	-	3	3	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
CO4	3	-	-	-	3	-	-	-	-	-	-	-	3	3	3
CO5	-	3	-	-	-	-	-	-	-	-	-	-	3	3	3
AVG	**3**	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CRO13 **HARDWARE SECURITY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the principles of secure hardware design, focusing on redundancy, fail-safes, and encryption for building resilient systems.
- To provide an understanding of the trade-offs between security and performance in implementing hardware security primitives.
- To develop the ability to apply side-channel analysis techniques, such as Differential Power Analysis, for evaluating cryptographic implementations.
- To equip students with knowledge of power management strategies to optimize energy efficiency in integrated circuits (ICs).
- To enable students to design and implement countermeasures against hardware threats, including Trojans, through redundancy, isolation, and error detection.

UNIT-I **MODERN HARDWARE DESIGN** **9**

Introduction – Mapping an algorithm to hardware – Binary GCD Processor – Enhancing the performance of a hardware design – modelling of the computational elements of the gcd processor.

UNIT-II **HARDWARE DESIGN OF THE ADVANCED ENCRYPTION STANDARD** **9**

Algorithmic and Architectural Optimizations for AES Design - Circuit for the AES S-Box - Implementation of the Mix Column Transformation - An Example Reconfigurable Design for the Rijndael Cryptosystem - Single Chip Encryptor/Decryptor

UNIT-III **SIDE – CHANNEL HARDWARE** **9**

Types of Side Channel Attacks - Kocher's Seminal Works - Power Attacks - Fault Attacks - Cache Attacks – Scan Chain-Based Attacks - Scan Chain-Based Attacks on Cryptographic Implementations - Scan Attack on Trivium - Testability of Cryptographic Designs

UNIT-IV **HARDWARE TROJANS** **9**

Introduction - Trojan Taxonomy and Examples - Multi-Level Attack - Effect of Hardware Trojan on Circuit Reliability - Hardware Trojan Insertion by Direct Modification of FPGA Configuration Bit stream-Statistical Approach for Trojan Detection

UNIT-V **SIDE-CHANNEL ANALYSIS TECHNIQUES FOR HARDWARE TROJANS DETECTION** **9**

Motivation for the Proposed Approaches - Multiple-Parameter Analysis-Based Trojan Detection - Integration with Logic Testing Approach - Obfuscation-Based Trojan Detection/Protection -

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Integrated Framework for Obfuscation – A FPGA-Based Design Technique for Trojan Isolation - A Design Infrastructure Approach to Prevent Circuit Malfunction.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Apply principles of secure hardware design, including redundancy, fail-safes, and robust encryption, to create resilient hardware systems.

CO2 : Analyze the performance impacts of implementing hardware security primitives, including the trade-offs between security and performance

CO3 : Apply Differential Power Analysis methods to extract secret keys by analyzing variations in power consumption during cryptographic operations.

CO4 : Implement power management techniques and strategies to reduce power consumption and improve energy efficiency in ICs

CO5 : Develop measures to mitigate the effects of hardware Trojans, including redundancy, isolation, and error detection mechanisms.

TEXT BOOKS:

1. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, "Hardware Security: Design, Threats, and Safeguards", CRC Press

REFERENCE BOOKS:

1. Ahmad-Reza Sadeghi and David Naccache (eds.): Towards Hardware-intrinsic Security: Theory and Practice, Springer.
2. Ted Huffmire et al: Handbook of FPGA Design Security, Springer.
3. Stefan Mangard, Elisabeth Oswald, Thomas Popp: Power analysis attacks - revealing the secrets of smart cards. Springer 2007.
4. Doug Stinson, Cryptography Theory and Practice, CRC Press.

E-RESOURCES:

https://www.routledge.com/Hardware-Security-Design-Threats-and Safeguards/MukhopadhyayChakraborty/p/book/9781439895832

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
CO2	-	3	-	-	3	-	-	-	-	-	-	-	3	3	3
CO3	-	3	3	-	3	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO5	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3
AVG	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CRO14	WEB AND MOBILE APPLICATION SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of mobile programming and the role of core concepts in application development.
- To provide knowledge of mobile user interface (UI) design principles aligned with user needs and business requirements.
- To explore the design and usability challenges of mobile applications considering device and resource constraints.
- To enable students to integrate databases and web technologies in advanced mobile application development.
- To train students in mobile application development platforms and tools (e.g., Android SDK, Eclipse) to create real-world solutions.

UNIT-I **INTRODUCTION** **9**

Mobile Applications – Characteristics and Benefits – Application Model – Infrastructure and Managing Resources – Mobile Software Engineering – Frameworks and Tools – Mobile devices Profiles.

UNIT-II **USER INTERFACE** **9**

Generic UI Development – UI and Mobile Application – Text to Speech techniques – Designing the right UI –Multimodal and Multichannel UI – Gesture based UIs –Screen Elements and Layouts – Voice XML – Java API.

UNIT-III **APPLICATION DESIGN** **9**

Memory Management – Design patterns for limited memory - Work flow for application development –Techniques for composing applications – Dynamic linking –Plugins and deployment – Security and Hacking.

UNIT-IV **APPLICATION DEVELOPMENT** **9**

Intents and services – Storing and Retrieving data – Communication via the Web – Notification and alarms graphics and multimedia – Telephony – Location based services – Packing and deployment – Security and Hacking.

UNIT-V **TOOLS** **9**

Google Android Platform – Eclipse Simulator – Android Application Architecture – Event based programming – Apple iPhone Platform – UI tool kit interfaces – Eventhandling and Graphics services –

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Layer animation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Assessing mobile UI implementation ensures alignment with user needs, business goals.

CO2 : Design of mobile applications involves understanding and addressing the software and resource constraints of mobile devices to usability.

CO3 : Apply advanced mobile applications that access the database and the web.

CO4 : Analyzing programming basics involves evaluating core concepts like variables, data types, and functions to build efficient applications.

CO5 : Development of mobile applications using Google Android and Eclipse simulator involves assessing current needs, identifying relevant features, and methods to create effective solutions.

TEXT BOOKS:

1. ZigurdMednieks, LaridDornin, "Programming Android", O Reily, 2017.
2. RetoMeier, Professional Android 2 Application Development, WroxWiley, 2019.

REFERENCE BOOKS:

1. AlasdairAllan. iPhone Programming, O Reily 2010.
2. Wei-Meng Lee,BegiiningIPhone SDK Programming with Objective – C, WroxWiley, Second Edition;2012.

E-RESOURCES:

https://onlinecourses.swayam2.ac.in/nou25_ge63/preview

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3
CO2	3	-	3	-	-	-	-	-	-	-	-	-	3	3	3
CO3	3	-	-	3	-	-	-	-	-	-	-	-	3	3	3
CO4	-	-	3	-	-	-	-	-	-	-	-	-	3	3	3
CO5	3	-	3	-	-	-	-	-	-	-	-	-	3	3	3
AVG	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23CRO15 **INFORMATION SECURITY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts and models of information security.
- To make students aware of risks, threats, and vulnerabilities in information systems.
- To emphasize the importance and role of security policies in safeguarding information.
- To provide knowledge on the logical and architectural design of secure information systems.
- To train students in the practical use of tools and techniques for implementing physical and system-level security measures.

UNIT-I **INTRODUCTION** **9**

Introduction to information security: History – Aspects of security – NSTISSC security model– Components of Information system – Securing the components – Balancing security and access – The SDLC – The security SDLC.

UNIT-II **SECURITY INVESTIGATION** **9**

Need for security – Business Needs – Threats – Attacks – Legal – Ethical and Professional Issues.

UNIT-III **SECURITY PRACTICE** **9**

Vulnerability analysis – Auditing – Anatomy of an auditing system –Design of auditing systems – Auditing mechanisms – Risk Management: Identifying and assessing risk – Assessing and controlling risk.

UNIT-IV **LOGICAL DESIGN** **9**

Blueprint for security – Information security policy –Standards and Practices – NIST models – VISA International security Model – Design of security architecture – Planning for continuity.

UNIT-V **PHYSICAL DESIGN AND IMPLEMENTATION** **9**

Security technology – IDS honey pots – Honey nets and Padded cell systems – Scanning and analysis tools – Access control devices – Implementing information security.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Explore the basic concept of information security models.

CO2 : Examine and identify the underlying factors and risks that highlight the need for

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addressing security issues.

CO3 : The effectiveness and applicability of security policies in ensuring information security.

CO4 : Analyze the requirements and components to develop the logical structure of the information system

CO5 : Implement Physical structure of information security system by using security tools.

TEXT BOOKS:

1. Michael E ,Whitman and Herbert J Mattord, "Principles of information Security". Thomson Indian, 2016.
2. Mark Rhodes Ousley, "Information Security: The Complete Reference", Pearson/PHI, 2013.

REFERENCE BOOKS:

1. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw -Hill, 2017.
2. Micki Krause, Harold F, Tipton, "Handbook of Information Security Management", CRC Press LLC,2004.;2007
3. Kevin P. Murphey. Machine Learning, a probabilistic perspective. The MIT Press Cambridge, Massachusetts, 2012.

E-RESOURCES:

https://nptel.ac.in/courses/106106129

https://theintactone.com/2024/06/05/logical-and-physical-design/

CO's – PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3
CO2	-	3	-	-	3	3	-	-	-	-	-	-	3	3	3
CO3	-	-	-	-	3	-	-	-	-	-	-	-	3	3	3
CO4	-	-	-	-	3	-	-	-	-	-	-	-	3	3	3
CO5	-	3	-	-	3	-	-	-	-	-	-	-	3	3	3
AVG	-	**3**	-	-	**3**	**3**	-	-	-	-	-	-	**3**	**3**	**3**

1 - low, 2 - medium, 3 - high, '-' - no correlation

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23AMO11	AI FOR EVERYONE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts of AI, Machine Learning, and Deep Learning along with their scope and capabilities for software requirements analysis.
- To familiarize students with key data terminology, workflows, and tools essential for building AI and Data Science projects, supporting effective software testing and maintenance.
- To develop the ability to plan, organize, and manage AI-based projects by understanding team roles and real-world implementation challenges.
- To create awareness of the societal, ethical, and environmental implications of AI, including issues like bias, adversarial attacks, and their impact on jobs and economies.
- To apply AI techniques and algorithms across various domains to address real-world problems

UNIT I **INTRODUCTION** **9**

Machine Learning – What is Data-Terminology of AI – What makes an AI Company – What Machine Learning Can and Cannot do – Non – Technical Explanation of Deep Learning – Basics of Neural Networks – Examples of AI – Application domains of AI.

UNIT II **BUILDING AI PROJECTS** **9**

Workflow of a Machine Learning Projects – Workflow of a Data Science Projects – How to use data – How to choose an AI Project – Working with an AI Team – How to Process and Visualize Data – Technical Tools for AI Teams – Use of Python in AI related Projects

UNIT III **BUILDING AI IN YOUR COMPANY** **9**

Example roles of an AI Team – AI Pitfalls to avoid, Survey of major AI Application Areas – Case Study: – Smart Speaker, Self-Driving Car

UNIT IV **AI AND SOCEITY** **9**

A Realistic View Of AI – Discrimination / Bias– Adversarial attacks on AI – Adverse uses of AI– AI and Developing Economies – AI and Jobs

UNIT V **APPLICATION OF AI** **9**

AI in Medical Imaging - Fraud Detection – Personalized Recommendations - Precision Agriculture - AI Powered Personalized Learning- AI Recruitment.

TOTAL: 45 PERIODS

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COURSE OUTCOMES :

At the end of the course the students will be able to

CO1: Describe the basic concepts of AI and Machine Learning

CO2: Illustrate how to build different AI projects.

CO3: Explain the working of self- driving systems.

CO4: Analyse the implications of AI technologies for sustainable and inclusive development

CO5: Apply AI techniques to any application domain.

TEXTBOOKS

1. Stuart Russell and Peter Norvig, Artificial Intelligence: *A* Modern Approach, Fourth Edition, Pearson Education, 2020.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Second Edition, O'Reilly Media, 2019.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
4. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, First Edition, MIT Press, 2012.

REFERENCE BOOKS:

1. Zoltán Somogyi,The Application of Artificial Intelligence: Step-by-Step Guide from Theory to Practice, Springer, 2020.
2. Priyadarshini Mehra, Sehgal & Singh, Artificial Intelligence: Applications and Innovations, Routledge, 2021.
3. Springer, Applications of Artificial Intelligence and Machine Learning, First Edition, 2022.

CO'S – PO'S, PSO'S MAPPING:

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

1-Low, 2-Medium, 3-High, "-"No Correlation

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22AMO12 MACHINE LEARNING AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Machine Learning including types of algorithms, processes, and applications.
- To learn supervised learning techniques like SVM, KNN, Naive Bayes, and Decision Trees for classification tasks.
- To enable students to understand and apply various regression techniques—including Linear, Polynomial, and Logistic Regression
- To explore unsupervised learning including clustering techniques like K-Means and Hierarchical Clustering for pattern discovery.
- To apply advanced unsupervised learning techniques like A priori and PCA for association rule mining and dimensionality reduction.

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Machine Learning – Need of Machine Leaning – Types of Machine Learning Algorithms – Machine Learning Process – Data Collection, Exploration, Preparation, Training, Optimization – Applications of Machine Learning.

UNIT II SUPERVISED LEARNING I 9

Supervised Machine Learning – Types of Supervised Machine Learning Algorithms– Classification Algorithms– Support Vector Machine – KNN – Naïve bayes classifiers – Decision Tree –Application of ML– Email Spam Filtering– Fraud Detection– Recommendation Systems

UNIT III SUPERVISED LEARNING II 9

Introduction to Regression Techniques – Linear Regression – Polynomial Regression, Logistic Regression. Application of ML – House Price Prediction, Stock Prediction

UNIT IV UNSUPERVISED LEARNING I 9

Unsupervised Machine Learning – Clustering– K- Means Clustering–Density Based Clustering– Distribution Based Clustering – Hierarchical Clustering–Application of ML– Customer Segmentation

UNIT V UNSUPERVISED LEARNING II 9

Association–A Priori Algorithm –Dimensionality Reduction–Principal Component Analysis– Application of ML –Market Based Analysis – Financial Data Analysis

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TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Describe the fundamental concepts of machine learning

CO2: Illustrate the classification algorithms and its applications

CO3: Examine the concepts of regression and its applications

CO4: Illustrate the features of clustering algorithms

CO5: Describe the association and dimensionality reduction concepts.

TEXTBOOKS

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st Edition, Springer, 2006.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 1st Edition, MIT Press, 2012.
3. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", 2nd Edition, Springer, 2009.
4. C. M. Bishop, "Clustering and Classification", 1st Edition, Springer, 2006.
5. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2011.

REFERENCE BOOKS:

1. Tom M. Mitchell, Machine Learning, 1st Edition, McGraw-Hill Education, 1997.
2. Ethem Alpaydin, Introduction to Machine Learning, 4th Edition, MIT Press, 2020.
3. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, 3rd Edition, Morgan Kaufmann, 2011.
4. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd Edition, O'Reilly Media, 2019.
5. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, 1st Edition, Cambridge University Press, 2014.

CO'S – PO'S, PSO'S MAPPING:

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-		1	-	-	2	1	1
2	2	3	2	2	3	-	-	-	1	1	-	-	3	1	2
3	2	3	2	2	2	2	-	1	2	2	-	-	2	1	2
4	1	2	1	1	2	3	2	3	1	2	-	-	2	1	1
5	1	2	1	1	2	-	-	-	1	1	-	-	3	1	3
AVG	**2**	**2**	**1**	**1**	**2**	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**2**	**1**	**2**

1-Low, 2-Medium, 3-High, "-"No Correlation

SVHEC-R2023

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23AMO13	NETWORK AUTOMATION USING AIML	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of network automation and its relevance to AI and machine learning.
- To explain ML techniques for network traffic prediction, fault detection and resource optimization.
- To develop the ability to apply ML models for network monitoring, traffic prediction, and anomaly detection.
- To explore the application of ML in automating network security and managing threats in real time.
- To Enable hands-on experience with open-source tools, frameworks, and deployment strategies for building intelligent and automated networks.

UNIT I INTRODUCTION TO NETWORK AUTOMATION 9

Evolution of network automation – Traditional vs. programmable networks – Overview of SDN, NFV– Role of automation in modern networks – Tools for automation: Ansible, Netmiko, NAPALM – Configuration management and provisioning.

UNIT II FUNDAMENTALS OF AI/ML IN NETWORKING 9

Overview of AI/ML – Supervised, Unsupervised, and Reinforcement Learning – ML pipelines – Feature extraction from network data – Introduction to data sources in networks – Log parsing and pre-processing.

UNIT III NETWORK MONITORING AND TRAFFIC PREDICTION 9

Traffic classification and prediction – Time series forecasting models (ARIMA, LSTM) – Anomaly detection using ML – QoS prediction – Case study: AI/ML-based bandwidth estimation.

UNIT IV AI/ML DRIVEN NETWORK SECURITY AUTOMATION 9

Intrusion Detection Systems using ML – Threat modelling – Malware detection – Network behaviour analysis – Automating firewall rules – Ethical issues and bias in automated decision making.

UNIT V IMPLEMENTATION FRAMEWORKS 9

Open-source tools: PyATS, Genie, Scapy, Wireshark + Python – Model deployment: Flask, Docker – Integration with cloud-native networks – AI/ML for 5G and edge networks – Real-world applications and case studies.

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TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1 : Explain the role and importance of automation in networking.

CO2 : Apply AI/ML models to network data for traffic prediction and anomaly detection.

CO3 : Use open-source tools to automate and monitor network operations.

CO4 : Evaluate the security implications of AI-based network systems.

CO5 : Design and deploy intelligent network automation workflows.

TEXT BOOKS

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
2. Kumar Saurabh,Machine Learning for Network Automation,First Edition,BPB Publications, 2022.
3. Kanchan Raj, Hands-On Network Programming with Python, Packt Publishing, 2019.
4. Yuxi (Hayden) Liu, Python Machine Learning by Example, 3rd Edition, Packt Publishing, 2020.
5. Adrian Canrill, Automating Networks with Ansible:From Basics to Advanced, First Edition, Leanpub,2023

REFERENCE BOOKS:

1. Thomas A. Limoncelli, Christina J. Hogan, and Strata R. Chalup, The Practice of Network Automation: Enterprise Automation with Python, Addison-Wesley Professional, 2021.
2. Timothy Winters et al., Network Programmability and Automation, First Edition, O'Relly Media, 2018.
3. Giuseppe Attardi, Machine Learning for Networking, Springer, 2021.
4. Amirsina Torfi, Machine Learning for Cybersecurity Cookbook, Packt Publishing, 2020.
5. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 7th Edition, Pearson Education, 2017.

CO'S – PO'S, PSO'S MAPPING:

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

1-Low, 2-Medium, 3-High, "-"No Correlation

SVHEC-R2023

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23AMO14 QUANTUM ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the background of classical computing and quantum computing.
- To study the details of quantum mechanics
- To understand entangled quantum subsystems and properties of entangled states
- To analyse the quantum information processing
- To explore the applications of quantum computing

UNIT I QUANTUM COMPUTING BASIC CONCEPTS 9

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Superpositions.

UNIT II QUANTUM ALGORITHMS 9

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT III STATE TRANSFORMATIONS AND ENTANGLED SUBSYSTEMS 9

Unitary Transformations - Quantum Gates - Language for Quantum Implementations - Quantum Subsystems, Properties of Entangled States - Quantum Error Correction, Graph states and codes, CSSCodes, Stabilizer Codes - Fault Tolerance and Robust Quantum Computing.

UNIT IV QUANTUM INFORMATION PROCESSING 9

Limitations of Quantum Computing - Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems, Bell states - Quantum teleportation. Quantum Cryptography, no cloning theorem

UNIT V QUANTUM AI APPLICATIONS 9

Quantum parallelism - Optimization problems - Drug discovery - Materials science - Financial modelling– Cyber security

TOTAL: 45 PERIODS

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COURSE OUTCOMES :

At the end of the course the students will be able to

CO1: Understand the basics of quantum computing.

CO2 : Extend the computation models.

CO3 : Outline the problems that can be expected to be solved well by quantum computers

CO4 : Simulate and analyse the characteristics of Quantum Computing Systems

CO5 : Utilize the application areas

TEXT BOOKS

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).

2. Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing For Everyone".

REFERENCE BOOKS:

1. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", TenthEdition, Cambridge University Press, 2010.

2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013

CO'S – PO'S, PSO'S MAPPING:

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

1-Low, 2-Medium, 3-High, "-"No Correlation

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23AMO15	REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Reinforcement Learning and the process of maximizing cumulative reward.
- To understand how RL problems are formalized using MDPs
- To explore various RL techniques, including Dynamic Programming and Temporal-Difference Learning to solve RL problems
- To learn more advanced topics such as eligibility traces, N-step prediction and the forward and backward views of TD(λ) to refine RL algorithms
- To analyse the trade-offs between model-based and model-free reinforcement learning approaches.

UNIT I **INTRODUCTION TO REINFORCEMENT LEARNING** **9**

Definitions and Fundamentals of Reinforcement Learning – Key characteristics of RL – Applications of Reinforcement Learning – Elements of RL(Agent,Environment, States,Actions,Rewards) Maximizing cumulative reward-Trial and Error search and delayed rewards – Limitations and Scope of RL

UNIT II **MARKOV DECISION PROCESSES** **9**

Introduction to MDPs – Formalization of RL problems with MDPs – The Markov property value functions and optimal value functions – Beltman Equations – Unified Notation for Episodic and continuing tasks.

UNIT III **TABULAR SOLUTION METHODS** **9**

Dynamic Programming: Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration – Monte Carlo Methods: Action value Estimation, Monte Carlo Control,- Temporal difference learning TD(0) -Q-Learning.

UNIT IV **ELIGIBILITY TRACES** **9**

N-step prediction – Forward view and Backward view of TD(λ) – Implementing TD(λ) – Repalacing and Accumulating Traces – Sarsa(λ) and Q(λ).

UNIT V **PLANNING AND LEARNING** **9**

Model based vs Model free RL – Integrating Planning, Acting and Learning – Dimensions of Reinforcement learning methods.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the fundamentals of reinforcement learning and its components

CO2 : Describe the Markov Decision Process framework and the role of Beltman equations

CO3 : Apply tabular methods, Monte Carlo methods and temporal difference learning

CO4 : Implement eligibility traces and n-step prediction in RL algorithms

CO5 : Analyse the difference between model based and model free RL approaches

TEXTBOOKS

1. Miguel Morales, Grokking Deep Reinforcement Learning, Manning Publications, *2020.*
2. Phil Winder, Reinforcement Learning: Industrial Applications of Intelligent Agents, O'Relly Media 2020

REFERENCE BOOKS:

1. Richard S.Sutton and AndrewG. Barto, Reinforcement learning: An Introduction, Second Edition, MIT Press, 2019.
2. Marco Wiering, Martijn van Otterlo(Ed),Reinforcement Learning, State-of-the-Art, Adaptation,LearningandOptimizationbookseries,ALO,volume12,Springer,2012.
3. Keng, WahLoon, Graesser, Laura, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison Wesley Data &Analytics Series, 2020.
4. Francois Chollet, Deep Learning with Python, Manning Publications, 2018.

CO'S – PO'S, PSO'S MAPPING:

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

1-Low, 2-Medium, 3-High, "-"No Correlation

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23BTO11	BIOTECHNOLOGY FOR ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic functions of the cell and their mechanisms in transport process.
- To get familiarize human anatomy and physiology.
- To learn about microbes, immune system and biomolecules.
- *To know the concepts of applied biology

UNIT-I BASICS OF CELL BIOLOGY 9

An overview of cells – origin and evolution of cells-cell theory-classification of cells – prokaryotic cells and eukaryotic cells; Structure of prokaryotic and eukaryotic cells and their organelles comparison of prokaryotic and eukaryotic cells; Transport across membranes – diffusion - active and passive diffusion.

UNIT-II BASICS OF MICROBIOLOGY 9

Classification of microorganism-microscopic examination of microorganisms; Structural organization and multiplication of bacteria-viruses-algae and fungi; Microorganism used for the production of penicillin-alcohol and vitamin B-12

UNIT-III INTRODUCTION TO INDUSTRIAL BIOPROCESS 9

Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.

UNIT-IV FERMENTATION INDUSTRY 9

Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods

UNIT-V PRODUCTION OF PRIMARY AND SECONDARY METABOLITES 9

A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid ,acetic acid; amino acids - glutamic acid, phenylalanine; ethanol . Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin. Production of single cell protein from wastes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Understand the functions of cell and their structural organization

CO2: Understand the basic of microbes and the products produced from them

CO3: Understand the basics of industrial bioprocess.

CO4: Explain the principle of a fermentation process and the chronological development of fermentation industry.

CO5: Learn the production of various primary and secondary metabolites.

CO's – PO's & PSO's MAPPING

CO/PO Mapping (3/2/1 indicates)													CO/PSOMapping		
COs	Programme Outcomes (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	1	1	1	-	-	-	-	-	-	2	2	1	3	2	-
CO2	1	2	-	-	1	-	-	1	2	-	-	-	2	1	-
CO3	3	3	3	3	2	2	2	-	-	-	1	-	1	2	3
CO4	2	1	2	2	1	2	3	3	-	-	3	3	2	2	2
CO5	1	3	1	3	-	2	2	2	-	3	3	2	1	3	1

Strength of correlation : 3-Strong ,2–Medium,1–Weak

TEXT BOOKS:

1. Peter F. Stanbur., Stephen J. Hall., A. Whitake., "Principles of Fermentation Technology", Science & Technology Books. 2007.

2. Presscott, S.C., Cecil G., Dun, "Industrial Microbiology", Agrobios (India), 2005.

3. Casida, L.E., "Industrial Microbiology", New Age International (P) Ltd, 1968.

REFERENCE BOOK

1. Crueger, W., Anneliese Cruege.,"Biotechnology: A Textbook of Industrial Microbiology", Panima Publishing Corporation, Edition 2, 2003.

2. Sathyanarayana, U., "Biotechnology", Books and Allied (P) Ltd. Kolkata, 2005.

3. Ratledge C., Kristiansen B., "Basic Biotechnology", Cambridge University Press, second Edition, 2001.

E-RESOURCES:

1. https://en.wikipedia.org/wiki/Cell_biology.
2. https://onlinelibrary.wiley.com/journal/15214028
3. https://www.researchgate.net/publication/380565385_Introduction_to_Bioprocess_Technology

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BoS/Pharma.Tech

23BTO12	ENZYME TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn the basics of the various aspects in enzyme technology
- To apply the enzyme technology in their respective disciplines

UNIT-I CLASSIFICATION, MECHANISM AND REGULATION OF ENZYME ACTIVITY 9

Introduction to enzymes, Interaction between enzyme and substrates, lock and key model, induced fit model features of active sites, activation energy. Nomenclature and classification of enzymes; mechanism and regulation of enzyme activity.

UNIT-II OPTIMIZATION OF ENZYME ACTIVITY BY VARIOUS PHYSICO-CHEMICAL METHODS 9

Basic kinetics of enzymatic reactions, MichaelisMenten kinetics, Estimation of kinetic constants, Kcat, turnover number, specific activity, Factors affecting enzyme activity; pH, temperature, substrate and product, concentration. Substrate, product and allosteric inhibition.

UNIT-III IMMOBILIZED ENZYMES AND BIOTRANSFORMATION 9

Various methods of Stabilizing enzymes, immobilization of enzymes, various methods of immobilization methods, adsorption, chemical methods, covalent, ion exchange, Basic mass transfer limitations in immobilized enzymes. Application of immobilized enzymes in various biotransformations

UNIT-IV PRODUCTION OF ENZYMES FROM VARIOUS SOURCES 9

Isolation and extraction of enzymes from plant,animal and microbial sources, Enzyme production from native strains for proteases, cellulases and other enzymes, Enzyme production form recombinant strains such as *E. coli, Pichia pastoris, Aspergillus niger*etc.

UNIT-V APPLICATION OF ENZYMES FOR INDUSTRIAL APPLICATIONS 9

Application of enzymes for commercial biotransformation processes such synthesis of fine chemicals, food, textiles and leather industries. Application enzymes in energy and environment. Biomedical application of enzymes such as biosensors etc.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to:

CO1 : Explain the mechanism and function of enzymes and its classification

CO2 : Learning to optimize the function of enzymes

CO3 : Immobilized enzymes and biotransformation

CO4 : Production of enzymes from various sources

CO5 : Understand the industrial application of enzymes.

TEXT BOOKS:

1. Enzymes Biocatalysis: Principles and Applications byAndrés Illanes (2008) ISBN 978-1-4020-8361-7.
2. Enzyme: Catalysis, kinetics and mechanisms by N.S. Punekar (2018). ISBN 978-981-13-0784-3.

REFERENCES:

1. Fundamentals of Enzymology: The cell and molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis stevens, Oxford University Press, USA
2. Enzymes in Industry: Production And Applications by Aehle W (2007) John Wiley & Sons Inc
3. Nelson, D.L et al., "Lehninger's Principles of Biochemistry" Stryer, Lubert. "Biochemistry". IV Edition, W.H Freeman & Co., 2000.
4. Voet, D.J and J.G. Voet and C.W. Pratt "Principles of Biochemistry" IIIrd Edition, John Wiley & Sons Inc., 2008.
5. Murray, R.K., et al., "Harper's Illustrated Biochemistry". XXVIIth Edition. McGraw-Hill, 2006.

CO's–PO's&PSO'Smapping

CO/POMapping (3/2/1 indicates strength of correlation)													**CO/PSOMapping**		
Cos	ProgrammeOutcomes(POs)												PSOs		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**	**PSO 3**
CO1	3	-			-	-	-	-	-	1	-	1	1	2	1
CO2	3	3	3	3	-	-	-	-	-	1	-	1	1	3	1
CO3	3	3	3	3	1	2	-	-	-	1	-	1	3	-	1
CO4	3	-		-	1	3	-	-	-	1	-	1	1	2	2
CO5	3	-		-	1	-	2	2	-	1	-	1	2	1	-

Strength of corelation : 1-low, 2- medium, 3–high, '-'-no corelation

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23BTO13	INTRODUCTION TO PLANT BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

The main learning objective of this course is to prepare the students to:

- To provide the basics of Agrobacterium and applications of plant biotechnology
- To provide the fundamentals of plant cell culture and offer knowledge about the micromanipulation and transgenic plants.

UNIT- I **PLANT GENOMES AND PLANT TISSUE CULTURE** **9**

Introduction- gene structure and gene expression-regulation, implication for plant transformationheterologous promoters, genome size and organization, mitochondrial and chloroplast genome. Plant tissue culture-plasticity and totipotency, culture, environment, growth regulators, media regulators,
culture types, plant regeneration.

UNIT-II **PLANT TRANSFORMATION TECHNIQUES** **9**

Introduction- Agrobacterium mediated gene transfer –Ti-plasmid-process of T-DNA transfer and integration, transformation in plant, Direct gene transfer methods, Binary vectors- basic features of vectors-optimization, clean gene technology, viral vectors- Gemini virus - cauliflower mosaic virus

UNIT-III **TRANSGENIC PLANTS-HERBICIDE AND PEST RESISTANCE** **9**

Herbicide resistance-use of herbicide in modern agriculture-strategies for engineering herbicide resistance. Environmental impact, pest resistance-nature and scale of insect / pest damage to crop-GM strategies- Bt approach to insect resistance-copy nature strategy-insect resistant crops and food safety

UNIT-IV **PLANT DISEASE RESISTANCE AND STRESS TOLERANCE** **9**

Introduction-plant-pathogen interactions-natural disease resistance pathways biotechnological approaches to disease resistance. Plant viruses- types-entry and replication transgenic approach-PDR Stress tolerance-abiotic stress-water deficit stress and various approaches for tolerance.

UNIT-V **MOLECULAR FARMING AND GM CROPS FUTURE PROSPECTS** **9**

Introduction-carbohydrates and lipids production-molecular farming of proteins, economic considerations for molecular farming.GM crops-current status-concerns about GM cropsregulations of GM crops and products-Greener genetic engineering.

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1: Apply the basic concepts of genetic engineering to establish plant tissue culture.

CO2: Gain knowledge about the significance of viral vectors in genetic transformation.

CO3: Understand GM strategies and BT approaches to develop pesticide and herbicide-resistant plants.

CO4: Demonstrate plant-pathogen interactions and various approaches for resistance.

CO5: Understand the importance of Molecular Pharming.

TEXT BOOKS

1. Adrian Slate., Nigel W.Scott.., Mark R.Fowler., "Plant Biotechnology-The genetic manipulation of plant's", Second edition Oxford University Press 2008.

2. Ignacimuthu .S., "Plant Biotechnology", Oxford and IBH Publishing Co Pvt. Ltd. New Delhi, 2003.

3. Singh B.D., "Text Book of Plant Biotechnology", Kalyani Publishers, 1998.

REFERENCE BOOKS

1. Heldt H., "Plant Biochemistry & Molecular Biology", Oxford University Press, 1997.

2. Bhojwani S.S., Razdan M.K. "Plant tissue culture: Theory and Practice", A revised edition, Elsevier science 1996.

3. Dseke L.J., Kirakosyan A., Kanfman P., Warber S., Duke J.A., Brielmann H.L, "Natural Products from plants" second edition, Taylor and Francis groups, 2006.

4. Ignacimuthu."Plant Biotechnology", Oxford Publishing co Pvt. Ltd, New Delhi, 1997.

CO's – PO's & PSO'S mapping

CO/POMapping (3/2/1 indicates strength of correlation)													CO/PSOMapping		
Cos	ProgrammeOutcomes(POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	1	-			-	-	-	-	-	1	-	1	1	3	1
CO2	3	2	3	3	2	-	-	-	-	1	-	1	1	2	1
CO3	3	3	3	3	1	2	-	-	2	1	-	1	3	-	2
CO4	3	-		-	1	3	-	-	-	1	-	1	1	2	2
CO5	3	-		-	1	-	2	2	-	1	-	1	2	1	-

Strength of corelation : 1-low, 2- medium, 3–high, '-'-no corelation

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23BTO14	BIOFUEL TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce students to the current global energy scenario and emphasize the need for sustainable alternatives by providing a comprehensive understanding of biofuels, biomass resources, and biorefinery concepts.
- To enable students to classify various biomass sources and evaluate their physical and chemical characteristics, thereby understanding the potential of first, second, and third-generation biofuels.

UNIT-I INTRODUCTION 9

Current energy scenario and the need for alternative fuels - overview of biofuel - bioenergy and biorefinery concepts - Biomass sources and classification - Physical and chemical characteristics and potential of different biomass materials - First - second and third generation biofuels

UNIT-II BIODIESEL 9

Transesterification reaction mechanism - Basics and chemistry of fats and oil - Oil resources and feedstock - Methods for biodiesel production - Types of catalysts employed; heterogeneous catalysis, enzyme-based biodiesel - Microalgae based biodiesel - Microalgae cultivation and harvesting methods.

UNIT-III BIOETHANOL 9

Different feedstock for Bioethanol production - Fermentation process - Sugarcane molasses and other sources for fermentation process. - Lignocellulosic pretreatment methods - Hydrolysis - Hydration – Lignin upgradation- Economics of bioethanol production

UNIT-IV BIO-OIL AND BIOHYDROGEN 9

Thermo-chemical conversion of lignocellulose biomass - Biomass processing for liquid fuel production - Biohydrogen production process: Chemical & Biological method; Factors affecting biohydrogen production; Microbial fuel cell & Electrolysis cell - Thermo chemical gasification principles and its application for different biomass treatment

UNIT-V BIOGAS TECHNOLOGY 9

Feedstock for biogas production - Aqueous wastes containing biodegradable organic matter - residues; Microbial and biochemical aspects; Operating parameters for biogas production - Kinetics and mechanism - Dry and wet fermentation

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: To provide foundational knowledge on global energy needs, types of biofuels, biomass resources, and biorefinery concepts, enabling students to understand the potential and classification of various biomass feedstocks.

CO2 To impart an understanding of the chemistry of fats and oils, transesterification mechanisms, biodiesel production methods, and microalgae-based fuel technologies, including cultivation and harvesting systems.

CO3: To introduce students to different bioethanol feedstocks, fermentation processes, lignocellulosic pretreatment, hydrolysis techniques, and the economic considerations of industrial bioethanol production.

CO4: To develop knowledge of thermochemical biomass conversion, liquid biofuel processing, chemical and biological hydrogen production pathways, and gasification technologies for diverse biomass systems.

CO5: To enable students to understand biogas feedstocks, microbial and biochemical digestion processes, operational parameters, kinetics, and the differences between dry and wet fermentation systems.

TEXT BOOKS:

1. Caye M Drapcho, Nhuan Phu Nghiem , Terry Walker , "Biofuels Engineering Process Technology",
2. David M Mousdale , "Introduction to Biofuels", CRC Press, 2010.

REFERENCE BOOKS:

1. Rezaiyan. J , N. P. Cheremisinoff , "Gasification Technologies, A Primer for Engineers and Scientists"
2. Venkata Ramana P , Srinivas S.N , "Biomass Energy Systems", Tata Energy Research Institute, 1996.

CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PS O3	PS O4
CO1	3	3	-	-	-	3	2	-	2	-	-	2	-	-	-	-
CO2	3	3	-	-	-	2	2	-	2	-	-	-	-	-	3	-
CO3	3	3	-	2	3	2	-	-	2	-	-	-	-	-	3	2
CO4	3	3	-	3	3	2	3	-	-	-	-	-	-	-	3	2
CO5	3	3	-	2	3	-	3	-	2	-	-	-	-	-	3	2

Strength of corelation : 1 - low, 2 - medium, 3 – high, '-' - no correlation

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23BTO15	FORENSIC TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart fundamental knowledge on forensic science and the application of biotechnological and molecular techniques in forensic investigations.
- To enable understanding of DNA-based identification methods along with ethical, legal, and quality aspects of forensic biotechnology.

UNIT-I INTRODUCTION TO FORENSIC BIOTECHNOLOGY 9

Scope and importance of forensic biotechnology -History and development of forensic science- Types of biological evidence - Crime scene investigation and sample handling- Chain of custody and contamination prevention

UNIT-II HUMAN GENETICS AND MOLECULAR BASIS OF FORENSICS 9

Human genome organization - Genetic polymorphism - Autosomal, Y-chromosomal and mitochondrial DNA - Sex determination markers - Population genetics in forensic analysis

UNIT-III DNA PROFILING AND MOLECULAR TECHNIQUES 9

DNA extraction from forensic samples - DNA quantification methods - PCR and forensic PCR inhibitors STR, VNTR and SNP analysis - DNA fingerprinting and interpretation.

UNIT-IV 9

Real-time PCR applications - Next-Generation Sequencing (NGS) - Mitochondrial DNA typing - Microbial forensics - Forensic proteomics and transcriptomics

UNIT-V 9

Paternity and kinship analysis -Identification in mass disasters - Wildlife forensic biotechnology - DNA databases (CODIS, Indian DNA databank) - Ethical, legal and quality assurance aspects

TOTAL : 45 PERIODS

Course Outcomes :

CO1 Understand the principles and scope of forensic biotechnology

CO2 Explain the genetic basis of forensic identification

CO3 Apply DNA profiling techniques for forensic analysis

CO4 Analyze advanced biotechnological tools used in forensics

Course Outcomes :

CO5 Evaluate forensic applications along with ethical and legal considerations

TEXT BOOKS :

1. Butler, J.M., *Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers*, 2nd Edition, Elsevi Academic Press.
2. Saferstein, R., *Criminalistics: An Introduction to Forensic Science*, 11th Edition, Pearson Education.

REFERENCE BOOKS :

1. Houck, M.M. & Siegel, J.A., *Fundamentals of Forensic Science*, 3rd Edition, Academic Press.
2. James, S.H., Nordby, J.J. & Bell, S., *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 4th Edition, CRC Press.
3. Jobling, M.A., Gill, P. & Evison, M.P., *Encoded Evidence: DNA in Forensic Analysis*, 1st Edition, Wiley-Blackwell.

CO's – PO's & PSO's MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO1	3	2	-	-	-	-		1	-	-	-	1	2	-	-
CO2	3	3	-	-	-	-	-	1	-	-	-	-	2	1	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-	3	2	1
CO4	2	3	2	3	2	-	-	-	-	-	-	1	3	2	2
CO5	1	2	-	-	-	3	2	3	2	2	-	2	1	3	2

Strength of corelation : 1 - low, 2 - medium, 3 – high, '-' - no correlation

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