P. A. COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai)
An ISO 9001:2015 Certified Institution - Accredited by NBA and NAAC with 'A' Grade
Pollachi – 642 002

B. E. MECHANICAL ENGINEERING

CURRICULA AND SYLLABI

(I to VIII Semester)

REGULATION

2022

Vision and Mission of the Institute and Department

Vision of the Institute

To progress to become a center of excellence in Engineering and Technology through creative and innovative practices in teaching-learning process and promoting research and development to produce globally competitive and employable professionals who are psychologically strong and emotionally balanced with social perception and professional ethics.

Mission of the Institute

To offer academic programmes, in the emerging areas of Engineering and Technology, provide training and research facilities and opportunities to promote student and faculty research in collaboration with Industry and Government for sustainable growth.

Vision of the Department

To achieve standards of quality education by keeping pace with modern trends and create technical manpower with capabilities of accepting challenges.

Mission of the Department

To impart quality and value based education among students to nourish the knowledge in Mechanical Engineering, create competent professionals and provide all possible support to promote research and development activities.

Program Educational Objectives (PEO)

The objectives of the programme are to provide the following to the students:

PEO 1: To acquire the fundamental and technical knowledge in the field of Mechanical Engineering and allied fields.

PEO 2: To impart skill based training program to design, analyze and create innovative solutions for technical challenges for the emerging industrial needs and higher studies.

PEO 3: To inculcate students with professional and ethical attitude, effective communication and managerial skills.

Program Specific Outcomes (PSO):

The following outcomes of the programme are provided to the students:

PSO 1: Understand the concepts in various areas of Mechanics, Manufacturing, Design, Materials and Thermal engineering.

PSO 2: Apply the engineering concepts in various domains and to solve the problems through latest design and manufacturing software tools.

PSO 3: Provide solution to the social relevant problems through mechanical engineering concepts with ethical values.

Program Outcomes (POs):

Engineering Graduates will be able to:

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.

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

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.

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
		Induction Programme	0	0	0	0
THEORY						
1	22CAHS101	Professional English - I	3	0	0	3
2	22CABS102	Matrices and Calculus	3	1	0	4
3	22CABS103	Engineering Physics	3	0	0	3
4	22CAES104	Engineering Graphics	1	0	4	3
5	22CAES105	C Programming	3	0	0	3
6	22CAHS109	Heritage of Tamils	1	0	0	1
PRACTICAL						
7	22CAES106	Programming in C Laboratory	0	0	3	1.5
8	22CAES107	Engineering Practices Laboratory	0	0	3	1.5
9	22CAHS108	Communication Skills Laboratory	0	0	2	1
		Total	**14**	**1**	**12**	**21**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22CAHS201	Professional English - II	3	0	0	3
2	22CABS202	Advanced Calculus and its Applications	3	1	0	4
3	22MEBS203	Material Science	3	0	0	3
4	22MEBS204	Applied Chemistry	3	0	0	3
5	22CAES205	Basics of Electrical and Electronics Engineering	3	0	0	3
6	22MEPC206	Engineering Mechanics	3	0	0	3
7	22CAHS202	Tamils and Technology	1	0	0	1
PRACTICAL						
8	22CABS107	Physics and Chemistry Laboratory	0	0	3	1.5
9	22MEES207	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
		Total	**19**	**1**	**6**	**23**

SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22CABS301	Transform Techniques and its Applications	3	1	0	4
2	22MEPC302	Engineering Thermodynamics	3	1	0	4
3	22MEPC303	Fluid Mechanics and Machinery	3	0	0	3
4	22MEPC304	Manufacturing Technology - I	3	0	0	3
5	22MEES305	Electrical Drives and Control	3	0	0	3
6	22CAMC306	Constitution of India	3	0	0	0
PRACTICAL						
7	22MEPC307	Fluid Mechanics and Machinery Laboratory	0	0	3	1.5
8	22MEPC308	Manufacturing Technology Laboratory - I	0	0	3	1.5
		Total	**18**	**2**	**6**	**20**

SEMESTER IV

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22CABS402	Numerical Methods	3	1	0	4
2	22MEPC401	Thermal Engineering	3	0	0	3
3	22MEPC403	Engineering Materials and Metallurgy	3	0	0	3
4	22MEPC404	Manufacturing Technology -II	3	0	0	3
5	22MEPC405	Strength of Materials	3	0	0	3
6	22CAHS306	Environmental Science and Engineering	3	0	0	3
PRACTICAL						
7	22MEPC407	Manufacturing Technology Laboratory - II	0	0	3	1.5
8	22MEPC408	Strength of Materials Laboratory	0	0	3	1.5
9	22MEPC409	Computer Aided Modelling Laboratory	0	0	4	2
		Total	**18**	**1**	**10**	**24**

SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22MEPC501	Heat and Mass Transfer	3	0	0	3
2	22MEPC502	Metrology and Measurements	3	0	0	3
3	22MEPC503	Computer Aided Design and Manufacturing	3	0	0	3
4	22MEPC504	Design of Machine Elements	3	0	0	3
5	22MEPE5xx	Professional Elective-I	3	0	0	3
6	22MEOExx	Open Elective - I	3	0	0	3
PRACTICAL						
7	22MEPC505	Thermal Engineering Laboratory	0	0	3	1.5
8	22MEPC506	Metrology and Measurements Laboratory	0	0	3	1.5
9	22MEPC507	Computer Aided Machining Laboratory	0	0	4	2
		Total	**18**	**0**	**10**	**23**

SEMESTER VI

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22MEPC601	Theory of Machines	3	0	0	3
2	22MEPC602	Design of Transmission Systems	3	0	0	3
3	22MEPC603	Finite Element Analysis	3	0	0	3
4	22CAHS604	Professional Ethics in Engineering	3	0	0	3
5	22MEPE6xx	Professional Elective –II	3	0	0	3
6	22MEOExx	Open Elective-II	3	0	0	3
PRACTICAL						
7	22MEPC605	Theory of Machines Laboratory	0	0	3	1.5
8	22MEPC606	Heat Transfer Laboratory	0	0	3	1.5
9	22MEEE607	Design and Fabrication Project	0	0	4	2
		Total	**18**	**0**	**10**	**23**

SEMESTER VII

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22MEPC701	Mechatronics	3	0	0	3
2	22MEPC702	Industrial Robotics	3	0	0	3
3	22MEPE7xx	Professional Elective-III	3	0	0	3
4	22MEPE7xx	Professional Elective-IV	3	0	0	3
5	22MEOExx	Open Elective-III	3	0	0	3
PRACTICAL						
7	22MEPC703	Mechatronics Laboratory	0	0	3	1.5
8	22MEPC704	Simulation and Analysis Laboratory	0	0	3	1.5
9	22MEEE705	Project Phase – I	0	0	4	2
		Total	**15**	**0**	**10**	**20**

SEMESTER VIII

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	22MEPE8xx	Professional Elective-V	3	0	0	3
2	22CAOExx	Open Elective-IV	3	0	0	3
PRACTICAL						
3	22MEEE801	Project Work	0	0	16	8
		Total	**6**	**0**	**16**	**14**

Total number of credits to be earned for award of the Degree = 168

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22CAHS101	Professional English – I	3	0	0	3
2	22CAHS109	Heritage of Tamils	1	0	0	1
3	22CAHS108	Communication Skills Laboratory	0	0	2	1
4	22CAHS201	Professional English – II	3	0	0	3
5	22CAHS202	Tamils and Technology	1	0	0	1
6	22CAHS306	Environmental Science and Engineering	3	0	0	3
7	22CAHS604	Professional Ethics in Engineering	3	0	0	3

BASIC SCIENCES (BS)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22CABS102	Matrices and Calculus	3	1	0	4
2	22CABS103	Engineering Physics	3	0	0	3
3	22CABS202	Advanced Calculus and its Applications	3	1	0	4
4	22MEBS203	Material Science	3	0	0	3
5	22MEBS204	Applied Chemistry	3	0	0	3
6	22CABS107	Physics and Chemistry Laboratory	0	0	3	1.5
7	22CABS301	Transform Techniques and its Applications	3	1	0	4
8	22CABS402	Numerical Methods	3	1	0	4

ENGINEERING SCIENCES (ES)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22CAES104	Engineering Graphics	1	0	4	3
2	22CAES105	C Programming	3	0	0	3
3	22CAES106	Programming in C Laboratory	0	0	3	1.5
4	22CAES107	Engineering Practices Laboratory	0	0	3	1.5
5	22CAES205	Basics of Electrical and Electronics Engineering	3	0	0	3
6	22MEES207	Basic Electrical and Electronics Engineering Laboratory	0	0	3	1.5
7	22MEES305	Electrical Drives and Control	3	0	0	3

PROFESSIONAL CORES (PC)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22MEPC206	Engineering Mechanics	3	0	0	3
2	22MEPC302	Engineering Thermodynamics	3	1	0	4
3	22MEPC303	Fluid Mechanics and Machinery	3	0	0	3
4	22MEPC304	Manufacturing Technology - I	3	0	0	3
5	22MEPC307	Fluid Mechanics and Machinery Laboratory	0	0	3	1.5
6	22MEPC308	Manufacturing Technology Laboratory - I	0	0	3	1.5
7	22MEPC401	Thermal Engineering	3	0	0	3
8	22MEPC403	Engineering Materials and Metallurgy	3	0	0	3
9	22MEPC404	Manufacturing Technology -II	3	0	0	3
10	22MEPC405	Strength of Materials	3	0	0	3
11	22MEPC407	Manufacturing Technology Laboratory - II	0	0	3	1.5
12	22MEPC408	Strength of Materials Laboratory	0	0	3	1.5
13	22MEPC409	Computer Aided Modelling Laboratory	0	0	4	2
14	22MEPC501	Heat and Mass Transfer	3	0	0	3
15	22MEPC502	Metrology and Measurements	3	0	0	3
16	22MEPC503	Computer Aided Design and Manufacturing	3	0	0	3
17	22MEPC504	Design of Machine Elements	3	0	0	3
18	22MEPC505	Thermal Engineering Laboratory	0	0	3	1.5
19	22MEPC506	Metrology and Measurements Laboratory	0	0	3	1.5
20	22MEPC507	Computer Aided Machining Laboratory	0	0	4	2
21	22MEPC601	Theory of Machines	3	0	0	3
22	22MEPC602	Design of Transmission Systems	3	0	0	3
23	22MEPC603	Finite Element Analysis	3	0	0	3
24	22MEPC605	Theory of Machines Laboratory	0	0	3	1.5
25	22MEPC606	Heat Transfer Laboratory	0	0	3	1.5
26	22MEPC701	Mechatronics	3	0	0	3
27	22MEPC702	Industrial Robotics	3	0	0	3
28	22MEPC703	Mechatronics Laboratory	0	0	3	1.5
29	22MEPC704	Simulation and Analysis Laboratory	0	0	3	1.5

PROFESSIONAL ELECTIVES (PE) – I (SEMESTER V)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22MEPE501	Composite Materials	3	0	0	3
2	22MEPE502	Design for Manufacturing and Assembly	3	0	0	3
3	22MEPE503	Design of Jigs, Fixtures and Press Tools	3	0	0	3
4	22MEPE504	Automobile Engineering	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – II (SEMESTER VI)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22MEPE601	Refrigeration and Air-conditioning	3	0	0	3
2	22MEPE602	Gas Dynamics and Jet Propulsion	3	0	0	3
3	22MEPE603	Design of Heat Exchangers	3	0	0	3
4	22MEPE604	Power Plant Engineering	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – III (SEMESTER VII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22MEPE701	Unconventional Machining Processes	3	0	0	3
2	22MEPE702	Lean Six Sigma	3	0	0	3
3	22MEPE703	Automation in Manufacturing	3	0	0	3
4	22MEPE704	Digital Manufacturing and IoT	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – IV (SEMESTER VII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22MEPE705	Advanced I.C. Engines	3	0	0	3
2	22MEPE706	Energy Conservation Management	3	0	0	3
3	22MEPE707	Renewable Energy Technology	3	0	0	3
4	22MEPE708	Equipment for Pollution Control	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – V (SEMESTER VIII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22MEPE801	Supply Chain Management	3	0	0	3
2	22MEPE802	Additive Manufacturing	3	0	0	3
3	22MEPE803	Lean Manufacturing	3	0	0	3
4	22MEPE804	Non Destructive Testing Techniques	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	22MEEE607	Design and Fabrication Project	0	0	4	2
2	22MEEE705	Project Phase – I	0	0	4	2
3	22MEEE801	Project Work	0	0	16	8

MANDATORY COURSES (MC) (NO – CREDIT)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	22CAMC306	Constitution of India	3	0	0	0

OPEN ELECTIVES

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	22ADOE01	Computer Vision	3	0	0	3
2.	22ADOE02	Ethics and AI	3	0	0	3
3.	22ADOE03	Network Security and Firewalls	3	0	0	3
4.	22ADOE04	R Programming	3	0	0	3
5.	22ADOE05	Programming with ASP.Net	3	0	0	3
6	22CSOE01	Computer Graphics and Simulation	3	0	0	3
7	22CSOE02	Data Integration & Big data	3	0	0	3
8	22CSOE03	Game Programming	3	0	0	3
9	22CSOE04	Storage Technologies	3	0	0	3
10	22CSOE05	Recommender Systems	3	0	0	3
11	22ECOE01	Computational Intelligence	3	0	0	3
12	22ECOE02	Wearable Devices	3	0	0	3
13	22ECOE03	VLSI Testing and Design For Testability	3	0	0	3
14	22ECOE04	IoT Based Systems Design	3	0	0	3
15	22ECOE05	Design Thinking	3	0	0	3
16	22EEOE01	Power Plant Engineering	3	0	0	3
17	22EEOE02	Sensors and Transducers	3	0	0	3
18	22EEOE03	Hybrid Energy Technology	3	0	0	3
19	22EEOE04	Biomedical Instrumentation	3	0	0	3
20	22EEOE05	Electric and Hybrid Vehicles	3	0	0	3

21	22ITOE01	Mobile Adhoc Networks	3	0	0	3
22	22ITOE02	Blockchain Technologies	3	0	0	3
23	22ITOE03	Open Source Technologies	3	0	0	3
24	22ITOE04	Android Application Development	3	0	0	3
25	22ITOE05	Digital and Mobile Forensics	3	0	0	3
26	22MEOE01	Testing of Materials	3	0	0	3
27	22MEOE02	Welding Technology	3	0	0	3
28	22MEOE03	Industrial Safety Engineering	3	0	0	3
29	22MEOE04	Marketing Management	3	0	0	3
30	22MEOE05	Maintenance Engineering	3	0	0	3

SUMMARY OF CREDIT DISTRIBUTION

Sl. No	Subject Area	Credits Per Semester								Total Credits	%of credit	Credit Range	
		I	II	III	IV	V	VI	VII	VIII			PA	AICTE
1.	HS	5	4	-	3	-	3	-	-	15	8.93	15	6-15
2.	BS	7	11.5	4	4	-	-	-	-	26.5	15.77	26.5	20-29
3.	ES	9	4.5	3	-	-	-	-	-	16.5	9.82	16.5	14-27
4.	PC	-	3	13	17	17	12	9	-	71	42.26	71	47-61
5.	PE	-	-	-	-	3	3	6	3	15	8.93	15	12-26
6.	OE	-	-	-	-	3	3	3	3	12	7.14	12	9-12
7.	EE	-	-	-	-	-	2	2	8	12	7.14	12	16-20
8.	MC	-	-	0	-	-	-	-	-	0	0.00	0	0-2
	Total	**21**	**23**	**20**	**24**	**23**	**23**	**20**	**14**	**168**	**100**	**168**	**160-173**

HS	Humanities and Social Sciences including management
BS	Basic Science
ES	Engineering Science
PC	Professional Core
PE	Professional Elective
OE	Open Elective
EE	Employability Enhancement Courses

MC	Mandatory Course

22CAHS101 PROFESSIONALENGLISH-I SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To improve the communicative competence of learners.
- To help learners use language effectively in academic /work contexts.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that is relevant to authentic contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.
- To use language efficiently in expressing their opinions via various media.

UNIT-I: INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 9

Listening - For general information – Listening and filling a form
Speaking - Self Introduction
Reading - Brochures and social media messages relevant to technical contexts.
Writing - Writing emails / letters (permission, accepting, declining)
Grammar - Present Tense, Parts of Speech.
Vocabulary - One word substitution; Abbreviations & Acronyms

UNIT-II: NARRATION AND SUMMATION 9

Listening - Listening Comprehension – Monologues - Dialogues.
Speaking - Narrating personal experiences /oral presentation
Reading - Reading biographies, newspaper reports, Reading Comprehension
Writing - Paragraph writing, Short Report on an event (field trip etc.) – discourse markers (connectives & sequence words)
Grammar - Past tense; Subject-Verb Agreement.
Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms

UNIT-III: DESCRIPTION OF A PROCESS / PRODUCT 9

Listening - Listen to a product and process descriptions and advertisements about a product.
Speaking - Picture description; giving instruction to use the product; advertising a product.
Reading - Reading advertisements, gadget reviews; user manuals.
Writing - Writing definitions; instructions; and Product /Process description.
Grammar - Degrees of comparison; Future Tense
Vocabulary - Homonyms; and Homophones.

UNIT-IV: CLASSIFICATION AND RECOMMENDATIONS 9

Listening - Listening and transfer of information- Note-taking.
Speaking - Small Talk; Mini presentations and making recommendations.
Reading - Reading for specific information- interpreting visual materials (pictures, labels. signs, postcards).

Writing - Note-making / recommendations; Transferring information from non verbal (tables, chart, graph etc,) to verbal mode.
Grammar - wh-yes or no- tags.
Vocabulary - Collocations; Fixed / Semi fixed expressions.

UNIT-V: EXPRESSION **9**

Listening - Listening to speeches (experts).
Speaking - Group discussion, Debate, & Role play activities
Reading - Cloze test, speed reading.
Writing - Essay Writing (Descriptive or narrative) - Cause & Effect Expressions
Grammar - Simple, Compound & Complex Sentences
Vocabulary - Idioms - Phrasal verbs.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication" Principles And Practices, Oxford Univ. Press, New Delhi 2022.
2. Dr.S. Mahalakshmi, "Professional English", VK Publications (India) Pvt. Ltd. (2022)
3. Meenakshi Raman & Sangeeta Sharma, "Professional English", Oxford Higher Education, 2018.
4. Aysha Viswamohan, "English For Technical Communication" (With CD), Mcgraw Hill Education, ISBN: 0070264244.
5. Department of English, Anna University, "English for Engineers & Technologists" Orient Blackswan Private Ltd. (2020) edit.
6. Dr. S. Gunasekaran, "A Work Book of Technical English", Vishnu Prints Media, Chennai-(2020) edit.

COURSE OUTCOMES:

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

CO1: Listen and comprehend complex academic texts.
CO2: Read and infer the denotative and connotative meanings of technical texts.
CO3: Write definitions, descriptions, narrations and essays on various topics.
CO4: Speak fluently and accurately informal and informal communicative contexts.
CO5: Express their opinions effectively in both oral and written medium of communication.

22CABS102 **MATRICES AND CALCULUS** **SEMESTER I**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To obtain the knowledge of Eigen values and diagonalization of a matrix.
- To be familiarize with differentiation of single variable and its applications.
- To acquire knowledge of differentiation for more than one variable and its applications.
- To obtain the knowledge of various techniques of integration.
- To acquire the knowledge of multiple integration and related applications.

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

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of a matrix by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation -Nature of quadratic forms.

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

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules – 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 – Maxima and minima of functions of two variables – 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, Integration of irrational functions – Improper integrals.

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.

Contact Periods:

Lecture: 45 Periods **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**

REFERENCES:

1 Kreyszig E., “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Edition, 2018.

2	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition,New Delhi, 2018.
3	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.
5	Thomas G.B., Hass J. and Weir M.D., "Thomas Calculus", Pearson Education, 14th Edition New Delhi, 2018.
6	Anton H., Bivens I. and Davis S., "Calculus", Wiley, 10th Edition, 2016.

COURSE OUTCOMES:

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

CO1: Understand the matrix algebra techniques for solving practical problems.

CO2: Understand the limit definition and rules of differentiation to differentiate functions.

CO3: Apply differentiation to solve maxima and minima problems.

CO4: Apply different methods of integration in solving practical problems.

CO5: Apply multiple integrals ideas in solving areas and volumes.

22CABS103 **ENGINEERING PHYSICS** **SEMESTER I**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students effectively to achieve understanding of mechanics of solids.
- To enable the students to gain knowledge of thermal conductivity of solids.
- To motivate the students towards the applications of acoustics and ultrasonics.
- To equip the students to understand the importance of quantum physics.
- To make the students to understand the basics of crystallography and its importance in studying materials properties.

UNIT-I: MECHANICS OF SOLIDS **9**

Elasticity – Hooke's law – Types of strain – Classification of Modulus of Elasticity – Poisson's Ratio – Stress-Strain diagram – Factors affecting elasticity – Moment, Couple and Torque – Derivation of Twisting Couple on a wire – Bending moment – Depression of a cantilever – Young's modulus by Uniform Bending – Non-Uniform bending – I shaped girders.

UNIT-II: THERMAL PROPERTIES **9**

Thermal Conductivity – Thermal Diffusivity – Specific Heat Capacity – Rectilinear Flow of Heat along a Uniform Bar – Heat conduction in solids – Flow of heat through compound media (parallel and perpendicular) – Determination of Thermal Conductivity of a Good Conductor by Forbe's Method: theory and experiment – Determination of Thermal Conductivity of a poor Conductor by Lee's Disc Method: theory and experiment.

UNIT-III: ACOUSTICS AND ULTRASONICS **9**

Classification of Sound – Decibel – Weber-Fechner law – Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedies. Piezoelectric crystals – Production of ultrasonics – Magnetostriction and piezoelectric methods – Non Destructive testing – Pulse echo system through transmission and reflection modes – Medical application – Sonogram.

UNIT-IV: QUANTUM MECHANICS **9**

Limitations of classical Physics – Introduction to Quantum theory – Dual nature of matter and radiation – Properties of matter waves – de Broglie wavelength in terms of voltage, energy, and temperature – Heisenberg's Uncertainty principle – Verification – Physical significance of wave function – Schrodinger's Time independent and Time dependent wave equations – Particle in a one-dimensional potential well.

UNIT-V: CRYSTALLOGRAPHY **9**

Crystal structures: Crystal lattice – Basis – Unit cell and lattice parameters – Crystal systems and Bravais lattices – Structure and packing fractions of SC, BCC, FCC, diamond and NaCl structures – Crystal planes, directions and Miller indices – Distance between successive planes –Crystalline and non-crystalline materials – Imperfections in crystals.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. D.Halliday, R.Resnick and J.Walker, Principles of Physics, Wiley (Indian Edition), 2015.
2. N.Garcia, A.Damask and S.Schwarz, Physics for Computer Science Students. Springer Verlag, 2012.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGrawHill (Indian Edition), 2017.
4. R.Wolfson, Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
5. Paul A. Tipler, Physics – Volume 1 & 2, CBS, (Indian Edition), 2004.
6. K.Thyagarajan and A.Ghatak, Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.

COURSE OUTCOMES:

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

CO1: Understand the importance of mechanics and their various properties.
CO2: Express their knowledge in thermal physics.
CO3: Apply acoustical and ultrasonic principles for industrial and medical applications.
CO4: Understand the importance of quantum physics.
CO5: Demonstrate a strong foundational knowledge about crystals.

22CAES104 ENGINEERING GRAPHICS SEMESTER I

L	T	P	C
1	0	4	3

COURSE OBJECTIVES:

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

- Drawing various types of conical and special engineering curves.
- Drawing orthographic projection of points, lines and 3D objects.
- Drawing projection of plane surfaces and projection of solids.
- Drawing section of solids and development of solids.
- Drawing isometric projections of simple solids and sketching of 3D objects.

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 3+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: ORTHOGRAPHIC PROJECTION OF POINTS, LINES AND 3D OBJECTS

3+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. Visualization concepts – Visualization principles – Representation of Three Dimensional objects – Layout of views – Sketching of multiple views from pictorial views of objects.

UNIT-III: PROJECTION OF PLANE SURFACES AND SOLIDS
3+12

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method – 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.

UNIT-IV: PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 3+12

Sectioning of 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 cone

UNIT – V: ISOMETRIC PROJECTIONS 3+12

Principles of Isometric projection – Isometric scale – Isometric projections of simple solids and truncated solids: Prisms, pyramids, cylinders, cones – Conversion of orthographic views to pictorial views (Simple objects)

Contact Periods:

Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Bhatt, N.D., "Engineering Drawing", Charotar Publishing House Pvt. Ltd., 53rd Edition, 2019.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., "Engineering Graphics with AutoCAD", PHI Learning, 2nd Edition, 2010.

COURSE OUTCOMES:

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

CO1: Construct the conic curves, involutes and cycloid.

CO2: Solve practical problems involving orthographic projection of points, lines and 3D objects.

CO3: Draw the projections of plane surfaces and simple solids.

CO4: Draw the section of solids and the development of simple solids.

CO5: Draw the isometric projections of simple solids and sketching of 3D objects

Special points applicable to End Semester Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

22CAES105 **C PROGRAMMING** **SEMESTER I**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions and pointers.
- To develop program in C using structures and union.
- To perform file handling operations in C and learn dynamically allocated memory techniques.

UNIT-I: BASICS OF C PROGRAMMING **11**

Generation and Organization of Computers – Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart. Introduction to programming paradigms: Structure of C program – Data Types – Constants – Keywords – Operators and Expressions – Input / Output statements.

UNIT-II: ARRAYS AND STRINGS **9**

Decision making statements – Switch statement – Looping statements – Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays – String: String operations – String Arrays – Simple programs: Sorting – Searching – Matrix operations.

UNIT-III: FUNCTIONS AND POINTERS **9**

Introduction to functions: Function prototype, function declaration, function definition, function call, Built-in functions (string functions, math functions) – Recursion – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

UNIT-IV: STRUCTURES AND UNION **9**

Structure – Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation – Singly linked list – Typedef – Union - Storage classes and Visibility.

UNIT-V: FILE PROCESSING **7**

Files: File opening modes – Types of file processing: Sequential access, Random access – Preprocessor directives – Command line arguments.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. Kernighan, B.W and Ritchie, D.M, "The C Programming language", 2nd Edition, Pearson Education, 2015
2. Reema Theraja "Fundamentals of Computing and Programming in C", 2nd Edition, Oxford University Press, 2016
3. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2013.
4. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018
5. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 16th revised edition, 2020.

COURSE OUTCOMES:

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

CO1: Develop simple applications in C using basic constructs
CO2: Design and implement applications using arrays and strings
CO3: Develop and implement applications in C using functions and pointers.
CO4: Develop applications in C using structures and union.
CO5: Design applications using sequential and random-access file processing.

22CAHS109 **HERITAGE OF TAMILS** **SEMESTERI**

L	T	P	C
1	0	0	1

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 Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

UNIT-II: HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTU **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 CONCEPT 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 Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Contact Periods:

Lecture: 15 Periods	**Tutorial: 0 Periods**	**Practical: 0 Periods**	**Total: 15 Periods**

REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22CAES106 PROGRAMMING IN C LABORATORY SEMESTER I

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing.

LIST OF EXPERIMENTS:

1. I/O statements, operators, expressions
2. Decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.
11. Mini project

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Develop C programs for simple applications making use of basic constructs, arrays and Strings.

CO2: Develop C programs involving functions, recursion, pointers, and structures.

CO3: Design applications using sequential and random access file processing.

LIST OF EQUIPMENT'S AND COMPONENTS

- Software Required – Turbo C Compiler / GNU C Compiler / Equivalent
- Operating System – Windows 7 / 8.1 / 10 / Linux
- Computers Required – 30 Nos.

22CAES107 ENGINEERING PRACTICES LABORATORY SEMESTER I

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

- Connecting various pipe fittings used in common household plumbing work, sawing, planning and making joints in wood materials used in common household wood work.
- Welding various joints in steel plates using arc welding work.
- Machining various simple processes like turning, drilling, and tapping in parts and making a tray out of metal sheet using sheet metal work.
- Wiring various electrical joints in common household electrical wire work
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)
PART I CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.

b) Preparing plumbing line sketches.

c) Laying pipe connection to the pump

d) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planning and
c) Making joints like T-Joint, Cross lap Joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture.
b) Studying common industrial trusses using models.

PART II MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

b) Practicing gas welding.

BASIC MACHINING WORK:

a) Simple Turning.
b) Simple Drilling.
c) Simple Tapping.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 24 Periods Total: 24 Periods

GROUP – B (ELECTRICAL & ELECTRONICS)
PART III ELECTRICAL ENGINEERING PRACTICES

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Measurement of voltage and current using solar panel
3. Stair case wiring
4. Assembling and Testing of Ceiling Fan
5. Study of lightning arrester

PART IV ELECTRONIC ENGINEERING PRACTICES

1. Study of Electronic components and equipments – Resistor, colour coding
2. Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
3. Verification of logic gates AND, OR, EX-OR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Assembling of 15 watts LED circuit

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 21 Periods Total: 21 Periods

COURSE OUTCOMES:

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

CO1: Apply the knowledge of pipeline and connecting various pipe fittings used in common household plumbing work and Use tools and equipments used in Carpentry.

CO2: Perform the various welding joints in steel plates using arc welding work.

CO3: Perform operation in a lathe machine and also fabricate parts like tray in sheet metal.

CO4: Wire various electrical joints in common household electrical wire work.

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

22CAHS108 COMMUNICATION SKILLS LABORATORY **SEMESTER I**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To enhance the Employability and Career Skills of students.
- To orient the students towards grooming as a professional.
- To make them Employability Graduates.
- To develop their confidence and help them in attending interviews successfully.
- To demonstrate an understanding of job applications and interviews for internship and placements.

LIST OF ACTIVITIES & EXERCISES

S. No.	Activity/Exercise
1.	Soft skills
2.	Giving & asking personal information
3.	Listening & Answering to a Lecture
4.	Small talk on everyday topics
5.	Strategies for presentation ; group/ pair presentation
6.	Job Application Letter with Resume
7.	Group Discussion
8.	Activities to improve GD skills
9.	Interview etiquette
10.	Career plan

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 30 Periods

Recommended Software
1. Globearena

REFERENCES:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015.
2. Interact English Lab Manual for Undergraduate Students, Orient Balckswan: Hyderabad, 2016.
3. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

COURSE OUTCOMES:

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

CO1: Make effective presentations.

CO2: Participate confidently in Group Discussions.

CO3: Attend job interviews and be successful in them.

CO4: Develop adequate Soft Skills required for the workplace.

CO5: Present their opinions in a planned and logical manner, and draft effective resume in context of job search.

22CAHS201	PROFESSIONALENGLISH-II	SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To engage learners in meaningful language activities to improve their LSRW skills.
- To enhance learners' awareness of general rules of writing for specific audiences.
- 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 **9**

Listening - Listening to oral presentation- Listening and Gap filling
Speaking - Marketing a product, Mock interviews
Reading - Reading advertisements, Reading to identify stylistic features(syntax, lexis and sentence structures)
Writing - Compare and Contrast Essay, Review writing
Grammar - If conditions, Direct and indirect speech
Vocabulary - Verbal analogies

UNIT-II: EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING **9**

Listening - Listening to longer technical, Listening technical information from podcasts
Speaking - Describing and discussing the reasons of accidents or disasters based on news Reports
Reading - Reading and understanding technical articles
Writing - Writing responses to complaints
Grammar - Active Passive Voice transformations, Infinitive and Gerund
Vocabulary - Technical Jargons

UNIT-III: PROBLEM SOVING **9**

Listening - Listening to video clips and answering the questions, listening to different view points on an issue
Speaking - Picture description
Reading - Case studies, excerpts from literary texts, news reports etc
Writing - Letter to the Editor, Checklists
Grammar - Error correction, Numerical adjectives
Vocabulary - Compound Words, Sentence Completion

UNIT-IV: REPORTING OF EVENTS AND RESEARCH **9**

Listening - Listening comprehension based on news reports and documentaries
Speaking - Interviewing, Presenting an oral report, Mini presentations on select topics
Reading - Newspaper articles
Writing - Delivering welcome address, Proposing Vote of thanks, Accident Report, Survey Report
Grammar - Phrases and its types
Vocabulary - Cliches, Redundancies

UNIT-V: THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY **9**

Listening - Listening to TED Talks, Job interviews(analysis of the interview performance)

Speaking	- Participating in a Role play, virtual interviews, Making presentations with visual aids
Reading	- Company profiles, Statement of Purpose(SOP), an excerpt of interview with Professionals
Writing	- Internship application, Cover letter & Resume, Precise writing, Summarizing
Grammar	- Subject- Verb agreement, Relative clauses
Vocabulary	- Numerical Adjectives

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Department of English, Anna University, English for Engineers & Technologists, Orient Blackswan, 2020.
2. Krishna Mohan, Meera Bannerji, Developing Communication Skills, Macmillan India Ltd, Delhi, 2020.
3. V. N. Arora and Laxmi Chandra, Improve Your Writing, Oxford University Press, New Delhi, 2020.
4. J. Anbazhzgan Vijay, Global Publishers, Chennai, 2019.
5. Raman, Meenakshi, Sharma. Sangeeta, Professional English, Oxford Unversity Press, New Delhi, 2019.
6. Prof. R.C. Sharma & Krishna Mohan, Business Correspondance and Report Writing, Tata McGraw Hall & Co. lts, New Delhi, 2019.

COURSE OUTCOMES:

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

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

22CABS202	ADVANCED CALCULUS AND ITS APPLICATIONS	SEMESTER II			
		L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To gain the knowledge of vector differentiation, integration and related applications.
- To be known about analytic functions with properties, construction of analytic function and the knowledge of conformal transformation.
- To obtain the knowledge of Cauchy's integral theorem, calculus of residues and complex integration around unit circle and semicircle.
- To gain methods to solve differential equations with constant and variable coefficients.
- To introduce the basic concepts of PDE for solving standard partial differential equations

UNIT-I: VECTOR CALCULUS **9+3**

Gradient and directional derivative - Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Volume integral - Green's, Gauss divergence and Stoke' s theorems (Excluding Proofs).

UNIT-II: ANALYTIC FUNCTIONS **9+3**

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties -Harmonic conjugates - Construction of analytic function - Conformal mapping - Mapping by functions $w= z + c$, cz ,$1/z$, z^2 - Bilinear transformation.

UNIT-III: COMPLEX INTEGRATION **9+3**

Line integral - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Singularities - Residues - Residue theorem - Application of residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour.

UNIT-IV: ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogenous equation of Euler's and Legendre's type - System of simultaneous linear differential equations with constant coefficients.

UNIT-V: PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations [$F(p,q) = 0$ and $z = px + qy + f(p,q)$] - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous types.

Contact Periods:
Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2018.
2. Kreyszig E., "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2018.

3. Bali N.P. and Manish Goyal, "A Text book of Engineering Mathematics", Laxmi Publications Pvt. Ltd, New Delhi, 10th Edition, 2021.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
5. Ramana B.V., "Higher Engineering Mathematics", Mc Graw Hill Education Pvt. Ltd, New Delhi, 11th Edition, 2018.
6. James G., "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 4th Edition, 2016.

COURSE OUTCOMES:

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

CO1: Acquire knowledge in Gradient, divergence and curl of a vector point function and related identities.

CO2: Understand the properties and formation of analytic function, mappings of standard functions and Bilinear transformation.

CO3: Understand calculus of residues to evaluate contour integration.

CO4: Apply various techniques in solving differential equations.

CO5: Understand how to solve the given standard partial differential equations.

22MEBS203 **MATERIALS SCIENCE** **SEMESTER II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To instill knowledge on various phase diagrams and their applications.
- To understand about magnetic materials and superconducting materials properties.
- To make the students to understand the importance of different types of Non-destructive testing methods in industries.
- To inculcate an idea of significance of modern engineering materials and their device applications.
- To gain knowledge on vacuum physics and their types for various measurement range.

UNIT-I: PHASE DIAGRAMS **9**

Solid solutions – Hume Rothery's rules – The phase rule – Single component system – One-component system of iron – Binary phase diagrams – Isomorphous systems – The tie-line rule – The lever rule – Application to isomorphous system – Eutectic phase diagram – Peritectic phase diagram – Other invariant reactions – Free energy composition curves for binary systems – Microstructural change during cooling.

UNIT-II: MAGNETIC AND SUPERCONDUCTING MATERIALS **9**

Origin of magnetic moment – Bohr magneton – Dia, Para, and Ferro magnetic materials – Domain Theory of ferromagnetism – Hysteresis – Hard and Soft magnetic materials. Superconductivity – Properties – Meissner effect, effect of magnetic field and heavy current – Types of superconductors – BCS theory of superconductivity (qualitative) – Applications of superconductors: Cryotron and Magnetic levitation.

UNIT-III: NON-DESTRUCTIVE TESTING **9**

X-ray Testing – Fluorescence – Phosphorescence – Fluoroscopy – Ultrasonic Testing – Pulse echo system – LASER Testing – Liquid penetrant Testing – Magnetic Particle Testing.

UNIT-IV: MODERN ENGINEERING MATERIALS **9**

Metallic glasses – Preparation of metallic glasses – Properties – Applications of the metallic glasses – Shape Memory Alloys (SMA) – Characteristics, properties of Ni-Ti alloy – applications of SMA – Advantages and disadvantages of SMA – Nanomaterials – Synthesis – Chemical vapour deposition – Ball milling – Properties of nanoparticles and applications of nanoparticles.

UNIT-V: VACUUM SCIENCE **9**

Introduction – Importance of vacuum in industries – Pumping speed and throughput – Types of pumps – Rotary vane type Vacuum pump(oil sealed), Diffusion Pump and Turbo Molecular Pump – Measurement of High Vacuum – McLeod Gauge – Pirani Gauge – Penning Gauge.

Contact Periods:
Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
2. Smith, W.F, Hashemi, J. & Prakash, R. “Materials Science and Engineering”, Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw Hill (Indian Edition), 2017.
4. R.Balasubramaniam, Callister’s Materials Science and Engineering. Wiley (Indian Edition), 2014.
5. D.Halliday, R.Resnick and J.Walker, Principles of Physics, Wiley (Indian Edition), 2015.
6. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

COURSE OUTCOMES:

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

CO1: Acquire knowledge about the types of phase diagrams and their applications.

CO2: Gain knowledge on the properties, types and applications of magnetic and superconducting materials.

CO3: Understand the importance of different Non-destructive testing methods for industrial applications.

CO4: Appreciate the importance of advanced engineering materials and their applications.

CO5: Know the basics and working principles of vacuum pumps and gauges for measuring various pressure ranges.

APPLIED CHEMISTRY **SEMESTER II**

22MEBS204

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 polymer chemistry, engineering applications of polymers and composites.
- To understand the principles of electrochemistry, electrochemical cells, emf and applications of emf measurements.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To make the student understand the preparation, properties and applications of miscellaneous materials used in industry.

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

Water quality parameters: Significance – Alkalinity, TDS, COD and BOD (definition and significance only). Hardness – Types, estimation of hardness by EDTA method – Boiler feed water troubles – Scale and sludge – Priming & foaming – Caustic embrittlement – Boiler corrosion. Softening of boiler feed water – Internal softening (colloidal, phosphate, sodium aluminate and calgon conditioning) – External softening – Demineralization process - Desalination of brackish water – Electrodialysis and Reverse Osmosis. Municipal water treatment - primary treatment and disinfection (UV, Ozonation, break-point chlorination).

UNIT-II: POLYMER AND COMPOSITES **9**

Introduction: Classification of polymers – Functionality – Degree of polymerization. Types of polymerization: Addition, condensation and copolymerization. Thermal Properties of polymers: Thermoplastic and Thermosetting – Glass Transition temperature (Tg) – significance – Factors affecting Tg, Molecular weight – Weight average, number average and polydispersity index. Preparation, properties and uses of PVC, Bakelite and Epoxy resin. Composites: definition, types of composites – Polymer matrix composites (PMC) – FRP.

UNIT-III: ELECTROCHEMISTRY **9**

Electrode potential – Electrochemical cells – Reversible and irreversible cells – EMF – measurement of emf. Emf series and its applications. Nernst equation (problems). Reference electrodes – Standard Hydrogen electrode – Calomel electrode, Ion selective electrode – glass electrode and measurement of pH. Potentiometric redox titration (Estimation ferrous ion) – Conductometric titration (Strong acid Vs Strong base).

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

Fuels – Classifications – Calorific value – Gross and Net calorific value (Problems using Dulong's formula). Combustion – Solid fuels – Coal-proximate and ultimate analysis – Significance. Coke – Characteristics – Manufacture by Otto Hoffman method. Liquid fuels – Petroleum processing and fractions. Knocking of internal combustion engines and diesel engines – Octane and cetane number – Anti-knocking agents. Power alcohol – Bio diesel.

UNIT-V: MISCELLANEOUS MATERIALS **9**

Refractories – Classification – Properties and manufacture of silica and magnesia bricks. Abrasives – Classification, properties – Manufacture of SiC. Lubricants – Characteristics –

Mechanism of lubrication – Additives for lubricants – Solid lubricants (Graphite and Molybdenum sulphide). Glass – Manufacture, types, properties and uses.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. P. C. Jain and Monica Jain, "Engineering Chemistry, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International Publishers, 6th Edition, 2019.
3. Sivasankar B. "Engineering Chemistry, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
4. S.S. Dara, "A Text book of Engineering Chemistry. S. Chand Publishing, 12th Edition, 2018.
5. Renu Bapna and Renu Gupta., “Engineering Chemistry”, Macmillan India Publisher Ltd., 2010.

COURSE OUTCOMES:

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

CO1: Understand the quality of water from quality parameters data and propose suitable treatment methodologies to treat water.

CO2: Acquire the basic knowledge of polymers, composites and FRP and their significance.

CO3: Understand the basic principles of electrochemistry and its applications.

CO4: Recognize different types of fuels and its combustion characteristics.

CO5: Familiar with the various engineering materials used in engineering applications.

22CAES205 BASICS OF ELECTRICALANDELECTRONICS ENGINEERING **SEMESTER II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT-I: ELECTRICAL CIRCUITS **9**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Independent and Dependent Sources – Simple problems.
Introduction to AC Circuits and Parameters: Waveforms, Average value, Value, RMS Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT-II: ELECTRICALMACHINES **9**

Construction and Working principle – DC Separately and Self-excited Generators, Types – emf Equation and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT-III: ANALOGELECTRONICS **9**

Resistor, Inductor and Capacitor in Electronic Circuits – Semiconductor Materials: PN Junction Diodes, Zener Diode – I-V Characteristics – Rectifiers – Bipolar Junction Transistor, JFET, SCR, MOSFET, IGBT – I-V Characteristics – Applications

UNIT-IV: DIGITAL ELECTRONICS **9**

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

UNIT-V: MEASUREMENTSANDINSTRUMENTATION **9**

Functional elements of an instrument, Standards and calibration, Operating Principle, types – Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers – DSO – Block diagram – Data acquisition.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", 2nd Edition, McGraw Hill Education, 2020
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, 2nd Edition, 2017.

3. Sedha R.S., “A textbook book of Applied Electronics”, S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, “Dorf’s Introduction to Electric Circuits”, Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.
6. Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Analyze the DC and AC circuits.

CO2: Explore the significance of electrical machines.

CO3: Analyze the characteristics of analog electronic devices.

CO4: Acquire the basic concepts of digital electronics.

CO5: Explain the operating principles of measuring instruments.

22MEPC206 ENGINEERING MECHANICS SEMESTER II

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 use scalar and vector analytical techniques for analysing 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: STATICS OF PARTICLES **9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, 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: EQUILIBRIUM OF RIGID BODIES **9**

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple – Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force – Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions – Reactions at Supports and Connections.

UNIT-III: DISTRIBUTED FORCES
9

Centroids of lines and areas – Symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass – Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass – Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT-IV: FRICTION **9**

The Laws of Dry Friction, Coefficients 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.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.
3. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5th Edition, McGraw Hill Higher Education, 2013.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.

COURSE OUTCOMES:

On successful completion of this course, the student 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

22CAHS202 **TAMILS AND TECHNOLOGY** **SEMESTER II**

L	T	P	C
1	0	0	1

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

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

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

Designing and Structural construction House & Designs in household materials duringSangam 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 goldCoins 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, Significance 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 Specific Society.

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

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

TOTAL: 15 PERIODS

REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் –கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22CABS107 PHYSICS AND CHEMISTRY LABORATORY SEMESTER II

L	T	P	C
0	0	3	1.5

PHYSICS LABORATORY:

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS:

1. Cantilever bending – Determination of Young's modulus.
2. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia.
3. Non-uniform bending – Determination of Young's modulus.
4. Laser- a) Determination of the wave length of the laser using grating.
   b) Determination of Numerical Aperture and acceptance angle using optical fiber.
5. Air wedge – Determination of thickness of a thin sheet/wire.
6. Ultrasonic interferometer – Determination of the velocity of sound and compressibility of liquids.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 24 Periods Total: 24 Periods

COURSE OUTCOMES:

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

CO1: Understand the functioning of various physics laboratory equipment.

CO2: Use experimental models to analyze laboratory data.

CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Access, process and analyze scientific information.

CO5: Solve problems individually and collaboratively.

CHEMISTRY LABORATORY:

COURSE OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
- To inculcate experimental skills to understanding of water quality parameters, such as hardness, alkalinity and dissolved oxygen.
- To induce the students to familiarize with electroanalytical techniques such as conductometry and potentiometry.
- To demonstrate the analysis of strong acid and strong base by conductometry.
- To equip the students for determination of hydrochloric acid by pH measurement.

LIST OF EXPERIMENTS:

1. Estimation of hardness by EDTA method.
2. Determination of types and amount of alkalinity in water sample.
3. Estimation of Dissolved Oxygen by Iodometry.
4. Determination of HCl by pH titration.
5. Conductometric titration of strong acid and strong base.
6. Estimation of iron content of the given solution using potentiometer.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 21 Periods Total: 21 Periods

REFERENCE:

1. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Qualitative Chemical Analysis, 2009.

COURSE OUTCOMES:

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

CO1: Outfit with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

CO2: Quantify the type and amount of alkalinity in water sample.

CO3: Equip with the methods and techniques involved in pH metry.

CO4: Apply the conductometric measurements in quantitative analysis of chemical substances.

CO5: Estimate the amount of ferrous ion present in solution by potentiometric titration.

22MEES207	BASICELECTRICAL AND ELECTRONICS ENGINEERINGLABORATORY	SEMESTER II			
		L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices

LIST OF EXPERIMENTS

1. Measurement of phase difference between voltage and current.
2. Verification of ohms and Kirchhoff's Laws.
3. Load test on DC shunt motor.
4. Load test on self excited DC generator.
5. Load test on single phase transformer.
6. Load test on single phase induction motor.
7. Characteristics of PN diode.
8. Characteristics of BJT.
9. Characteristics of SCR.
10. Characteristics of MOSFET.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical:45 Periods Total: 45 Periods

COURSEOUTCOMES:

After completing this course, the students will be able to

- Use experimental methods to verify the Ohm's and Kirchhoff's Laws.
- Analyze experimentally the load characteristics of electrical machines
- Analyze the characteristics of basic electronic devices

22CABS301	TRANSFORM TECHNIQUES AND ITS APPLICATIONS	SEMESTER III

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- 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 be familiar with techniques of Laplace and Inverse Laplace transformations.
- 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: FOURIER SERIES

9+3

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

UNIT -II: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

9+3

Classification of PDE – Fourier Series solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction.

UNIT-III: LAPLACE TRANSFORMS

9+3

Existence conditions – Transforms of elementary functions – Basic properties – Initial and final value theorems – Inverse transforms –Convolution theorem –Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

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 – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform.

Contact periods:

Lecture: 45 Periods	Tutorial: 15 Periods	Practical: 0 Periods	Total: 60 Periods

REFERENCES:

1. Bali N.P. and Manish Goyal, “A Text book of Engineering Mathematics”, Laxmi Publications Pvt. Ltd, New Delhi, 10th Edition, 2021.
2. Grewal B. S., “Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
3. Ramana B.V., “Higher Engineering Mathematics”, Mc Graw Hill Education Pvt. Ltd, New Delhi, 11th Edition, 2018.
4. Kreyszig E., “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Edition, 2018.
5. James G., "Advanced Modern Engineering Mathematics", 3rdEdition, Pearson Education, New Delhi, 2016.
6. Andrews L. C and Shivamoggi B, "Integral Transforms for Engineers" SPIE Press, 1999.

COURSE OUTCOMES:

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

CO1: Solve differential equations using Fourier series analysis which plays a vital role in Engineering applications.

CO2: Appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.

CO3: Understand Laplace transform and inverse transform of simple functions, various related theorems and application to differential equations with constant coefficients.

CO4: Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of Engineering.

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

22MEPC302 ENGINEERINGTHERMODYNAMICS SEMESTER III

(Use of Steam Table and Psychrometric charts is permitted)

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic principles of classical thermodynamics and first law.
- To introduce the second law of thermodynamics with applications.
- To understand the properties of pure substance and steam power cycle
- To understand various gas laws and thermodynamic relations
- To apply the concepts of gas mixtures and psychrometric processes.

UNIT-I: BASIC CONCEPTS AND FIRST LAW 9+3

Basic concepts – Concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic equilibrium state, Path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, Definition and comparison, Sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics – Concept of temperature and thermal equilibrium – Relationship between temperature scales – New temperature scales. First law of thermodynamics – Application to closed and open systems – Steady and unsteady flow processes.

UNIT -II: SECOND LAW AND AVAILABILITY ANALYSIS 9+3

Heat reservoir, Source and sink. Heat engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds equations, Entropy change for – Pure substance, Ideal gases – Different processes, Principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law efficiency.

UNIT-III: PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9+3

Formation of steam and its thermodynamic properties, P-v, P-T, T-v, T-s, h-s diagrams. P–v–T surface. Use of Steam Table and Mollier chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle improvement methods – Reheat and regenerative cycles, Economiser, Pre-heater, Binary and Combined cycles.

UNIT-IV: IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9+3

Properties of Ideal gas – Ideal and real gas comparison – Equations of state for ideal and real gases – Reduced properties. Compressibility factor – Principle of corresponding states. Generalised compressibility chart and its use – Maxwell relations, Tds equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson coefficient, Clausius Clapeyron equation, Phase change processes. Simple calculations.

UNIT-V: GAS MIXTURES AND PSYCHROMETRY 9+3

Mole and mass fraction, Dalton's and Amagat's law. Properties of gas mixture – Molar mass, gas constant, Density, Change in internal energy, Enthalpy, Entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – Adiabatic saturation, sensible heating and cooling, Humidification, Dehumidification, Evaporative cooling and adiabatic mixing. Simple applications.

Contact periods:
Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods

REFERENCES:

1. Nag P.K., "Engineering Thermodynamics", 6th Edition, McGraw Hill Education, 2017.
2. Arora C.P., Thermodynamics, Tata McGraw - Hill Education, 2017.
3. Moran, Shapiro and Boettner, Bailey "Principals of Engineering Thermodynamics", 7thEdition, Wiley India Pvt Ltd-2013.
4. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.
5. Holman J.P., "Thermodynamics", 10th Edition, McGraw Hill Education, 2011.
6. Michael A. Boles, Yunus A. Cengel, "Thermodynamics: An Engineering Approach", 7th Edition, Tata McGraw - Hill Education, 2011.
7. Rajput R.K., "Engineering Thermodynamics", Laxmi Publications, 2010.
8. Rao Y.V.C., "An Introduction to Thermodynamics", Revised Edition, Orient Longman, 2009.

COURSE OUTCOMES:

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

CO1: Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.

CO2: Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.

CO3: Apply Rankine cycle to steam power plant and compare few cycle improvement methods.

CO4: Derive simple thermodynamic relations of ideal and real gases.

CO5: Calculate the properties of gas mixtures and moist air and its use in psychrometric processes.

22MEPC303 FLUID MECHANICS AND MACHINERY SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- The properties of fluids and concept of control volume are studied.
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT-I: FLUID PROPERTIES AND FLOW CHARACTERISTICS
9

Units and dimensions – Properties of fluids- Mass density, Specific weight, Specific volume, specific gravity, Viscosity, Compressibility, Vapour pressure, Surface tension and capillarity. Flow characteristics – Concept of control volume – Application of continuity equation, energy equation and momentum equation.

UNIT -II: FLOW THROUGH CIRCULARCONDUITS
9

Hydraulic and energy gradient – Laminar flow through circular conduits and circular annuli – Boundary layer concepts – Types of boundary layer thickness – Darcy Weisbach equation –Friction factor – Commercial pipes – Minor losses – Flow through pipes in series and parallel.

UNIT-III: DIMENSIONAL ANALYSIS
9

Need for dimensional analysis – Methods of dimensional analysis – Similitude – Types of similitude – Dimensionless parameters – Application of dimensionless parameters – Model analysis.

UNIT-IV: PUMPS
9

Impact of jets – Euler's equation – Theory of Roto-dynamic machines – Various efficiencies – Velocity components at entry and exit of the rotor – Velocity triangles – Centrifugal pumps – Working principle – Work done by the impeller – Performance curves – Reciprocating pump – Working principle – Rotary pumps – Classification.

UNIT-V: TURBINES
9

Classification of turbines – Heads and efficiencies – Velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines – Working principles – Work done by water on the runner – Draft tube. Specific speed – Unit quantities – Performance curves for turbines – Governing of turbines.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 2016.
2. Rajput R. K., “Text book of Fluid Mechanics and Hydraulics Machines in S.I. Units” S. Chand & Co Ltd., 2015.
3. Modi P.N and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2013.
4. Graebel W.P., "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.
5. Bansal R.K., “A Textbook of Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, New Delhi – 2010.
6. Streeter V. L and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010.

COURSE OUTCOMES:

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

CO1: Apply mathematical knowledge to predict the properties and characteristics of a fluid.

CO2: Evaluate and calculate major and minor losses associated with pipe flow in piping networks.

CO3: Mathematically predict the nature of physical quantities.

CO4: Analyse the performance of pumps.

CO5: Analyse the performance of turbines.

22MEPC304 MANUFACTURING TECHNOLOGY – I SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the special casting processes and practice mould preparation.
- To learn various metal joining processes and gain welding skills.
- To provide the knowledge on various bulk deformation processes and its applications.
- To expose knowledge on sheet metal forming processes, special forming processes and to make small sheet metal parts.
- To learn about the various plastics moulding and forming processes and to make simple plastic part.

UNIT-I: METAL CASTING PROCESSES
9

Sand casting: Sand mould – Type of patterns – Pattern materials – Pattern allowances – Moulding sand properties and testing – Cores –Types and applications – Moulding machines – Types and applications; Melting furnaces: Blast and Cupola furnaces; Principle of special casting processes: Shell – Investment – Ceramic mould – Pressure die casting – Centrifugal Casting – CO_2 process – Stir casting; Defects in sand casting.

UNIT -II: JOINING PROCESSES
9

Operating principle, Basic equipment, Merits and applications of: Fusion welding processes: Gas welding – Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding – Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of resistance welding – Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and friction stir welding; Brazing and soldering; Weld defects: types, causes and cure.

UNIT-III: METAL FORMING PROCESSES
9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Forging operations. Rolling of metals– Types of rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of extrusion – Types – Hot and cold extrusion.

UNIT-IV: SHEET METAL PROCESSES
9

Sheet metal characteristics – 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.

UNIT-V: MANUFACTURE OF PLASTIC COMPONENTS
9

Types and characteristics of plastics – Moulding of thermoplastics – Working principles and typical applications – Injection moulding – Plunger and screw machines – Compression

moulding, Transfer moulding – Typical industrial applications – Introduction to blow moulding – Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Hajra Choudhury S.K., "Elements of Workshop Technology" - Vol. I, Media Promoters & Publishers Private Limited, Mumbai, 2013.
2. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education Limited, New Delhi, 2013.
3. Dr.Vijayaraghavan G.K., "Manufacturing Technology – I", Lakshmi publication, Chennai, 2013.
4. Sharma P.C., "Manufacturing Technology – I", S. Chand and Company Private Limited, New Delhi, 2011.
5. Rao P. N., "Manufacturing Technology" Vol. I, Tata McGraw-Hill Publishing Company Private Limited, New Delhi, 2010.

COURSE OUTCOMES:

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

CO1: Explain different metal casting processes, associated defects, merits and demerits.

CO2: Compare different metal joining processes.

CO3: Summarize various hot working and cold working methods of metals.

CO4: Explain various sheet metal making processes.

CO5: Distinguish various methods of manufacturing plastic components.

22MEES305	ELECTRICAL DRIVES AND CONTROLS	SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives.
- To study the conventional and solid-state speed control of D.C. drives.
- To 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 – Heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

UNIT-II: DRIVE MOTOR CHARACTERISTICS
9

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.
9
DRIVES

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.
9
DRIVES

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – Applications.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

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. Vedam Subrahmaniam, “Electric Drives (Concepts and Applications)”, Tata McGraw-Hill, 2010.
4. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2006.
5. Singh. M.D., K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 2006.

COURSE OUTCOMES:

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

CO1: Discuss the basic concepts of different types of electrical machines and their performance.

CO2: Explain the different methods of starting D.C motors and induction motors.

CO3: Discuss the conventional and solid-state drives.

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.

22CAMC306	CONSTITUTION OF INDIA	SEMESTER III

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To know about Indian constitution.
- To know about central government functionalities in India.
- To know about state government functionalities in India.
- To know about Indian society.
- To know about election commission of India.

UNIT-I: INTRODUCTION

9

Constitution - Definition, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental rights and duties, Directive principles of State policy.

UNIT -II: UNION GOVERNMENT AND ITS ADMINISTRATION

9

Structure of the Indian Union: Federalism, Centre – State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha.

UNIT-III: STATE GOVERNMENT AND ITS ADMINISTRATION

9

Governor: Role and position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.

UNIT-IV: LOCAL ADMINISTRATION

9

District's administration head: Role and Importance, Municipalities: Introduction, Mayor and role of elected representative, CEO of Municipal corporation, Panchayat raj: Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Position and role, Block level: Organizational hierarchy (Different departments), Village level: Role of elected and appointed officials, Importance of grass root democracy.

UNIT-V: ELECTION COMMISSION

9

Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and functioning, Institute and bodies for the welfare of SC/ST/OBC and women.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Sharma and Brij Kishore, "Introduction to the Consitution of India," Prentice Hall of India, New Delhi, 2018.

2. Durga Das Basu, “Introduction to the Constitution of India”, Prentice Hall of India, New Delhi, 2018.
3. Laxmikanth M., “Indian Polity”, Mcgraw Hill Education (India) Private Limited, 2016.
4. Agarwal R.C., “Indian Political System”, S. Chand and Company, New Delhi, 2004.

COURSE OUTCOMES:

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

CO1: Understand the concepts of constitution assembly.

CO2: Develop knowledge of union government and its administration.

CO3: Develop knowledge of state government and its administration.

CO4: Develop knowledge of local administration.

CO5: Learn to use the function of election commission.

22MEPC307 FLUID MECHANICS AND MACHINERY LABORATORY **SEMESTER III**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To have hands on experience in flow measurements.
- To determine the energy loss in conduits.
- To demonstrate the characteristics curves of pumps.
- To demonstrate the characteristics curves of Turbines.
- To design and conduct experiments, as well as to analyze and interpret data.

LIST OF EXPERIMENTS

1. Determination of the coefficient of discharge of given Orifice meter.
2. Determination of the coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of Centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of Reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel turbine.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Determine the coefficient of discharge of given flow measurement equipment.
CO2: Determine the friction factor of given set of pipes.
CO3: Conduct the experiment and drawing the characteristics curves of positive displacement pump.
CO4: Conduct the experiment and drawing the characteristics curves of Roto Dynamic pump.
CO5: Conduct the experiment and drawing the characteristics curves of Turbine.

22MEPC308 **MANUFACTURING TECHNOLOGY LABORATORY-I** **SEMESTER III**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- Selecting appropriate tools, equipment's and machines to complete a given job.
- To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.
- To Performing various machining process such as lathe, shaper, drilling, milling machines etc.,
- To equip with the practical knowledge required in the core industries.
- To analysing the defects in the cast and machined components.

LIST OF EXPERIMENTS

I. Machining and Machining time estimations for:

1. Taper Turning
2. External Thread cutting
3. Internal Thread cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping

II. Manufacturing of simple sheet metal components using shearing and bending operations.

III. Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding/Submerged arc welding.

IV. Preparing green sand moulds with cast patterns.

Contact periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

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

CO1: Demonstrate and fabricate different types of components using the machine tools.

CO2: Create the work piece as per given shape and size using lathe.

CO3: Make the work piece as per given shape and size using shaper machine.

CO4: Use sheet metal fabrication tools and make simple tray and funnel.

CO5: Joint two metals using arc welding and use different moulding tools, patterns and prepare sand mould.

22CABS402 NUMERICAL METHODS SEMESTER IV

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 in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

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.

UNIT -II: INTERPOLATION AND APPROXIMATION
9+3

Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Difference operators and relations – Interpolation with equal intervals –Newton's forward and backward difference formulae.

UNIT-III: NUMERICAL DIFFERENTIATION AND INTEGRATION
9+3

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT-IV: INITIAL VALUE PROBLEMS FOR 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 equations – Multi step methods – Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

UNIT-V: BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIALEQUATIONS **9+3**

Finite difference methods for solving second order two-point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit

and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Contact periods:

Lecture: 45 Periods	**Tutorial: 15 Periods**	**Practical: 0 Periods**	**Total: 60 Periods**

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 10th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna publishers, 10th Edition, New Delhi, 2015.
3. Steven C.Chapra and Raymond P.Canale, "Numerical Methods for Engineers", 7th Edition, McGraw – Hill Education, 2015.
4. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
5. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 7th Edition, New Delhi, 2007.
6. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.

COURSE OUTCOMES:

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

CO1: Understand the basic concepts and techniques of solving algebraic and transcendental equations.

CO2: Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.

CO3: Apply the numerical techniques of differentiation and integration for engineering problems.

CO4: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO5: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

22MEPC401 THERMAL ENGINEERING SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes.
- To apply the thermodynamic concepts in IC engines.
- To apply the thermodynamic concepts for Nozzles and Turbines.
- To study the concepts for Air-compressors.
- To study the concepts for Refrigeration and Air conditioning systems.

UNIT-I: GAS POWER CYCLES9

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency – Comparison of cycles.

UNIT -II: INTERNAL COMBUSTION ENGINES

9

Classification – Components and their function. Valve timing diagram and port timing diagram – Actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburettor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System – Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation.

UNIT-III: STEAM NOZZLES AND TURBINES

9

Flow of steam through nozzles, shapes of nozzles, Effect of friction, Critical pressure ratio, supersaturated flow. Impulse and Reaction principles, Compounding, Velocity diagram for simple and multi-stage turbines, Speed regulations – Governors.

UNIT-IV: AIR COMPRESSOR

9

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

UNIT-V: REFRIGERATION AND AIR CONDITIONING 9

Refrigerants – Vapour compression refrigeration cycle – Super heat, sub cooling – Performance calculations – Working principle of vapour absorption system, Ammonia – Water, Lithium bromide – Water systems (Description only). Air conditioning system – Processes, Types and working principles. – Concept of RSHF, GSHF, ESHF – Cooling load calculations.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Arora C.P., “Refrigeration and Air Conditioning”, 4th Edition Tata McGraw-Hill Publishers 2020.

2. Ramalingam K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2nd Edition, 2018.
3. Rajput R. K., “Thermal Engineering”, Laxmi Publications Pvt Limited, 10th Edition 2017.
4. Ganesan V., “Internal Combustion Engines”, 4thEdition, Tata Mcgraw-Hill 2017.
5. Kothandaraman C.P, Domkundwar S and Domkundwar A.V., “A Course in Thermal Engineering", Dhanpat Rai & Sons, 2016.
6. Rudramoorthy R., “Thermal Engineering”, Tata McGraw-Hill, New Delhi, 2012.
7. Sarkar B.K., “Thermal Engineering” Tata McGraw-Hill Publishers, 2007.

COURSE OUTCOMES:

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

CO1: Apply thermodynamic concepts to different air standard cycles and solve problems.

CO2: Explain the functioning and performance parameters of IC Engines.

CO3: Solve problems in steam nozzle and steam turbines.

CO4: Solve problems in single stage and multistage air compressors.

CO5: Solve problems using refrigerant table and psychrometric charts.

22MEPC403 ENGINEERING MATERIALS AND METALLURGY **SEMESTER IV**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials.
- To identify and select suitable materials for various Heat Treatment process.
- To study about the different types of ferrous and Non-ferrous metals.
- To study about the different types of Non metallic materials.
- To impart knowledge on various metal testing methods.

UNIT-I: ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, Substitutional and interstitial – Phase diagrams, Isomorphous, Eutectic, Eutectoid, Peritectic, and peritectoid reactions, Iron-carbon equilibrium diagram. Classification of steel and cast Iron microstructure, Properties and application.

UNIT -II: HEAT TREATMENT 9

Definition – Full annealing, Stress relief, Recrystallisation and spheroidising – Normalising, hardening and tempering of steel. Isothermal transformation diagrams – Cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test – Austempering, martempering – Case hardening, Carburizing, Nitriding, Cyaniding, Carbonitriding – Flame and induction hardening – Vacuum and Plasma hardening.

UNIT-III: FERROUS AND NON-FERROUS METALS 9

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

UNIT-IV: NON-METALLIC MATERIALS 9

Polymers – Types of polymer, Commodity and Engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes) – Engineering ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON –Composites – Classifications – Metal matrix and FRP – Applications of composites.

UNIT-V: MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, Slip and twinning – Types of fracture – Testing of materials under tension, Compression and shear loads – Hardness tests (Brinell, Vickers and

Rockwell), Hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Raghavan V., "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 2015.
2. Williams D. Callister, "Material Science and Engineering" Wiley India Pvt. Ltd, Revised Indian Edition 2014.
3. Jindal U.C., Material Science and Metallurgy, "Engineering Materials and Metallurgy", 1st Edition, Dorling Kindersley, 2012.
4. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.
5. Upadhyay G.S and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.
6. Avner S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1997.

COURSE OUTCOMES:

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

CO1: Discuss on the alloys and phase diagram of steels.
CO2: Select and apply the different heat treatment processes.
CO3: Explain the types of ferrous and non-ferrous metals.
CO4: Discuss the properties and applications of non-metallic materials.
CO5: Explain the testing of mechanical properties.

22MEPC404 MANUFACTURING TECHNOLOGY – II SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the metal cutting theory and calculate the forces involved in it.
- To study construction, working and operations of centre, semi-automatic and automatic lathes.
- To provide the knowledge on construction, working of milling and gear cutting machines.
- To impart knowledge on construction, working and operations of reciprocating, drilling and boring machines.
- To provide knowledge on construction, working of broaching, grinding and few fine finishing processes.

UNIT-I: THEORY OF METAL CUTTING
9

Mechanics of chip formation, Single point cutting tool, Forces in machining, Types of chip, cutting tools– Nomenclature, Orthogonal 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, Machining time and power estimation. Capstan and turret lathes–Tool layout – Automatic lathes: Semi-automatic – Single spindle : Swiss type, Automatic screw type – Multi spindle:

UNIT-III: SHAPER, MILLING AND GEAR CUTTING MACHINES
9

Shaper – Types of operations. Drilling, reaming, Boring and Tapping. Milling operations-types of milling cutter. Gear cutting – Forming and generation principle and construction of gear milling, Hobbing and gear shaping processes – Finishing of gears.

UNIT-IV: ABRASIVE PROCESS AND BROACHING
9

Abrasive processes: Grinding wheel – Specifications and selection, Types of grinding process– Cylindrical grinding, Surface grinding, Centreless grinding and internal grinding – Typical applications – Concepts of surface integrity, Broaching machines: Broach construction – Push, Pull, Surface and continuous broaching machines.

UNIT-V: CNC MACHINING
9

Numerical Control (NC) machine tools – CNC types, Constructional details, Special features, machining centre, Part programming fundamentals CNC – Manual part programming – Micromachining – Waffer machining.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Dr.Vijayaraghavan G.K., “Manufacturing Technology-II”, Lakshmi publications, Chennai, 2017.
2. Kaushish J.P., “Manufacturing Processes”, Prentice Hall India Learning Private Limited., New Delhi, 2013.
3. Serope Kalpakjian and Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education Limited, New Delhi, 2013.
4. Rao P.N., “Manufacturing Technology – Metal Cutting and Machine Tools”, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2013.
5. Hajra Choudhury S.K., “Elements of Workshop Technology”, Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013.
6. Sharma P.C., “Manufacturing Technology – II”, S.Chand& Company Limited. New Delhi, 2012.

COURSE OUTCOMES:

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

CO1: Explain the mechanism of material removal processes.

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

CO3: Describe the constructional and operational features of shaper, planner, milling, and drilling, sawing and broaching machines.

CO4: Explain the types of grinding and other super finishing processes apart from gear manufacturing processes.

CO5: Summarize numerical control of machine tools and write a part program.

22MEPC405 STRENGTH OF MATERIALS SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To compute slopes and deflections in determinate beams by various methods.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To 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 – Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

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

Beams – Types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – Hanging beams. Theory of simple bending– Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT-III: DEFLECTION OF BEAMS
9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams – Conjugate beam method.

UNIT-IV: TORSION9

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

UNIT-V: THIN CYLINDERS, SPHERES AND THICK CYLINDERS
9

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

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Bansal R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016.
2. Hibbeler R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013.

3. James M. Gere, “Mechanics of Materials”, Cengage Learning, India, 2012.
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.
5. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009.
6. Ferdinand P. Been, Russell Johnson J.R and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing co. Ltd., New Delhi, 2005.

COURSE OUTCOMES:

Upon completion of this 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: Calculate the slope and deflection in beams using different methods.

CO4: Apply basic equation of simple torsion in designing of shafts and helical spring.

CO5: Analyse and design thin and thick shells for the applied internal and external pressures.

22CAHS306 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **SEMESTER IV**

(Common to all Branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn about natural resources, exploitation and its conservation.
- To understand the concept of ecosystem and preservation of biodiversity.
- To acquire knowledge about the role of a human being in maintaining a clean and useful environment for the future generation.
- To impart awareness of various social issues affecting the environment.
- To know about population explosion in the environment.

UNIT-I: ENVIRONMENT AND NATURALRESOURCES
10

Definition, scope and importance of environment – Forest resources: Use and over exploitation – Deforestation –Dams and their effects on forests and tribal people – Water resources: Use and over utilization of surface and ground water – Mineral resources: Use and over exploitation – Environmental effects of extracting and using mineral resources – Food resources : changes caused by agriculture –Effects of modern agriculture – fertilizer – pesticide problems, water logging, salinity – Energy resources: Growing energy needs, renewable and non-renewable energy sources, Use of alternate energy sources – Role of an individual in conservation of natural resources.

UNIT -II: ECOSYSTEMSAND BIODIVERSITY
10

Concept of an ecosystem – Structure and function of an ecosystem – Energy flow in the ecosystem – Ecological succession – Food chains, food webs – Forest ecosystem – Introduction to biodiversity – Genetic, species and ecosystem diversity – Value of biodiversity – India as a mega – diversity nation – Hot-spots of biodiversity – Threats to biodiversity – Endangered and endemic species – Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT-III: POLLUTION AND SOLID WASTE MANAGEMENT
10

Definition – Causes, effects and control measures of – Air pollution, Water pollution, Soil pollution, Marine pollution and Noise pollution – Solid waste management: Causes, Effects and Control measures of municipal solid wastes – Role of an individual in prevention of pollution – Disaster management: Floods, Earthquake, Cyclone and Landslides.

UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT
8

From unsustainable to sustainable development – Urban problems related to energy – Water conservation –Rain water harvesting – Watershed management – Resettlement and rehabilitation of people – Climate change – Global warming – Acid rain – Ozone layer depletion, Nuclear accidents and holocaust – Consumerism and waste products – 12 principles of green chemistry – Environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Forest conservation act.

UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT
7

Population growth, variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – Women and child welfare – Environmental impact assessment (EIA) – GIS – Remote sensing – Role of information technology in environment protection and human health.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Deswal.S and Deswal.A, "A Basic Course in Environmental Studies", Dhanpat Rai & Co (P) Ltd, New Delhi, 2021.
2. Anubha Kaushik and C.P.Kaushik, "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, New Delhi, 2019.
3. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2016.
4. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt. Ltd., Hyderabad, 2015.
5. Tyler. G Miller and Scott E. Spoolman, Environmental Science, Cengage Learning India PVT, LTD, Delhi, 2014.
6. Gilbert M. Masters and Wendell P.Ela "Introduction to Environmental Engineering and Science", 3rd Edition, Pearson Education, 2013.

COURSE OUTCOMES:

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

CO1: Develop an understanding of different types of natural resources

CO2: Realise the importance of ecosystem and biodiversity for maintaining ecological balance.

CO3: Create awareness about environmental pollution and role of human being in environmental protection.

CO4: Gain adequate knowledge about the social issues of the environment and solutions to solve the issues.

CO5: Understand the population explosion and current technology to protect the environment and human health.

22MEPC407 **MANUFACTURING TECHNOLOGY LABORATORY-II** **SEMESTER IV**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To study and practice on various milling machines.
- To acquire knowledge on appropriate tools, equipment's and machines to complete a given job using gear hobbing machine.
- To equip with the practical knowledge required in grinding machines.
- To study the knowledge on slotting machine.
- To impart the knowledge on planner machine.

LIST OF EXPERIMENTS

Machining and Machining time estimations for :

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical Gear cutting in milling machine
4. Gear generation in hobbling machine
5. Plain Surface grinding
6. Cylindrical grinding
7. Tool angle grinding with tool and cutter grinder
8. Measurement of cutting forces in Milling process.
9. Measurement of cutting forces in Turning process.
10. Keyway Spline Cutting using slotter.
11. V-slot in planner machine
12. Step cutting in planner machine

Contact periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

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

CO1: Create contour milling in vertical milling machine.
CO2: Use different machine tools to manufacturing gears.
CO3: Use different machine tools for finishing operations.
CO4: Measure cutting forces and make tool using cutter grinder.
CO5: Create various models in planner machine.

22MEPC408 STRENGTH OF MATERIALS LABORATORY SEMESTER IV

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To make measurements of different strains, stress and elastic properties of materials used in Mechanical Engineering.
- To provide physical observations to complement concepts learnt.
- To introduce experimental procedures and common measurement instruments, equipment, devices.
- To exposure to a variety of established material testing procedures and techniques.
- To different methods of evaluation and inferences drawn from observations.

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals – Brinell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test and Tensile test on helical springs
8. Effect of hardening- Improvement in hardness and impact resistance of steels
9. Tempering- Improvement Mechanical properties Comparison
    a) Unhardened specimen
    b) Quenched Specimen
    c) Quenched and tempered specimen
10. Microscopic Examination of
    a) Hardened samples
    b) Hardened and tempered samples

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Understand the mechanical properties of metals.
CO2: Determine the strength and stiffness of materials under external and internal loads.
CO3: Understand the stress strain and deformation of objects under external loads.
CO4: Acquire knowledge on spring properties applicable to engineering.
CO5: Understand the materials internal structure.

22MEPC409	COMPUTER AIDED MODELLING LABORATORY	SEMESTER IV

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To study basic conventions, abbreviations and symbols used in engineering drawings.
- To create 2D and 3D models for regular shapes.
- To develop the assembly drawing for given joints components using CAD software.
- To develop the assembly drawing for given coupling and bearing components using CAD software.
- To develop the assembly drawing for given miscellaneous machine components using CAD software.

LIST OF EXPERIMENTS

1. Study basic conventions, abbreviations, and symbols used in technical drawings.
2. Create 2D and 3D models with regular shapes
3. Create a three-dimensional modelling and assembly of the cotter joint
4. Create a three-dimensional modelling and assembly of the knuckle joint
5. Create a three-dimensional modelling and assembly of the flange coupling
6. Create a three-dimensional modelling and assembly of the universal coupling
7. Create a three-dimensional modelling and assembly of the footstep bearing
8. Create a three-dimensional modelling and assembly of the plummer block
9. Create a three-dimensional modelling and assembly of the screw jack
10. Create a three-dimensional modelling and assembly of the machine vice
11. Create a three-dimensional modelling and assembly of the connecting rod end
12. Create a three-dimensional modelling and assembly of the control valve

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

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

CO1: Use proper basics symbols convention abbreviations in assembly drawings.
CO2: Re-create given drawings and sectional views.
CO3: Develop the assembly drawing of mechanical joint components as per standard.
CO4: Develop the assembly drawing of coupling machine components as per standard.
CO5: Develop the assembly drawing of miscellaneous machine components as per standard.

22MEPC501 **HEAT AND MASS TRANSFER** **SEMESTER V**

(Use of Approved Heat and Mass Transfer Data Book is Permitted)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge of conduction heat transfer mechanisms.
- To provide the knowledge on the principles of free and forced convection.
- To study the performance of various types of heat exchanger.
- To impart the knowledge on black body radiation and grey body radiation.
- To learn about diffusion and convective mass transfer.

UNIT-I: CONDUCTION

9

General differential equation of heat conduction – Cartesian and Polar coordinates – One dimensional steady state heat conduction – Plane and composite systems – Conduction with Internal heat Generation – Extended surfaces – Unsteady heat conduction – Lumped analysis – Semi infinite and infinite solids –Use of Heisler's charts.

UNIT -II: CONVECTION

9

Free and forced convection – Hydrodynamic and thermal boundary layer. Free and forced convection during external flow over plates and cylinders and internal flow through tubes.

UNIT-III: PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

9

Nusselt's theory of condensation – Regimes of pool boiling and flow boiling. Correlations in boiling and condensation. Heat exchanger types – Overall heat transfer coefficient – Fouling factors – Analysis – LMTD method – NTU method.

UNIT-IV: RADIATION

9

Black body radiation – Grey body radiation – Shape factor – Electrical analogy – Radiation Shields. Radiation through gases.

UNIT-V: MASS TRANSFER **9**

Basic concepts – Diffusion mass transfer – Fick's law of diffusion – Steady state molecular diffusion – Convective mass transfer – Momentum, Heat and mass transfer analogy – Convective mass transfer correlations.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Rajput R.K., "A Text Book of Heat and Mass Transfer", S. Chand Publications, 7th Edition, 2018.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015.
3. Nag P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 3rd Edition, 2011.

4. Sachdeva R.C., “Fundamentals of Engineering Heat & Mass Transfer”, New Age International Publishers, 2009
5. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 6th Edition, 2006.
6. Kothandaraman C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2006.
7. Holman J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000.

COURSE OUTCOMES:

Upon completion of this 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 phenomena of boiling and condensation, apply 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 and convective mass transfer equations and correlations to solve problems for different applications.

22MEPC502 METROLOGY AND MEASUREMENTS SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basic principles of measurements.
- To provide knowledge on various metrological equipment's available to measure the dimension of the components.
- To acquire knowledge of advances in metrology.
- To study the correct procedure adopted to measure the dimension of the components.
- To understand the measurement of force, torque, power, flow and temperature measurements.

UNIT-I: BASICS OF METROLOGY
9

Introduction to Metrology – Need – Elements – Workpiece – Instruments – Persons – Environment – Their effect on precision and accuracy – Errors – Errors in measurements – Types – Control – Types of standards.

UNIT-II: LINEAR AND ANGULAR MEASUREMENTS
9

Linear measuring instruments – Evolution – Types – Classification – Limit gauges – Gauge design – Terminology – Procedure – Concepts of interchangeability and selective assembly – Angular measuring instruments – Types – Bevel protractor, Clinometers, Angle gauges, Spirit level, Sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT-III: ADVANCES IN METROLOGY
9

Basic concept of lasers – Advantages of lasers – Laser interferometers – Types – DC and AC lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of machine vision system – Element – Applications.

UNIT-IV: FORM MEASUREMENT
9

Principles and methods of straightness – Flatness measurement – Thread measurement, Gear measurement, Surface finish measurement, Roundness measurement – Applications.

UNIT-V: MEASUREMENT OF POWER, FLOW AND TEMPERATURE 9

Force, Torque, Power – Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, Rotameter, Pitot tube – Temperature: Bimetallic strip, Thermocouples, Electrical resistance thermometer – Reliability and Readability – Calibration.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Gupta I.C., "A Text-Book of Engineering Metrology", Dhanpat Rai Publications, 2018.
2. Beckwith, Marangoni and Lienhard, "Mechanical Measurements", Pearson Education, 2014.
3. Raghavendra and Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.
4. Holman J.P., "Experimental Methods for Engineers", McGraw Hill Book Company, 2011.
5. Jain R.K., "Engineering Metrology", Khanna Publishers, 2009.
6. Jain R.K., "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 2004.
7. Charles Reginald Shot bolt, "Metrology for Engineers", 5th Edition, Cengage Learning EMEA, 1990.

COURSE OUTCOMES:

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

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

CO2: Outline the principles of linear and angular measurement tools used for industrial applications.

CO3: Explain the procedure for conducting computer aided inspection.

CO4: Demonstrate the techniques of form measurement used for industrial components.

CO5: Discuss various measuring techniques of mechanical properties in industrial applications.

22MEPC503	COMPUTER AIDED DESIGN AND MANUFACTURING	SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of how computers are being used in mechanical component design.
- To understand the geometric modeling of various aspects of manufacturing.
- To provide the different types of Standard systems used in CAD.
- To understand the NC & CNC programming concepts to develop part programme for Lathe & Milling Machines.
- To apply the different types of techniques used in Cellular Manufacturing and FMS.

UNIT-I: INTRODUCTION **9**

Product cycle – Design process – Sequential and concurrent engineering – Computer aided design – CAD system architecture – Computer graphics – Co-ordinate systems – 2D and 3D transformations –Homogeneous coordinates – Line drawing – Clipping – Viewing transformation – Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control – Introduction to CAD/CAM – CAD/CAM concepts – Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance

UNIT-II: GEOMETRIC MODELING **9**

Representation of curves – Hermite curve – Bezier curve – B-spline curves – Rational curves – Techniques for surface modeling – Surface patch – Coons and bicubic patches – Bezier and B-spline surfaces. Solid modeling techniques – CSG and B-rep.

UNIT-III: CAD STANDARDS **9**

Standards for computer graphics – Graphical Kernel System (GKS) – Standards for exchange images – Open Graphics Library (OpenGL) – Data exchange standards – IGES, STEP, CALS etc. – Communication standards

UNIT-IV: FUNDAMENTAL OF CNC AND PART PROGRAMING **9**

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

UNIT-V: CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS) **9**

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

Contact periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007
3. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education -2003.
4. Radhakrishnan P, Subramanyan. S and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
5. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management" Second Edition, Pearson Education, 1999.
6. Hearn and M. Pauline Baker "Computer Graphics". Prentice Hall, Inc,1992
7. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.

COURSE OUTCOMES:

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

CO1: Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics.

CO2: Explain the fundamentals of parametric curves, surfaces and Solids.

CO3: Summarize the different types of Standard systems used in CAD.

CO4: Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines.

CO5: Summarize the different types of techniques used in Cellular Manufacturing and FMS.

22MEPC504 DESIGN OF MACHINE ELEMENTS SEMESTER V

(Use of P S G Design Data Book is permitted)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the various steps involved in the Design Process.
- To learn designing the shaft under various loading conditions.
- To learn designing helical, leaf springs, flywheels for various applications.
- To learn the design of temporary and permanent Joints.
- To learn designing and select rolling and sliding contact bearings, rigid and flexible couplings.

UNIT-I: BASICS OF DESIGN

9

Basic procedure and requirements for designing machine elements – Stress-strain diagrams – Mechanical properties of engineering materials – Preferred numbers, Fits and tolerances – Modes of failure – Stresses in machine elements: Tension, Compression, Shear, Bearing stress, Stress due to bending and eccentric axial loading – Principal stresses – Theories of elastic failure – Selection and use of failure theories.

UNIT -II: FLUCTUATING STRESSES AND DESIGN OF SHAFT

9

Stress concentration – Fluctuating stresses – Fatigue failure – Endurance limit – Low and high cycle fatigue – Notch sensitivity – Reversed stresses (Design for finite and Infinite life) – Soderberg, Goodman and Gerber relations – Design of shaft under static and fatigue loading.

UNIT-III: DESIGN OF ENERGY STORING ELEMENTS

9

Design of helical, Torsional and leaf springs – Design of flywheels considering stresses in rims and arms for engines and punching machines.

UNIT-IV: DESIGN OF TEMPORARY AND PERMANENT JOINTS

9

Design of riveted, welded joints in plates and pressure vessels – Design of eccentrically loaded riveted and welded joints – Design bolted joints – Design of joints with variable loading, adhesive joints.

UNIT-V: MISCELLANEOUS ELEMENTS 9

Design of rigid, flexible coupling – Design of connecting rods and crank shafts – Design of Cotter and Knuckle Joint – Design and selection of rolling and sliding contact bearing.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Sundararajamoorthy T.V and Shanmugam N., “Machine Design”, Anuradha Publications, Chennai, 2018.

2. Patel R.B., “Design of Machine Elements”, MacMillan Publishers India P. Ltd., Tech-Max Educational resources, 2018.
3. Bhandari V., “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2017.
4. Gope P.C., “Machine Design – Fundamental and Application”, PHI learning private ltd, New Delhi, 2012.
5. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley, 2011.
6. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett, “Mechanical Engineering Design”, 9th Edition, Tata McGraw-Hill, 2011.
7. Alfred Hall, Halowenko A and Laughlin H., “Machine Design”, Tata McGraw-Hill BookCo. (Schaum’s Outline), 2010.
8. Ansel Ugural, “Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.

COURSE OUTCOMES:

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

CO1: Understand the different types of stresses, materials properties and their significance in machine elements design.

CO2: Design the shafts by considering failure theories for reliability.

CO3: Design the energy storing elements for various applications according to the prescribed standards.

CO4: Design the temporary and permanent joints for fabrication of different machine components and boilers as per the standards.

CO5: Design the connecting rod, crank shaft cotter and knuckle joints and selection of couplings and bearings for industrial applications.

22MEPC505 THERMAL ENGINEERING LABORATORY SEMESTER V

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To characterize the fuels / lubricates used in an IC Engines.
- To sketch the valve timing diagram & port Timing diagram of an I.C engine.
- To do experiment on performance of an IC Engines.
- To do experiment on heat balance sheet of an IC Engines.
- To calculate the performance of steam generator and steam turbine.

LIST OF EXPERIMENTS

1. Study of Internal Combustion Engine.
2. Determination of flash point and fire point of various fuels / lubricants.
3. Determination of viscosity of given oil by using red wood Viscometer.
4. Valve timing and Port timing diagrams.
5. Performance Test on 4-stroke Diesel Engine.
6. Heat balance Test on 4-stroke Diesel Engine.
7. Morse test on Multi-cylinder Petrol Engine.
8. Retardation test on a Diesel Engine.
9. Study on Steam Generators and Turbines.
10. Performance and Energy balance test on a Steam Generator.
11. Performance and Energy balance test on Steam Turbine.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Categorize the characteristics of fuels/Lubricates used in IC Engines.
CO2: Sketch the value timing diagram of IC Engines.
CO3: Calculate the performance of IC Engines.
CO4: Conduct the heat balance test on IC Engines.
CO5: Conduct the performance test on steam boiler and steam turbine.

22MEPC506 METROLOGY AND MEASUREMENTS LABORATORY **SEMESTER V**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To understand calibration techniques of various measuring devices.
- To demonstrate the angular measurements carried out in manufacturing industries.
- To illustrate the use of various measuring tools measuring techniques.
- To learn the principles and devices involved in measuring surface textures.
- To studythe methods of various measurements like force and torque.

LIST OF EXPERIMENTS

1. Calibration of Vernier calliper and Micrometer with Slip Gauge.
2. Measurement of given samples using Vernier height gauge.
3. Bore Diameter Measurement by Telescope Gauge.
4. Measurement of Dimensions using Mechanical Comparator.
5. Cutting tool Parameters measurement by Tool Makers Microscope.
6. Use of gear teeth Vernier callipers and checking the chordal addendum and chordal height of spur gear.
7. Measurement of Angles using Sine Bar.
8. Measurement of Angles using Bevel Protractor.
9. Measurement of Surface Finish.
10. Use of Autocollimator to find the flatness of surface plate.
11. Force Measurement.
12. Torque Measurement.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Identify various instruments and gauges for measurement.

CO2: Select a suitable measuring instrument for measurement of angular dimensions and use the same for carrying out measurements.

CO3: Make use of gear tooth Vernier and Tool Makers Microscope for measuring Gear and thread parameters

CO4: Measure straightness, Flatness and surface roughness.

CO5: Apply the load cell to measure the force and Torque.

22MEPC507 **COMPUTER AIDED MACHINING LABORATORY** **SEMESTER V**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To study the CNC programming codes.
- To write the part programmes for the CNC turning centre.
- To write the part programmes for the CNC machining centre.
- To make the components using CNC machines.
- To explain the generating part programming data through CAM software.

LIST OF EXPERIMENTS

1. Part Programming - CNC Machining Centre
    1. Linear interpolation.
    2. Circular interpolation.
    3. Mirroring operation.
    4. Canned cycle operations.
2. Part Programming - CNC Machining Centre
    5. Straight, Taper and Radius turning operation.
    6. Thread cutting operation.
    7. Drilling and Tapping cycle operation.
    8. Canned cycle operations.
3. Computer Aided Part Programming
    9. CNC program generation using CAM software.
    10. Application of CAPP in Machining and Turning Centre.

Contact periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 60 Periods** **Total: 60 Periods**

COURSE OUTCOMES:

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

CO1: Understand the CNC part programming codes.
CO2: Develop manual part programs for the CNC machining centre.
CO3: Develop manual part programs for the CNC turning centre.
CO4: Make the components using CNC turning and machining centre.
CO5: Generate part programming using G and M code through CAM software.

22MEPC601 **THEORY OF MACHINES** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- 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.
- To study the basic concepts of toothed gearing and kinematics of gear trains
- To analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- To analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

UNIT-I: KINEMATICS OF MECHANISMS
9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slider crank chain – Displacement, velocity and acceleration analysis of simple mechanisms(four bar mechanism and single slider crank mechanism)-graphical method for velocity and acceleration polygons – cams – classifications of cams and followers – displacement diagrams – Uniform velocity, simple harmonic and uniform acceleration and retardation motions-layout of plate cam profiles.

UNIT -II: GEARS AND GEAR TRAINS
9

Spur gear – Law of toothed gearing – Involute gearing – Gear tooth action interference and undercutting – Gear trains velocities of the gears in gear trains such as Simple, Compound, Reverted & Epicyclic (using tabulation method) gear trains, Differential gear train (theory only) – Simple problems on gear trains.

UNIT-III: FORCE ANALYSIS
9

Dynamic force analysis – Inertia forces in reciprocating parts: Introduction, D-Alembert's Principle – Velocity and acceleration of the piston – Forces on the reciprocating parts of an engine considering friction and inertia of moving parts – Flywheel: Function – Operation of flywheel in a punching machine – Turning moment diagram – Fluctuation of energy and fluctuation of speed of crank shaft.

UNIT-IV: BALANCING AND VIBRATION
9

Static and dynamic balancing – Balancing of rotating masses – Balancing of single rotating mass, balancing of several masses in single and several planes – Balancing of reciprocating masses (Introduction only) – Free vibrations – Equations of motion – Natural Frequency – Damped Vibration – Critical speed of shafts – Torsional vibration.

UNIT-V: MECHANISMS FOR CONTROL9

Governors: Introduction – Function and types of governors – Centrifugal governors – Watt governor – Porter governor – Proell governor – Hartnell governor – Characteristics of

governor. Gyroscope: Concept of gyroscope – Angular acceleration – Gyroscopic effects in ships – Airplanes – Stability of automobile.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rdedition 2019.
2. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
4. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2nd edition, 2014.
5. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.
6. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.
7. Khurmi, R.S., "Theory of Machines", 14thEdition, S Chand Publications, 2005.

COURSE OUTCOMES:

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

CO1: Identify and explain the fundamental components of mechanical systems, such as links, joints, cams, and gears, and their roles in producing specific motion outputs.

CO2: Analyze the kinematics of toothed gearing systems, including gear trains, to understand how gears transfer motion and force between shafts.

CO3: Apply force analysis techniques to study the force-motion relationship in mechanical systems and components subjected to external forces.

CO4: Analyze and identify unbalanced forces and undesirable vibrations in mechanisms, and apply methods to relieve their effects on system performance

CO5: Design and analyze mechanisms for speed control and stability under varying operational conditions.

22MEPC602 DESIGN OF TRANSMISSION SYSTEMS SEMESTER VI

(Use of P S G Design Data Book is permitted)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To select and design hoisting ropes, belts, V belts, ribbed V belts, and chains for power transmission
- To analyze and design spur and helical gears, calculate their size, and understand gear strength and wear
- To understand the key concepts, forces, and materials used for bevel and worm gears, and how to size these gear pairs.
- To design different types of gearboxes, including sliding mesh, constant mesh, and planetary gearboxes.
- To design various types of clutches and brakes used in power transmission systems.

UNIT-I: DESIGN OF POWER TRANSMISSION ELEMENTS
9

Selection of hoisting wire ropes, Design of Flat belt, V belt, Ribbed V belt – Design of transmission chains and sprockets.

UNIT -II: SPUR AND HELICAL GEARS
9

Kinematics – Force analysis in gears – Stress analysis – Dynamic effects – Gear blank design – Estimating gear size, Module and face width – Power rating calculations based on strength and wear considerations, Crossed helical gear terminology – Estimating the size of the pair of cross 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: Terminology, Thermal capacity, Materials – Forces and stresses, Efficiency, Estimating the size of the worm gear pair. Merits and demerits of bevel and worm gears

UNIT-IV: DESIGN OF GEAR BOX
9

Geometric progression – Standard step ratio – Ray diagram, Kinematic layout – Design of sliding mesh and constant mesh gear box – Introduction to planetary gear box.

UNIT-V: CLUTCHES AND BRAKES **9**

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.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Robert L Mott, Machine Elements in Mechanical Design", 6th edition, Pearson/Prentice Hall, 2021.
2. Design Data Book, PSG College of Technology, M/s, Kalaikathir Publishers, Coimbatore, 2020.
3. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 11th Edition, Tata McGraw-Hill, 2020.
4. Sundararajamoorthy T.V, Shanmugam N., "Machine Design", Anuradha Publications, Chennai, 2018.
5. Bhandari V., "Design of Machine Elements", 5th Edition, Tata McGraw-Hill Book Co, 2017.
6. Orthwein W., "Machine Component Design", Jaico Publishing Co, 2013.
7. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 5th Edition, Wiley, 2011.

COURSE OUTCOMES:

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

CO1: Select and design suitable power transmission elements for various applications, considering factors like load, speed, and material properties.

CO2: Perform kinematic and force analysis of spur and helical gears, estimate gear sizes, and calculate the power rating based on strength and wear criteria.

CO3: Design bevel and worm gears, analyze their forces and stresses, and estimate the proper size and dimensions for gear pairs based on thermal capacity and efficiency considerations

CO4: Design gearboxes, including sliding mesh, constant mesh, and planetary gearboxes, using kinematic layouts, geometric progression, and standard step ratios.

CO5: Design various types of clutches and brakes used in power transmission systems, ensuring proper mechanical performance and efficiency.

22MEPC603 FINITE ELEMENT ANALYSIS SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of numerical methods and their advantages.
- To introduce the concepts of mathematical modelling of boundary value problems.
- To solve one-dimensional (1D) structural and heat transfer problems.
- To solve plane stress, plane strain and axisymmetric problems using two-dimensional (2D) element.
- To provide knowledge on isoparametric elements and numerical integration for complex problems.

UNIT-I: RELEVANCE OF FEM
9

Historical background – Basic concept of FEM – General finite element modelling procedure; Discretization process, Element types(1D, 2D and 3D Domains), Degree of freedom, Numbering of nodes and element – Global and local coordinate system – Mesh refinement, Convergence requirements – Matrix algebra –Commercial finite element packages.

UNIT -II: CHARACTERISTIC MATRICES AND LOAD VECTORS
9

One dimensional governing equation – Structural and heat transfer problems – Variational method – Variation calculus – Weighted residual methods – Galerkin method – Ritz method – Generalized coordinate's approach – Principle of minimization of potential energy.

UNIT-III: ONE DIMENSIONAL PROBLEMS
9

Derivation of shape functions, Stiffness matrices and force vectors – Assembly of Matrices – Shape function characteristics – Problems in axial load members, Trusses, Heat transfer through composite walls and fins.

UNIT-IV: TWO DIMENSIONAL PROBLEMS
9

Derivation of shape functions for triangular elements, Element stiffness matrix – Force vectors – Finite element equations –Concept of plane stress, plane strain and Axisymmetric formulation – Stress and strain calculation – Introduction to coupled field analysis.

UNIT-V: HIGHER ORDER ELEMENTS **9**

Natural coordinate systems – Isoparametric elements – Shape functions for four-node quadrilateral element – One and two dimensions – Jacobian transformation – Serendipity and Lagrangian element – Numerical integration.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Reddy J.N., “Introduction to the Finite Element Method”, 4th Edition, Tata McGraw-Hill, 2021.
2. Singiresu.S.Rao, “The Finite Element Method in Engineering”, 6th Edition, Butterworth Heinemann, 2018.
3. Chandrupatla and Belagundu, “Introduction to Finite Elements in Engineering”, 4th Edition, Prentice Hall College Div, 2018.
4. Logan D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 5th Edition, 2018.
5. J Seshu P., “Textbook of Finite Element Analysis”, Prentice Hall of India, 2017.
6. Bhavikatti S S, “Finite Element Analysis”, New Age International, 2015.
7. David V.Hutton, “Fundamentals of Finite Element Analysis”, McGraw Hill Inc, Newyork, 2004.

COURSE OUTCOMES:

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

CO1: Understand the applications of numerical methods and their advantages.

CO2: Evaluate complexities in solving boundary value problems and effective solving methods.

CO3: Apply numerical techniques to solve 1D structural and heat transfer problems.

CO4: Analyze two-dimensional problems in mechanical engineering.

CO5: Use higher-order elements to obtain more accurate solutions.

22CAHS604 PROFESSIONAL ETHICS IN ENGINEERING SEMESTER VI

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To understand the importance of Values and Ethics in their professional careers.
- To know the different ideas of engineering ethics.
- To Infer moral judgment concerning the profession
- To inculcate the sense of social responsibility.
- To know the global issues of ethics.

UNIT-I: HUMAN VALUES
9

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

UNIT -II: ENGINEERING ETHICS
9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of ethical theories.

UNIT-III: ENGINEERING AS SOCIAL EXPERIMENTATION
9

Engineering as experimentation – Engineers as responsible experimenters – Codes of ethics – A balanced outlook on law.

UNIT-IV: SAFETY, RESPONSIBILITIES AND RIGHTS
9

Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk – Respect for Authority – Collective bargaining – Confidentiality – Conflicts of interest – Occupational crime – Professional rights – Employee rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT-V: GLOBAL ISSUES **9**

Multinational corporations – Environmental ethics – Computer ethics – Weapons development – Engineers as managers – Consulting Engineers – Engineers as expert witnesses and advisors – Moral leadership – Code of conduct – Corporate social responsibility.

Contact periods:

Lecture: 45 Periods	Tutorial: 0 Periods	Practical: 0 Periods	Total: 45 Periods

REFERENCES:

1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
2. Govindarajan M., Natarajan S. and Senthil Kumar V. S., “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
4. John R. Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility,” Mc Graw Hill education, India Pvt.
6. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
7. Edmund G. and Robert L. Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 2001.

COURSE OUTCOMES:

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

CO1: Apply human values.

CO2: Apply ethical issues related to Engineering.

CO3: Realize the code of Ethics.

CO4: Realize the responsibilities and rights in the society.

CO5: Know Global Issues.

22MEPC605 **THEORY OF MACHINES LABORATORY** **SEMESTER VI**

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To understand the fundamental parameters and operating principles of gears and epicyclic gear trains, and analyze their applications in power transmission and mechanical systems.
- To experimentally determine the moment of inertia of rotational systems, including flywheels and symmetric bodies, and understand their influence on the dynamics of mechanical systems.
- To analyze the behavior of undamped free vibrations in single-degree-of-freedom systems, including spring-mass and torsional vibration systems, and understand their significance in mechanical system design and analysis.
- To study the dynamic behavior of cam mechanisms and governors, analyzing their roles in motion control and speed regulation in mechanical systems.
- To analyze the principles of gyroscopic motion and determine the critical speed of shafts, understanding their effects on stability and performance in rotating mechanical systems.

LIST OF EXPERIMENTS

1. Study of gear parameters.
2. Epicycle gear Train.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Undamped free vibrations of a single degree freedom Spring-mass system.
6. Torsional Vibration (Undamped) of single and double rotor shaft system.
7. Dynamic analysis of Cam mechanism.
8. Experiment on Watt, Porter, Proell and Hartnell Governors
9. Experiment on motorized gyroscope.
10. Determination of critical speed of shafts.

Contact periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES:

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

CO1: Evaluate the parameters and operating principles of gears and epicyclic gear trains, and apply their knowledge to design and analyze power transmission systems.

CO2: Experimentally determine the moment of inertia of rotational systems, such as flywheels and symmetric bodies, and assess their impact on mechanical dynamics.

CO3: Develop the ability to study and interpret undamped free vibrations in single-degree-of-freedom systems, including spring-mass and torsional systems, for designing stable and efficient mechanical systems.

CO4: Analyze the dynamic performance of cam mechanisms and governors, evaluating their effectiveness in controlling motion and maintaining speed stability in machinery.

CO5: To assess the principles of gyroscopic motion and determine the critical speed of shafts, applying their understanding to improve the stability and performance of rotating systems.

22MEPC606 HEAT TRANSFER LABORATORY SEMESTER VI

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To determine the thermal conductivity of various materials through guarded plate, lagged pipe and composite wall apparatus.
- To determine the thermal conductivity and heat transfer coefficient of different materials through insulating powder, natural convection and forced convection apparatus.
- To learn the fin efficiency and radiation concepts of different materials through pin fin, Stefan-Boltzmann and emissivity apparatus.
- To determine the heat exchanger effectiveness, Cooling load and volumetric efficiency of different materials through heat exchanger, cooling tower and air compressor apparatus.
- To conduct the performance tests on refrigeration & air conditioning systems.

LIST OF EXPERIMENTS

1. Thermal conductivity measurement using guarded plate apparatus
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus
3. Determination of Thermal conductivity of composite wall
4. Determination of Thermal conductivity of insulating powder
5. Determination of heat transfer coefficient under natural convection from a vertical cylinder
6. Determination of heat transfer coefficient under forced convection from a tube
7. Heat transfer from pin-fin apparatus. (natural & forced convection modes)
8. Determination of Stefan – Boltzmann constant
9. Determination of emissivity of a grey surface
10. Effectiveness of Parallel / counter flow heat exchanger
11. Performance test in a fluidized Bed Cooling Tower
12. Performance test on a reciprocating air compressor
13. Determination of COP of a refrigeration system
14. Experiments on Psychrometric processes
15. Performance test in a HC Refrigeration System

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Conduct experiment on Predict the thermal conductivity of solids and liquids.

CO2: Conduct experiment on Estimate the thermal conductivity and heat transfer coefficient values of various fluids.

CO3: Conduct experiment on Find out the fin efficiency and Stefan Boltzmann constant and emissivity values of grey body.

CO4: Conduct experiment on Test the performance of heat exchanger, cooling tower and air compressor.

CO5: Conduct experiment on Calculate the COP of Refrigeration and Air Conditioning systems.

22MEEE607	DESIGN AND FABRICATION PROJECT	SEMESTER VI			
		L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To find the solutions by formulating proper methodology.
- To study the concepts of various machine elements.
- To utilize the concepts in the designing of machine elements.
- To train the students to fabricate the model as per design standards.
- To train the students in preparing project reports and to face reviews and viva voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

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

CO1: Explain the solution for engineering problems.
CO2: Understand the basic concepts of various machine elements.
CO3: Design the machine element or the mechanical product.
CO4: Fabricate the machine element or the mechanical product.
CO5: Demonstrate the working model of the machine element or the mechanical product.

22MEPC701 **MECHATRONICS** **SEMESTER VII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the elements and techniques involved in Mechatronics systems.
- To introduce the architecture of microprocessor and microcontroller.
- To familiarize the concept of peripheral interface.
- To explain the architecture of PLC.
- To understand the simple Mechatronics systems.

UNIT-I: INTRODUCTION **9**

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors.

UNIT -II: 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER **9**

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram.

UNIT-III: PROGRAMMABLE PERIPHERAL INTERFACE **9**

Introduction – Architecture of 8255, Keyboard interfacing, LED display – Interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Light Control interface.

UNIT-IV: PROGRAMMABLE LOGIC CONTROLLER **9**

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT-V: ACTUATORS AND MECHATRONIC SYSTEM DESIGN **9**

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process – Stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier

Contact periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 6th Edition, Prentice Hall, 2013
2. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International 4th Edition, 2012.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2nd 2010.

4. Smaili.A and Mrad.F , “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2008
5. Bolton, “Mechatronics”, Prentice Hall, 2008
6. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
7. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Know about the various elements used in Mechatronics system.

CO2: Acquire knowledge about the architecture of microprocessor and microcontroller.

CO3: Aware of the concept of peripheral interface.

CO4: Explain architecture of PLC.

CO5: Solve simple problems using Mechatronics system.

22MEPC702 INDUSTRIAL ROBOTICS SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To describe different robotic components and their operations.
- To explain various types of drive systems and end effectors.
- To explain various sensors and machine vision.
- To impart knowledge in robot kinematics and programming.
- To learn about robot safety issues and economic considerations.

UNIT-I: FUNDAMENTALS OF ROBOT
9

Robot – Definition – Robot anatomy – Coordinate systems, Work envelope, Types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of motion, Payload – Robot parts and their functions – Need for robots – Different applications.

UNIT -II: ROBOT DRIVE SYSTEMS AND END EFFECTORS
9

Pneumatic drives – Hydraulic drives – Mechanical drives – Electrical drives (Servo motors and Stepper motors) – Salient features, Applications and comparison of all these drives, End effectors; types, Grippers; Mechanical grippers, Pneumatic and hydraulic grippers, Magnetic grippers, Vacuum grippers, Two fingered and Three-fingered grippers, Internal grippers and external grippers; Selection and design considerations.

UNIT-III: SENSORS AND MACHINE VISION
9

Requirements of a sensor, principles and applications of Position sensors (Piezoelectric sensor, Linear Variable Differential Transformer, Resolvers, Optical encoders, and Pneumatic position sensors) - Range sensors (Triangulations principles, Structured lighting approach) - Touch sensors (Binary sensors and Analog sensors) – Force and Torque sensor - Remote center compliance -Slip sensors, Introduction to Machine Vision; Functions, Image processing and analysis, Applications – Inspection, Identification, Visual servoing and navigation.

UNIT-IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING
9

Forward kinematics and Reverse kinematics of manipulators with Two and three Degrees of Freedom, homogeneous transformation matrix, simple problems (2D), Lead through programming, Robot programming languages – VAL Programming – Motion commands, Sensor commands, End effectors commands and Simple programs for loading, unloading and palletizing operations.

UNIT-V: IMPLEMENTATION AND ROBOT ECONOMICS 9

Automated guided vehicle – Types; Implementation of robots in industries – Various steps; Safety considerations for robot operations – Roles of Robot in under water and medical field – Economic analysis of robots; Payback and Rate of return method.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. John J. Craig., “Introduction to Robotics: Mechanics and Control”, 4th edition, Pearson Education, 2022.
2. Groover, M.P. “Automation, Production Systems, Computer Integrated Manufacturing”, Pearson Education, 2016.
3. Deb S R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
4. Groover M P., “Industrial Robotics – Technology Programming and Applications”, McGraw Hill, 2012.
5. Klafter R D., Chmielewski T A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2005.
6. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
7. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co., 1992.

COURSE OUTCOMES:

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

CO1: Understand the fundamental concept of robot for the selection of various applications.

CO2: Illustrate the different types of robot drive systems as well as robot end effectors.

CO3: Apply the different sensors and image processing techniques in robotics to improve the ability of robots.

CO4: Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.

CO5: Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

22MEPC703 MECHATRONICS LABORATORY SEMESTER VII

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- Design appropriate circuits to automate and control the hydraulic, pneumatic and electric actuators.
- Developing a model of pneumatic and hydraulic circuits by using simulation software.
- Apply PLC & microcontroller as a control unit Mechatronics system.
- Applying a suitable sensor and image processing technique for Mechatronics systems.
- Measuring of physical quantity such as displacement, temperature and also the operation of signal conditioning circuits.

LIST OF EXPERIMENTS

1. Control of Hydraulic, Pneumatic, and Electro-Pneumatic Circuits.
2. Modeling and analysis of Hydraulic, Pneumatic, and Electrical Circuits using FLUIDSIM Software.
3. Simulation of logic gates using WPL PLC software.
4. Image Processing Techniques using MATLAB Software.
5. Assembly Language Programming of 8085 – Addition, Subtraction, Multiplication, and Division.
6. Assembly Language Programming of 8085 – Sorting and Code Conversion.
7. Stepper Motor Interface.
8. Speed Control of DC Motor.
9. Study of Various Types of Transducers.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Implementation of hydraulic, pneumatic and electro-pneumatic circuits.
CO2: Simulate basic operations using PLC.
CO3: Implementation of Image Processing Techniques for application in machine vision.
CO4: Develop assembly-language programs for microprocessor-based arithmetic operations and the interfacing of various I/O devices.
CO5: Study of various types of transducers.

22MEPC704 SIMULATION AND ANALYSIS LABORATORY SEMESTER VII

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To apply the FEA software tools to perform structure analysis in 1D component.
- To apply the FEA software tools to perform structure analysis in 2D component.
- To perform the stress analysis in three dimensional component using FEA software tools.
- To apply the FEA software tools to perform the heat transfer analysis in 2D component.
- To apply the FEA software tools to solve the dynamic problems.

LIST OF EXPERIMENTS

1. Force and stress analysis in trusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of simple compound bar.
4. Stress analysis of a plate with a circular hole.
5. Stress analysis of rectangular L-bracket.
6. Stress analysis of an axi-symmetric component.
7. Stress analysis of three dimensional component.
8. Thermal stress analysis of a 2D component.
9. Conductive heat transfer analysis of a 2D component.
10. Convective heat transfer analysis of a 2D component.
11. Modal analysis of a 2D component.
12. Modal analysis of beams.
13. Harmonic analysis of a 2D component.
14. Simulation of free vibration characteristics of spring, and mass system.

Contact periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

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

CO1: Perform the force, deflection and stress analysis on one dimensional problems using analysis software tools.

CO2: Perform the stress analysis on simple two dimensional structural components using analysis software tools.

CO3: Perform the stress analysis on three dimensional structural components using analysis software tools.

CO4: Perform the thermal stress and heat transfer analysis on simple two dimensional components using analysis software tools.

CO5: Perform dynamic analysis on simple systems using analysis software tools.

22MEEE705 **PROJECT PHASE - I** **SEMESTER VII**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- Opportunity to design and develop small working models.
- Develop experimental or simulation solutions to small industrial problems.
- Facilitate problem identification, formulation and solution.
- Work collaboratively in small groups.
- Enhance the presentation and technical report writing skills.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into groups of about four members per group and work under a project supervisor. The device / system / component(s) to be designed/ fabricated / investigated / analyzed may be decided in consultation with the supervisor. An industrial expert may be included as an external supervisor. A project report to be submitted by the group and the fabricated model / investigation / analysis to be reviewed and evaluated continuously by a committee constituted by the head of the department / program coordinator.

Contact periods:

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

COURSE OUTCOMES:

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

CO1: Model or simulate solutions to small engineering problems considering environmental issues.

CO2: Apply the principles of mechanical engineering to solve engineering problems.

CO3: Perform feasibility study and manage activities to complete task in specified duration.

CO4: Assign and undertake tasks in a team as per team discussion.

CO5: Do presentation and write technical reports for effective communication within and outside the team.

22MEEE801 **PROJECT WORK** **SEMESTER VIII**

L	T	P	C
0	0	16	8

COURSE OBJECTIVES:

- Opportunity to design and develop small working models.
- Develop experimental or simulation solutions to small industrial problems.
- Facilitate problem identification, formulation and solution.
- Work collaboratively in small groups.
- Enhance the presentation and technical report writing skills.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into groups of about four members per group and work under a project supervisor. The device / system / component(s) to be designed/ fabricated / investigated / analyzed may be decided in consultation with the supervisor. An industrial expert may be included as an external supervisor. A project report to be submitted by the group and the fabricated model / investigation / analysis to be reviewed and evaluated continuously by a committee constituted by the head of the department / program coordinator.

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods

COURSE OUTCOMES:

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

CO1: Model or simulate solutions to small engineering problems considering environmental issues.

CO2: Apply the principles of mechanical engineering to solve engineering problems.

CO3: Perform feasibility study and manage activities to complete task in specified duration.

CO4: Assign and undertake tasks in a team as per team discussion.

CO5: Do presentation and write technical reports for effective communication within and outside the team.

22MEPE501 COMPOSITE MATERIALS SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the fundamentals of properties of composite.
- To understand the manufacturing methods of polymer matrix composites.
- To gain knowledge on metal matrix composite and its manufacturing techniques.
- To study the properties of ceramic composites.
- To learn the recent advances in carbon/carbon composites.

UNIT-I: INTRODUCTION OF COMPOSITES
9

Fundamentals of composite – Need for composites – Enhancement of properties – Classification of composites matrix – Polymer matrix composites (PMC) – Metal matrix composites (MMC) – Ceramic matrix composites (CMC) – Reinforcement – Glass fibers, Boron fibers, carbon fibers, Armid fibers, whiskers – Particle reinforced composites – Fiber reinforced composites – Advantages and applications of various types of composites.

UNIT-II: POLYMER MATRIX COMPOSITES 9

Polymer matrix resins – Thermosetting resins – Thermoplastic resins – Reinforcement fibers – Rovings – Woven fabrics – Non woven random mats – Various types of fibers – Manufacturing of PMCs – Hand layup processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding – Resin transfer moulding – Autoclave moulding – Pultrusion – Filament winding – Injection moulding – Thermoplastic tape laying – Fiber reinforced plastics (FRP) – Glass fiber reinforced plastics (GRP).

UNIT-III: METAL MATRIX COMPOSITES
9

Metal matrix composite, Characteristics of MMC – Various types of Alloy vs MMC – Advantages of MMC – Limitations of MMC – Metal matrix composite applications – Reinforcements – Particles – Fibers – Effect of reinforcement – Volume fraction – Rule of mixtures – Manufacturing of MMCs – Powder metallurgy process – Diffusion bonding – Stir casting – Squeeze casting, applications of MMC in aerospace, automotive industries.

UNIT-IV: CERAMICS 9

Engineering ceramic materials – Properties and applications – Advantages – Limitations – Monolithic ceramics – Need for CMC – Ceramic matrix – Various types of ceramic matrix composites – Oxide ceramics – Non oxide ceramics – Aluminium oxide – Silicon nitride – Reinforcements – Particles, fibers, whiskers – Sintering – Hot pressing – Cold isostatic pressing – Hot isostatic pressing – Lanxide process.

UNIT-V: CARBON COMPOSITES 9

Carbon/carbon composites – Advantages of carbon matrix – Limitations of carbon matrix carbon fiber – Chemical vapour deposition of carbon on carbon fiber – Sol gel technique – Composites for aerospace applications.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Krishan K. Chawla "Composite Materials Science and Engineering", Springer, 3rd Edition, 2013.
2. Srinivasan K., "Composite Materials: Production, Properties, Testing and Applications", Narosa Publishers, 1st Edition, 2012.
3. Deborah D.L. Chung "Composite materials: Science and Application", Springer, 2nd Edition, 2010.
4. William D. Callister and David G. Rethwisch "Material Science and Engineering", John Wiley, 8th Edition, 2010.
5. Mallick P.K., "Fiber-reinforced Composites, Materials, Manufacturing and Design", CRC Press, 3rd Edition, 2007.
6. Sharma S.C., "Composite Materials", Narosa Publishers, 1st Edition, 2000.

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of composite.

CO2: Understand the properties and manufacturing methods of polymer matrix composites.

CO3: Understand the properties of metal matrix composite and its manufacturing techniques.

CO4: Understand the properties of ceramic composites.

CO5: Learn the recent advances in carbon/carbon composites.

22MEPE502 DESIGN FOR MANUFACTURE AND ASSEMBLY SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand modern manufacturing operations their capabilities, limitations and how to design for lowest cost.
- To gain insight into how designers influence manufacturing schedule and cost.
- To learn how to analyze products and able to improve their manufacturability and lower costs.
- To understand the relationship between customer desires, functional requirements.
- To understand the relationship between product materials, product design, and manufacturing process selection.

UNIT-I: DESIGN PRINCIPLE 9

Economics of process selection – General design principles of manufacturability – Proper material selections – Strength and mechanical factors – Geometric tolerances – Design for serviceability – Tolerance Charting Techniques. General aspects of the designers work – Design factors – Systematic working plan – Basic design.

UNIT-II: DESIGN FOR MANUFACTURING 9

DFM guidelines and specific design rules, Machining Process: Overview of various machining processes – General design rules for machining, Dimensional tolerance and surface roughness. Material Casting: Appraisal of various casting processes, Design guidelines for casting, Use of solidification simulation in casting design, charts. Performance characteristics, material selection process and economics of materials. Design of Forgings: DFM guidelines for closed – Die forging, parting lines of die drop forging die design.

UNIT-III: METAL JOINING
9

Appraisal of various processes, Factor in the design of welding elements, General design guidelines, Pre and post treatment of welds, Effect of thermal stresses in weld joints, design for brazed joints. Sheet metal forming: Stamping, Bending, Stretching and deep drawing, General design guide lines, Keeler, Goodman forming line diagram.

UNIT-IV: ASSEMBLE ADVANTAGES 9

Development of assemble process, choice of assemble methods; assemble advantages, social effects of automation. Atomic Assembly Transfer Systems: Continuous transfer, intermittent transfer, Indexing Mechanism, Operator paced free transfer machine.

UNIT-V: DESIGN OF MANUAL ASSEMBLY 9

General design guidelines for manual assembly, Assembly efficiency, Classification system for manual handling, Insertion and fastening. Effect of part symmetry, Part thickness, Size and weight on handling time, Parts required for two hands for manipulation, Effect of symmetry and chamfer design on insertion operations, Estimation of insertion time.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, "Product design for manufacture and assembly", 2nd Edition, Taylor and Francis 2019.
2. Matousek R., "Engineering Design", Blackie and Son Limited, Glasgow, 2015.
3. Eggert R.J., "Engineering Design", Pearson Education, Inc. New Jersey, 2014.
4. Kalandar Saheb S.D and Prabhakar O., "Engineering Design for Manufacture", ISPE 2014.
5. Peck H., "Designing for Manufacture", Pitman Publications, London, 2013.
6. Dieter G.E., "Engineering Design: A Materials and processing Approach", McGraw Hill Co. Ltd, 5th Edition, 2012.

COURSE OUTCOMES:

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

CO1: Understand constraints of manufacturing processes that limit design possibilities with respect to cycle time, material handling, and other factory costs.

CO2: Apply quantitative methods to assess DFA between different designs.

CO3: Apply principles of DFA to increase manufacturing efficiency in assembly processes.

CO4: Distinguish poor practices from robust design practices for discussed processes.

CO5: Apply a systematic understanding of knowledge in the field of metal casting and forging.

22MEPE503 DESIGN OF JIGS, FIXTURES & PRESS TOOLS SEMESTER V

(Use of P S G Design Data Book is permitted)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the functions of Jigs, fixtures and press tools.
- To understand the design principles of Jigs, fixtures and press tools.
- To gain proficiency in the development of required views of the final design.
- To understand the press working terminologies.
- To understand the elements of cutting dies.

UNIT-I: LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design – Function and advantages of Jigs and fixtures – Basic elements – Principles of location – Locating methods and devices – Redundant location – Principles of clamping – Mechanical actuation – Pneumatic and hydraulic actuation standard parts.

UNIT-II: JIGS AND FIXTURES 9

Design and development of jigs and fixtures for given component – Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Quick change fixtures.

UNIT-III: PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES
9

Press Working Terminologies – Operations – Types of presses – Press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure – Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT-IV: BENDING FORMING AND DRAWING DIES 9

Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – Knockouts – Direct and indirect – Pressure pads – Ejectors – Draw die inserts – Draw beads – Ironing – Design and development of bending, forming, drawing reverse re-drawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT-V: OTHER FORMING TECHNIQUES 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – Recent trends in tool design – Computer Aids for sheet metal forming Analysis – Basic introduction – Tooling for numerically controlled machines – Setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Design Data Hand Book, PSG College of Technology, Coimbatore, 2020.
2. Joshi P.H., "Press Tools -Design and Construction", S. Chand Publishing, 2017
3. Balachandran V., "Design of Jigs Fixtures & Press Tools", Notion Press, Chennai, 2015.
4. Venkataraman K., "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005
5. Joshi, P.H., "Jigs and Fixtures", 2nd Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
6. Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
7. Donaldson, Lecain and Goold "Tool Design", 3rd Edition Tata McGraw Hill, 2000.

COURSE OUTCOMES:

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

CO1: Summarize the different methods of Locating Jigs and Fixtures and Clamping principles.

CO2: Design and develop jigs and fixtures for given component.

CO3: Discuss the press working terminologies and elements of cutting dies.

CO4: Distinguish between Bending and Drawing dies.

CO5: Understand the different types of forming techniques.

22MEPE504 AUTOMOBILE ENGINEERING SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the construction and working principle of various parts of an automobile.
- To learn the engine auxiliary systems and engine emission control.
- To understand the working of different types of transmission systems.
- To study the Steering, Brakes and Suspension Systems.
- To learn the alternate sources of energy for IC Engines.

UNIT-I: VEHICLE STRUCTURE **9**

Types of automobiles – Vehicle construction and different layouts – Chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved).

UNIT-II: ENGINE AUXILIARY SYSTEMS **9**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system, Turbo chargers (WGT, VGT) and Engine emission control by three way catalytic converter system.

UNIT-III: TRANSMISSION SYSTEMS
9

Clutch – Types and construction, gear boxes – Manual and automatic, Over drive, transfer box, fluid flywheel, Propeller shaft, slip joints, Universal joints, Differential and rear axle, Hotchkiss drive and torque tube drive.

UNIT-IV: STEERING, BRAKES AND SUSPENSION SYSTEMS **9**

Steering geometry and types of steering gear box – Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS).

UNIT-V: ALTERNATIVE ENERGY SOURCES **9**

Use of natural gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles – Engine modifications required – Performance, Combustion and Emission characteristics of SI and CI engines with these alternate fuels – Electric and Hybrid vehicles, Fuel cell.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Kirpal Singh, "Automobile Engineering", Vol. 1&2, Seventh Edition, Standard Publishers, New Delhi, 14th Edition 2021.
2. Ganesan V. "Internal Combustion Engines", 4th Edition, Tata McGraw-Hill, 2017
3. Joseph Heitner, "Automotive Mechanics," 2nd Edition, East-West Press, 2004.
4. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

5. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.

COURSE OUTCOMES:

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

CO1: Classify various types of automobiles and vehicle structures.

CO2: Discuss the engine auxiliary systems and engine emission control.

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.

22MEPE601 REFRIGERATION AND AIR CONDITIONING **SEMESTER VI**

(use of refrigeration and air conditioning tables and psychrometric chart permitted)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basic concepts of refrigeration.
- To study the vapor compression refrigeration systems
- To study the various types of refrigeration systems.
- To learn the psychrometric properties and psychrometric processes.
- To provide knowledge on design aspects of Air conditioning systems

UNIT I:INTRODUCTION 9

Introduction to Refrigeration – Unit of Refrigeration and COP – Ideal cycles – Refrigerants desirable properties – Classification – Nomenclature –Ozone Depletion Potential (ODP) & Global Warming Potential (GWP).

UNIT-II:VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams – Deviations from theoretical cycle – Sub cooling and super heating – Effects of condenser and evaporator pressure on COP – Multipressure system – Low temperature refrigeration cycle – Cascade systems – Problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT-III: VAPOUR ABSORPTION AND 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: PSYCHROMETRY 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: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, Internal heat load; Fresh air load, human comfort &Indoor Air Quality (IAQ) principles, Layout of plants; Air distribution system; Filters; Air conditioning systems with controls: Temperature, pressure and humidity sensors, Actuators & Safety controls.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Arora C P., "Refrigeration and Air Conditioning", 3rd Edition, McGraw Hill, New Delhi, 2017.

2. ASHRAE Hand book, Fundamentals, 2010.
3. Roy J. Dossat, "Principles of Refrigeration", 4th Edition, Pearson Education Asia, 2009,
4. Jones W P., "Air Conditioning Engineering", 5th Edition, Elsevier Butterworth-Heinemann, 2007.
5. Stoecker W F and Jones J W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.

COURSE OUTCOMES:

Upon completion of this 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.

22MEPE602 GAS DYNAMICS AND JET PROPULSION SEMESTER VI

(Use of standard gas tables permitted)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the fundamental principles of compressible flow.
- To resolve the problems on isentropic flow through variable area ducts, Fanno flow and Rayleigh flow.
- To study the phenomenon of shock waves and its effect on flow.
- To gain the basic knowledge about jet propulsion.
- To gain the basic knowledge about rocket propulsion.

UNIT-I:BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and diffusers.

UNIT-II:FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties.

UNIT-III: NORMAL AND OBLIQUE SHOCKS

9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT-IV: JET PROPULSION 9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, Cycle analysis and use of stagnation state performance of ram jet, Turbojet, Turbofan and Turbo prop engines.

UNIT-V: ROCKET PROPULSION 9

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – Space flights.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Yahya S M., "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", 6th Edition, New Age International (P) Limited, New Delhi, 2019.
2. Anderson J D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2012.
3. Robert D. Zuker, Oscar Biblarz, “Fundamentals of Gas Dynamics”, 2nd Edition, John Wiley & Sons, 2011.
4. Ganesan V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
5. Sutton G P., "Rocket Propulsion Elements", John wiley, New York, 2010.

6. James John, Theo Keith, “Gas Dynamics”, 3rd Edition, Dorling Kindersley, 2010.
7. Saravanamutto, Rogers G E C and Cohen. H, "Gas Turbine Theory", Prentice Hall, 2001.

COURSE OUTCOMES:

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

CO1: Apply the concept of compressible flows in variable area ducts.

CO2: Apply the concept of compressible flows in constant area ducts.

CO3: Examine the effect of compression and expansion waves in compressible flow.

CO4: Use the concept of gas dynamics in Jet propulsion.

CO5: Apply the concept of gas dynamics in rocket propulsion.

22MEPE603	DESIGN OF HEAT EXCHANGERS	SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the classification of Heat exchangers.
- To learn the thermal and stress analysis on various parts of the heat exchangers.
- To study the design concepts of shell and the tube Heat exchangers.
- To study the design concepts of compact and plate heat exchangers.
- To study the design concepts of condensers and cooling towers.

UNIT-I:INTRODUCTION **9**

Types of heat exchangers, shell and tube heat exchangers – Regenerators and recuperators – Temperature distribution and its implications – Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA).

UNIT-II:STRESS ANALYSIS **9**

Stress in tubes – Header sheets and pressure vessels – Thermal stresses, shear stresses – Types of failures, Buckling of tubes, Flow induced vibration.

UNIT-III: PROCESS DESIGN OF HEAT EXCHANGERS **9**

Heat transfer correlations, Overall heat transfer coefficient, Analysis of heat exchangers – LMTD and NTU effectiveness method. Sizing of finned tube heat exchangers, U-tube heat exchangers, Design of shell and tube heat exchangers, Fouling factors and Pressure drop calculations.

UNIT-IV: COMPACT AND PLATE HEAT EXCHANGER **9**

Types – Merits and Demerits – Design of compact heat exchangers, Plate heat exchangers, Performance influencing parameters, Limitations.

UNIT-V: CONDENSERS AND COOLING TOWERS **9**

Design of surface and evaporative condensers – Cooling tower – Performance characteristic.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Robert W. Serth, “Process Heat Transfer Principles and Applications”, Academic press, Elesevier, 2007.
2. Shah R K and Dušan P. Sekulić, “Fundamentals of Heat Exchanger Design”, John Wiley & Sons, 2003.
3. Sadik Kakac and Hongtan Liu, “Heat Exchangers Selection, Rating and Thermal Design”, CRC Press, 2002.
4. John E. Hessel greaves, “Compact Heat Exchangers: Selection, Design, and Operation”, Elsevier science Ltd, 2001.
5. Kuppan T., “Heat Exchanger Design Hand Book”, New York: Marcel Dekker, 2000.

COURSE OUTCOMES:

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

CO1: Understand the classification of Heat exchangers.

CO2: Apply the mathematical knowledge for thermal and stress analysis on Heat exchangers components.

CO3: Understand the design concepts of shell and the tube Heat exchangers.

CO4: Understand the design concepts of compact and plate heat exchangers.

CO5: Understand the design concepts of condensers and cooling towers.

22MEPE604 POWER PLANT ENGINEERING SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To create awareness about power plants, the working of coal based thermal power plants.
- To understand the functioning of diesel and gas power plants.
- To provide an overview of Nuclear Power Plants.
- To learn how power is achieved from various renewable energy sources.
- To analyze the parameters in operating the power plants.

UNIT-I:COAL BASED THERMAL POWER PLANTS 9

Rankine cycle – improvisations, Layout of modern coal power plant, Super critical boilers, FBC Boilers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary cycles and cogeneration systems.

UNIT-II:DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Diesel and gas turbine power plants – Combined cycle power plants – Integrated gasifier based combined cycle systems.

UNIT-III: NUCLEAR POWER PLANTS
9

Basics of Nuclear Engineering, Layout and subsystems of nuclear power plants, Working of Nuclear reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANadaDeuterium- Uranium reactor (CANDU) Nuclear power plants.

UNIT-IV: POWER FROM RENEWABLE ENERGY 9

Hydroelectric power plants, Principle, Construction and working of wind, Tidal, Solar, Geo thermal, Biogas and fuel cell power systems.

UNIT-V: ENERGY AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, Load curve, Pollution control technologies including Waste disposal options for coal and nuclear power plants.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. El-Wakil M M., "Power Plant Technology", 5th Edition Tata McGraw – Hill Publishing Company Ltd., 2017.
2. Arora S C and Domkundwar S, “Power Plant Engineering”, 8th Edition, Dhanpat Rai, 2016
3. R.K. Rajput, “A text book of Power Plant Engineering”, 4th edition, Tata McGraw Hill Education, 2015.
4. Nag P K., "Power Plant Engineering", 4thEdition, Tata McGraw – Hill Publishing Company Ltd., 2015
5. R.K. Hedge, “Power Plant Engineering”, 1st Edition, Pearson Education, 2015.
6. Godfrey Boyle, "Renewable Energy", Open University, Oxford University Press in association with the Open University, 2004.

COURSE OUTCOMES:

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

CO1: Illustrate the various circuits in steam power plant and high-pressure boilers.

CO2: Discuss the working of diesel and gas turbine power plants.

CO3: Summarize the various nuclear reactors and waste disposal methods.

CO4: Explain the working of renewable power plants.

CO5: Discuss the energy and environmental issues of power plants.

22MEPE701 UNCONVENTIONAL MACHINING PROCESSES SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the need for unconventional machining processes and its merits and demerits.
- To know the working principles and process parameters of Thermal vs Electrical energy process.
- To study about the variations between chemical and electro chemical energy processes.
- To get knowledge about advanced nano finishing processes.
- To be updated with the modern trends in the field of non-traditional machining processes.

UNIT-I: INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining process – Need – Classification – Merits, Demerits and applications. Abrasive Jet machining – Water Jet machining – Abrasive water Jet machining – Ultrasonic machining. (AJM, WJM, AWJM and USM). Working principles – Equipment used – Process parameters – MRR- Applications.

UNIT-II: THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working principle - Equipment's – Process parameters – Surface finish and MRR – Electrode / Tool – Power and control Circuits – Tool wear – Dielectric – Flushing – Applications. Laser beam machining and drilling, (LBM), Plasma arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment – Types – Beam control techniques – Applications.

UNIT-III: CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro - Chemical machining (CHM and ECM) – Etchants – Maskant – Techniques of applying maskants – Process parameters – Surface finish and MRR – Applications. Principles of ECM – Equipment's – Surface roughness and MRR Electrical circuit – Process parameters – ECG and ECH – Applications.

UNIT-IV: ADVANCED NANO FINISHING PROCESSES 9

Abrasive flow machining, Chemo – Mechanical polishing, Magnetic abrasive finishing, Magneto rheological finishing, Magneto rheological abrasive flow finishing their working principles, Equipment's, effect of process parameters, Applications, Advantages and limitations.

UNIT-V: RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9

Electro chemical spark machining (ECSM) – Electrical discharge diamond grinding (EDDG) their working principles, equipment's, Effect of process parameters, Applications, Advantages and limitations, Comparison of non-traditional machining processes.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Vijay K. Jain "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P C and Shan H S., "Modern Machining Processes", Tata McGraw-Hill, New Delhi, 2007.
3. Paul De Garmo, Black J T and Ronald A. Kohser, "Material and Processes in Manufacturing". Prentice Hall of India Pvt. Ltd., 8th Edition, New Delhi, 2001.
4. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
5. Benedict G F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.

COURSE OUTCOMES:

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

CO1: Explain the need for unconventional machining processes and its classification.

CO2: Compare various thermal energy and electrical energy based unconventional machining processes.

CO3: Summarize various chemical and electro-chemical energy based unconventional machining processes.

CO4: Explain various Nano abrasives based unconventional machining processes.

CO5: Distinguish various recent trends based unconventional machining processes.

22MEPE702 **LEAN SIX SIGMA** **SEMESTER VII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understand Lean and Six Sigma history and assess quality impact on performance.
- Apply Lean Six Sigma tools for process improvement and control.
- Evaluate leadership's role and use FMEA for risk analysis.
- Plan Six Sigma deployment with stakeholder engagement.
- Analyse Six Sigma ROI and implement Lean waste reduction.

UNIT-I: LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS **9**

Historical Overview – Definition of quality – What is six sigma – TQM and Six sigma – Lean manufacturing and six sigma – Six sigma and process tolerance – Six sigma and cultural changes – Six sigma capability – Six sigma need assessments – Implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing.

UNIT-II: THE SCOPE OF TOOLS AND TECHNIQUES **9**

Tools for definition – IPO diagram, Flow diagram, CTQ Tree, Project Charter –Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT-III: SIX SIGMA METHODOLOGIES
9

Design For Six Sigma (DFSS), Design For Six Sigma Method – Failure Mode Effect Analysis (FMEA), FMEA process – Risk Priority Number (RPN) – Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP) – Developing communication plan – Take holder.

UNIT-IV: SIX SIGMA IMPLEMENTATION AND CHALLENGES **9**

Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – Alternative approach – Implementation – Leadership training, close communication system, project selection – Project management and team – Champion training – Customer quality index – Challenges – Program failure, CPQ v/s Six sigma, structure the deployment of six sigma – Cultural challenge – Customer / Internal metrics

UNIT-V: EVALUATION AND CONTINUOUS IMPROVEMENT METHODS **9**

Evaluation strategy – The economics of six sigma quality, Return on six Sigma (ROSS), ROI, Poor project estimates – Continuous improvement – Lean manufacturing – Value, Customer focus, Perfection, focus on waste, Overproduction – Waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people.

Contact periods:

Lecture: 45 Periods	**Tutorial: 0 Periods**	**Practical: 0 Periods**	**Total: 45 Periods**

REFERENCES:

1. Sperl, Todd, Lean Six Sigma: A Beginner's Guide to Understanding and Practicing Lean Six Sigma, Independently Published, 2023.
2. Chua, Richard, AI and Lean Six Sigma, Productivity Press, 2023.
3. O'Rourke, Tracy, Lean Six Sigma: Step-by-Step (DMAIC Guide), Routledge, 2022.
4. Eckes, George, Six Sigma for Everyone, Wiley, 2021.
5. George, Michael L.; Maxey, John; Rowlands, David; Price, Mark, The Lean Six Sigma Pocket Tool book: A Quick Reference Guide to 100 Tools for Improving Quality and Speed, McGraw-Hill, 2020.

COURSE OUTCOMES:

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

CO1: Analyse Lean & Six Sigma evolution and assess quality's impact on performance.

CO2: Apply key tools (SIPOC, FMEA) for process improvement.

CO3: Evaluate leadership's role and calculate RPN for risk mitigation.

CO4: Design Six Sigma deployment with stakeholder strategies.

CO5: Measure ROI and implement Lean waste reduction.

22MEPE703 AUTOMATION IN MANUFACTURING SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental principles and strategies of automation in modern manufacturing systems.
- To familiarize students with various control technologies, including sensors, actuators, and PLCs.
- To explain the concept and operation of fixed automation, such as transfer lines and assembly systems.
- To train students in programmable automation technologies like CNC machines and industrial robotics.
- To provide knowledge on automated material handling, storage, and data capture technologies.

UNIT-I: MANUFACTURING OPERATIONS 9

Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, Manufacturing economics.

UNIT-II: CONTROL TECHNOLOGIES 9

Automated systems – Elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – Ladder logic diagrams.

UNIT-III: TRANSFER LINES
9

Automated production lines – Applications, Analysis – With and without buffers, automated assembly systems, line unbalancing concept.

UNIT-IV: NUMERICAL CONTROL AND ROBOTICS 9

NC – CNC – Part programming – DNC– Adaptive control – Robot anatomy – Specifications – End effectors – Industrial applications.

UNIT-V: AUTOMATED HANDLINGAND STORAGE 9

Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture – Bar code technology.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Mikell P.Groover, Automation, "Production Systems and Computer Integrated Manufacturing" PHI, 2008.
2. Nick Dawkins - Automation and Controls, 2014.
3. Peter G. Martin and Gregory Hale - Automation Made Easy, 2010.
4. Frank Lamb - Industrial Automation Mc Graw Hill, 2013.
5. Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang - Computer Aided Manufacturing, Pearson 2009.

6. Mikell P.Groover, Emory W. Zimmers, Jr., “CAD/CAM: Computer- Aided Design and Manufacturing”, PHI, 2007.

COURSE OUTCOMES:

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

CO1: Demonstrate understanding of automation strategies and their application in manufacturing.

CO2: Analyze and design control systems using PLCs, sensors, and actuators for automated systems.

CO3: Evaluate and apply transfer line configurations for efficient production workflows.

CO4: Develop and interpret NC part programs and understand robotic systems for industrial use.

CO5: Select and implement suitable automated handling and storage systems for various manufacturing environments.

22MEPE704 DIGITAL MANUFACTURING AND IoT SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the various aspects of digital manufacturing.
- To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
- To formulate of smart manufacturing systems in the digital work environment.
- To interpret IoT to support the digital manufacturing.
- To elaborate the significance of digital twin.

UNIT-I: INTRODUCTION **9**

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 **9**

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
9

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 **9**

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 **9**

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.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, “Digital Twin Driven Smart Manufacturing”, Elsevier Science., United States, 2019.

2. Ronald R. Yager and Jordan Pascual Espada, “New Advances in the Internet of Things”, Springer., Switzerland, 2018.
3. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing The Digital Transformation”, Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.
5. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
6. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
7. Mikell P.Groover, Automation, “Production Systems and Computer Integrated Manufacturing” PHI, 2008.

COURSE OUTCOMES:

Upon completion of this 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 processes through digital twin.

22MEPE705 ADVANCED I.C. ENGINES SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know about the combustion process in SI engine and emissions formation during the combustion cycle and their treatment.
- To know about the combustion process in CI engine and emissions formation during the combustion cycle and their treatment
- To study about types of pollution control and the emission standards.
- To develop the knowledge about alternative fuels.
- To enhance the knowledge modern trends in IC engines.

UNIT-I: SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & direct injection – Stages of combustion – Normal and abnormal combustion – Knock – Factors affecting knock – Combustion chambers.

UNIT-II: COMPRESSION IGNITION ENGINES 9

Diesel fuel injection systems – Stages of combustion – Knocking – Factors affecting knock – Direct and indirect injection systems – Combustion chambers – Fuel spray behaviour – Spray structure and spray penetration – Air motion – Introduction to turbo charging.

UNIT-III: POLLUTANT FORMATION AND CONTROL 9

Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and particulate matter – Methods of controlling Emissions – Catalytic converters, Selective catalytic reduction and particulate traps – Methods of measurement – Emission norms and driving cycles.

UNIT-IV: ALTERNATIVE FUELS 9

Alcohol, Hydrogen, Compressed Natural gas, Liquefied petroleum gas and Bio diesel – Properties, Suitability, Merits and demerits – Engine modifications.

UNIT-V: RECENT TRENDS 9

Air assisted combustion, Homogeneous charge compression ignition engines – Variable geometry turbochargers – Common rail direct injection systems – Hybrid electric vehicles – NOx adsorbers – Onboard diagnostics.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ramalingam K K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2018.
2. Ganesan V., "Internal Combustion Engines", IInd Edition, TMH, 2017.

3. Mathur R B and Sharma R P., "Internal Combustion Engines", Dhanpat Rai & Sons 2014.
4. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.
5. Duffy Smith, "Auto Fuel Systems", the Good Heart Willcox Company, Inc., 1987.

COURSE OUTCOMES:

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

CO1: Understand the various combustion processes in SI engines.

CO2: Understand the various combustion processes in CI engines.

CO3: Acquire the knowledge of concepts of exhaust emissions, methods to control the pollutants and the emission standards.

CO4: Explain the different types of alternative fuels.

CO5: Understand the modern concepts like Lean burn, HCCI, GDI.

22MEPE706	ENERGY CONSERVATION AND MANAGEMENT	SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand and analyse the energy data of industries.
- To carryout energy accounting and balancing.
- To conduct energy audit and suggest methodologies for energy savings.
- To utilise the available resources in optimal ways.
- To understand the energy economics.

UNIT I: INTRODUCTION **9**

Energy – Power – Past & present scenario of world; National energy consumption data – Environmental aspects associated with energy utilization – Energy auditing: Need, Types, Methodology and barriers. Role of energy managers. Instruments for energy auditing.

UNIT II: ELECTRICAL SYSTEMS **9**

Components of EB billing – HT and LT supply, Transformers, Cable sizing, Concept of capacitors, Power factor improvement, Harmonics, Electric motors – Motor efficiency Computation, Energy efficient motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED lighting and scope of Encon in illumination.

UNIT III: THERMAL SYSTEMS **9**

Stoichiometry, Boilers, Furnaces and thermic fluid heaters – Efficiency computation and encon measures. Steam: Distribution & usage: Steam traps, Condensate recovery, Flash steam utilization, Insulators & refractories.

UNIT IV: ENERGY CONSERVATION IN MAJOR UTILITIES **9**

Pumps, Fans, Blowers, Compressed air systems, Refrigeration and air conditioning Systems – Cooling towers – D.G. sets.

UNIT-V: ECONOMICS **9**

Energy economics – Discount rate, Payback period, Internal rate of return, Net present Value, Life cycle costing – ESCO concept.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ashok sethuraman, “Practical guide to Energy Conservation and Management”, Notion press media Pvt. Limited, 2020.
2. Dale R. Patrick, Stephen W. Fardo, Ray E Richardson, Brian W. Fardo, “Energy Conservation Guidebook”, 3rd Edition, River Publications, 2020.
3. Mehmet Kanoglu, “Energy Efficiency and Management for Engineers”, McGraw Hill LLC, 2020.
4. Patrik Thollander, Magnus Karlson, Patrik Rohdin, Johan Wollin, Jakob Rosenqvist, “Introduction to Industrial Energy Efficiency”, Academic Press, 2020.

5. S. S. Thipse., “Energy Conservation and Management”, Alpha Science International, Limited, 2014
6. Witte LC, Schmidt P S and Brown D R., “Industrial Energy Management and Utilisation”, Hemisphere Publ, Washington, 1988.
7. Murphy W R and Mc KAY G., “Energy Management”, Butterworths, London 1987.

COURSE OUTCOMES:

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

CO1: Understand the significance and procedure for energy conservation and audit.

CO2: Analyze, Calculate and Improve the energy efficiency and performance of electrical utilities.

CO3: Analyze, Calculate and Improve the energy efficiency and performance of thermal utilities.

CO4: Analyze, Calculate and Improve the energy efficiency and performance of mechanical utilities.

CO5: Carry out the energy accounting and balancing.

22MEPE707 EQUIPMENT FOR POLLUTION CONTROL SEMESTER VII

L	T	P	C
3	0	0	3

OBJECTIVE:

- To study the pollution control regulation and standards, water and wastewater.
- To study the equipment for various water pollution.
- To study the equipment for air pollution control.
- To study the equipment for solid waste processing.
- To 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

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. CPCB, "Pollution Control Acts, Rules and Notifications issued there under, PCL Series - Central Pollution Control Board, Delhi, 2021.
2. Noel de Nevers, "Air Pollution Control Engg", Mc Graw Hill, New York, 2016.
3. 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.
4. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, 1st edition, 2015.
5. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, 4th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2014.
6. Rao. C.S (2006), “Environmental Pollution and Control Engineering”, 2nd Edition, Revised, Wiley Eastern Limited, India.
7. Shyam Diwan and Armin Rosencranz, Environmental Law and Policy in India, Oxford, 2001.

COURSE OUTCOMES:

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

CO1: Explain the different types of pollution, their sources and effects.

CO2: Discuss the pollution control regulations and standards.

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.

22MEPE708 RENEWABLE ENERGY TECHNOLOGIES SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the Indian and global energy scenario.
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To 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 wind farms – 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 – Thermo chemical 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.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; 1st edition (10 December 2020), ISBN-10 : 9390385636
2. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
3. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
4. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
5. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
6. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707
7. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.

COURSE OUTCOMES:

Upon completion of this 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.

CO4: Explore the various bio-energy technologies.

CO5: Discuss the ocean and geothermal technologies**.**

22MEPE801 SUPPLY CHAIN MANAGEMENT SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand SCM, its elements, objectives, importance, and key drivers.
- To learn strategic sourcing, supplier management, negotiation, and performance improvement.
- To prepare the logistics, transportation, warehousing, order fulfilment, and last mile delivery.
- To analysis supply chain risks, assessment, mitigation, contingency, and resilience planning.
- To understand globalization, its drivers, impact on supply chains, and global management strategies.

UNIT-I: INTRODUCTION 9

Definition and scope of Supply Chain Management (SCM): Key elements of SCM – Objectives of SCM – Importance and Benefits of effective Supply Chain Management – Key drivers in SCM.

UNIT -II: PROCUREMENT AND SUPPLIER MANAGEMENT 9

Strategic sourcing process – Supplier selection criteria – Strategies for Supplier Relationship management – Negotiation Process – Contract Management – Supplier Performance measurement process – Strategies for Supplier Performance improvement

UNIT-III: LOGISTICS AND DISTRIBUTION MANAGEMENT 9

Importance of Logistics – Functions of Logistics in SCM – Transportation modes – Factors in selection of transportation modes – Types of Warehouses (WH) – WH functions – WH Operations and Technologies – Order fulfilment process – Aspects of managing product returns – Challenges in Last Mile Delivery (LMD) – Technologies and Innovations in LMD

UNIT-IV: SUPPLY CHAIN DISRUPTIONS AND RISK MANAGEMENT 9

Types of Supply Chain Disruptions – Steps in Risk Assessment Process – Risk Identification Methods – Risk Assessment Techniques – Risk Mitigation Strategies – Contingency Planning Process – Business Continuity Planning (BCP): Components – Building Supply Chain Resilience – Assessment of Supply Chain Resilience.

UNIT-V: GLOBALIZATION 9

Globalization: Importance, Benefits – Drivers of Globalization: Market expansion, Cost efficiencies, Technological advancements, Liberalization of Trade – Impact on Supply chains: Extended supply networks, Global sourcing and Procurement, Supply chain collaboration, Cultural and Diversity considerations – Strategies: Global network design, Information and Communication Technologies, Talent management and Cross-cultural skills.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Randy Subramany, "Supply Chain Management: Origins, Evolutions, and Transformations", Amazon Kindle, 2023.
2. Sunil Chopra and Peter Meindl, "Supply Chain Management – Strategy, Planning and Operation", PHI, 2016.
3. Wisner, Keong Leong and Keah-Choon Tan, "Principles of Supply Chain Management A Balanced Approach", Thomson Press, 2005.
4. Coyle, Bardi, Longley, "The Management of Business Logistics – A Supply Chain Perspective", Thomson Press, 2006.
5. Jeremy F Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe the fundamentals of supply chain management
CO2: Explain the basics of procurement and supplier management
CO3: Identify suitable logistics and distribution management techniques
CO4: Articulate the risk management strategies for supply chain disruptions
CO5: Interpret the effect of globalization on supply chain

22MEPE802 ADDITIVE MANUFACTURING SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals, evolution, and impact of Additive Manufacturing across product development.
- To provide knowledge of reverse engineering, digitization, and CAD modeling essential for AM.
- To explain liquid- and solid-based AM systems and their operating principles.
- To impart knowledge on powder-based AM systems and their industrial relevance.
- To introduce advanced and emerging AM technologies beyond the conventional processes.

UNIT-I: INTRODUCTION
9

Need – Development of AM systems – AM process chain – Impact of AM on Product Development – Virtual Prototyping – Rapid Tooling – RP to AM – Classification of AM processes – Benefits – Applications – Case studies.

UNIT -II: REVERSE ENGINEERING AND CAD MODELING
9

Basic concept – Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wireframe, surface and solid modeling – Data format interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation.

UNIT-III: LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS
9

Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, Recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modelling (FDM): Principle, details of processes, process variables, types, products, materials and application. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications.

UNIT-IV: POWDER BASED ADDITIVE MANUFACTURING SYSTEMS
9

Selective Laser Sintering (SLS): Principle, process, indirect and direct SLS - powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications – case Studies, Selective Laser Melting and Electron Beam Melting.

UNIT-V: OTHER ADDITIVE MANUFACTURING SYSTEMS 9

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based AM systems - Demerits, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Bio Additive Manufacturing.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland, 2021.
2. Liou, L.W. and Liou, F.W "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.
3. Chua, C.K., Leong K.F. and Lim C.S. "Rapid prototyping: Principles and applications", 2nd edition, World Scientific Publishers, 2010.
4. Hilton, P.D. and Jacobs, P.F "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC press, 2005.
5. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.

COURSE OUTCOMES:

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

CO1: Describe the need and fundamentals of Additive Manufacturing (AM) systems.

CO2: Create and analyze 2D and 3D models using CAD modelling software, discuss the fundamentals of Reverse Engineering and integrating with manufacturing systems.

CO3: Describe liquid based and solid based additive manufacturing systems and their applications.

CO4: Apply knowledge of powder based additive manufacturing techniques in the field of manufacturing and other fields.

CO5: Discuss other variety of Additive Manufacturing (AM) technologies and apply their potential to support design and manufacturing and case studies relevant to customized manufacturing.

22MEPE803 LEAN MANUFACTURING SEMESTER VIII

L	T	P	C
0	0	3	3

COURSE OBJECTIVES:

- To understand the evolution, principles, and fundamental concepts that form the basis of lean manufacturing
- To learn the essential lean tools and techniques for improving stability, flow, and efficiency in manufacturing systems.
- To develop the skill to create and analyze current and future state value stream maps for identifying waste and improving processes.
- To understand quality-focused lean practices such as mistake-proofing, visual management, and process capability for continuous improvement.
- To explore the human aspect of lean through involvement, kaizen, standardization, and cultural transformation.

UNIT-I: FOUNDATION AND CONCEPTS OF LEAN
9

Historical evolution of lean manufacturing – Objectives of lean manufacturing – Key principles and implications of lean manufacturing – Traditional verses lean manufacturing. – Ford System – Growing Dysfunction — Ten steps to lean production – Necessity of Lean Production – Systems and lean thinking – Construction of Lean Production – Lean images and Lean Activities

UNIT -II: LEAN TOOLS AND METHODOLOGY
9

Primary tools – Implementing 5S, Workplace organization – Stability – Just-In-Time –Takt time – One piece flow – Pull, Cellular systems, Six Sigma. SMED: Single minute exchange of dies – Theory and practice of the SMED system – TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process – Overall Equipment Effectiveness – Computation of OEE.

UNIT-III: VALUE STREAM MAPPING
9

Process Mapping and Value Stream Mapping – Current state map – Future state map – VSM symbols – Mapping tips – Need for process maps – Types and its construction – Steps in preparing VSM – Comparison of CSVAM and FSVSA – Simulation scenario case studies.

UNIT-IV: INTEGRATED QUALITY
9

Development and necessity – Poke Yoke – mistake proofing – Quality improvement – Leveling and Visual management. Common errors – Inspection system and Zone control – Using Poke Yokes – Jidoka implementation -Process capability study – Lean six sigma.

UNIT-V: LEAN INVOLVEMENT AND CULTURE **9**

Necessity of involvement – Waste of Humanity – Activities supporting involvement – Kaizen Circle Activity – Practical Kaizen Training – Key factors in Practical Kaizen

Training – Lean Culture – Standardization – Standards and abnormality control – 'Five Why' analysis.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R, "Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities", Prentice Hall of India Learning Limited, New Delhi, 2012.
2. Gopalakrishnan N, "Simplified Lean Manufacture: Elements, Rules, Tools and Implementation", Prentice Hall of India Learning Private Limited, India, 2010.
3. Liker, J and Meier, D "The Toyota Way", Field book, McGraw-Hill, 2010.
4. Dennis P "Lean Production Simplified: A Plain Language Guide to the World's Most Powerful Production System", Productivity Press, New York, 2009.
5. Bill Carreira, "Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits", Prentice Hall of India Learning Private Limited, India, 2009

COURSE OUTCOMES:

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

CO1: Describe about the origin and foundation of lean production

CO2: Explain various lean tools and methodologies.

CO3: Explain the methods and processes of Value Stream Mapping.

CO4: Describe about quality in lean system using various techniques.

CO5: Describe about lean involvement and culture.

22MEPE804 NON DESTRUCTIVE TESTING TECHNIQUES SEMESTER VIII

L	T	P	C
0	0	3	3

COURSE OBJECTIVES:

- To introduce the basics of NDT, its comparison with mechanical testing, and the role of various visual and optical inspection techniques.
- To explain the principles, materials, and processes involved in liquid penetrant and magnetic particle inspection.
- To provide knowledge on radiographic testing principles, radiation sources, image recording, and safety practices.
- To describe the principles, instrumentation, and applications of ultrasonic testing for material evaluation.
- To introduce electrical and special NDT methods including eddy current, acoustic emission, leak detection, and thermal inspection.

UNIT-I: INTRODUCTION
9

NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.

UNIT -II: LIQUID PENETRANT & MAGNETIC INSPECTION
9

Penetrant systems: Principles – Process – Liquid penetrant materials – Emulsifiers – Cleaners developers – Sensitivity – Advantages, Limitations and Applications. Magnetic methods: Advantages, Limitations – Methods of generating fields: magnetic particles and suspending liquids. Magnetography – Field sensitive probes: applications. Measurement of metal properties.

UNIT-III: RADIOGRAPHIC METHODS
9

Principles of radiography – Sources of radiation – Ionising radiation – Sources – X-rays, gamma rays Recording of radiation – Radiographic sensitivity – Fluoroscopic methods – special techniques. Radiation safety. Advantages, Limitations and Applications.

UNIT-IV: ULTRASONIC TESTING OF MATERIALS
9

Ultrasonic testing: Principle – Advantages, Disadvantages, Applications – Generation of Ultrasonic waves – general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.

UNIT-V: ELECTRICAL AND SPECIAL METHODS 9

Electrical methods: Eddy current methods: potential – Drop methods, applications – Other methods: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ravi Prakash "Non-Destructive Testing Techniques", New Age International Publishers, 2010.
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing",Narosa Publishing House, 2009.
3. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005.
4. Charles, J. Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
5. J. Krautkramer & Herbert Krautkramer, "Ultrasonic Testing of Materials", Narosa Publishing House, New Delhi.

COURSE OUTCOMES:

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

CO1: Classify various non-destructive testing and choose the right method of testing for detection of defects on various materials.

CO2: Check different metals and alloys by visual inspection method.

CO3: Explain and perform X-ray and Gamma ray radiography testing methods.

CO4: Explain and perform Ultrasonic testing.

CO5: Explain and perform non-destructive tests like: Leak Test, Eddy current test, Acoustic Emission methods and Thermal inspection.

22ADOE01 **COMPUTER VISION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT-I: INTRODUCTION TO IMAGE FORMATION AND PROCESSING **9**

Computer Vision - Geometric primitives and transformations - Photometric image formation – The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms- Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT-II: FEATURE DETECTION, MATCHING AND SEGMENTATION **9**

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shiftand mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT-III: FEATURE-BASED ALIGNMENT & MOTION ESTIMATION **9**

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration – Triangulation- Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow – Layered motion.

UNIT-IV: 3D RECONSTRUCTION **9**

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT-V: IMAGE-BASED RENDERING AND RECOGNITION **9**

View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes – Video based rendering-Object detection - Face recognition - Instance recognition - Category recognition -Context and scene understanding- Recognition databases and test sets.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
5. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
6. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, "A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.

COURSE OUTCOMES:

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

CO1: To understand basic knowledge, theories and methods in image processing and computer vision.

CO2: To implement basic and some advanced image processing techniques in Open CV.

CO3: To apply 2D a feature-based based image alignment, segmentation and motion estimations.

CO4: To apply 3D image reconstruction techniques

CO5: To design and develop innovative image processing and computer vision applications.

22ADOE02 **ETHICS AND AI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT-I: INTRODUCTION **9**

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust.

UNIT-II: ETHICAL INITIATIVES IN AI **9**

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.

UNIT-III: AI STANDARDS AND REGULATION **9**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations -Ontological Standard for Ethically Driven Robotics and Automation Systems.

UNIT-IV: ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS **9**

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology – Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility Roboethics Taxonomy.

UNIT-V: AI AND ETHICS- CHALLENGES AND OPPORTUNITIES **9**

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries- National and International Strategies on AI.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield,"The ethics of artificial intelligence: Issues and initiatives", EPRS European Parliamentary Research Service Scientific Foresight Unit March2020.
2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014

3. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
4. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022
6. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.

COURSE OUTCOMES:

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

CO1: Learn about morality and ethics in AI

CO2: Acquire the knowledge of real time application ethics, issues and its challenges.

CO3: Understand the ethical harms and ethical initiatives in AI

CO4: Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems

CO5: Understand the concepts of Roboethics and Morality with professional responsibilities.

22ADOE03 NETWORK SECURITY AND FIREWALLS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of cryptography.
- To learn the key management techniques and authentication approaches.
- To explore the network and transport layer security techniques.
- To understand the application layer security standards.
- To learn the real time security practices.

UNIT-I: INTRODUCTION **9**

Basics of cryptography, conventional and public-key cryptography, hash functions, authentication and digital signatures.

UNIT-II: KEY MANAGEMENT AND AUTHENTICATION **9**

Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.

UNIT-III: ACCESS CONTROL AND SECURITY **9**

Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1XPort-Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application.

UNIT-IV: APPLICATION LAYER SECURITY **9**

Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain Keys Identified Mail. Wireless
Network Security: Mobile Device Security

UNIT-V: FIREWALLS **9**

Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. Block chains, Cloud Security and IoT security

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690.
2. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C.Kaufman, Prentice Hall, 2002.

3. Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004.
4. Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327-141-1.
5. Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, ISBN-10: 1284031675, ISBN-13: 978-1284031676.
6. The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dream tech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.

COURSE OUTCOMES:

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

CO1: Classify the encryption techniques
CO2: Illustrate the key management technique and authentication.
CO3: Evaluate the security techniques applied to network and transport layer
CO4: Discuss the application layer security standards.
CO5: Apply security practices for real time applications.

22ADOE04 **R PROGRAMMING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics in R programming in terms of constructs, control statements, string functions.
- To learn to apply R programming for Text processing.
- To expose the use of R Big Data analytics.
- To able to appreciate and apply the R programming from a statistical perspective.
- To make clear the concept for data visualization and statistics and probability.

UNIT-I: INTRODUCTION TO R **9**

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element name.

UNIT-II: MATRICES, ARRAYS AND LISTS **9**

Matrices, Arrays and Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT-III: DATA FRAMES **9**

Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions.

UNIT-IV: CONTROL STATEMENTS, FUNCTIONS, R GRAPHS **9**

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues –Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots**.**

UNIT-V: INTERFACING **9**

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear models – Time Series and Auto-correlation – Clustering.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Andy Vickler, "R Programming: This book includes: R Basics for Beginners + R Data Analysis and Statistics + R Data Visualization", Ladoo Publishing LLC, 2022.
2. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013.

3. Mark Gardener, “Beginning R – The Statistical Programming Language”, Wiley, 2013.
4. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, 2013.
5. Norman Mat off, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011.

COURSE OUTCOMES:

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

CO1: Create artful graphs to visualize complex data sets and functions.
CO2: Write more efficient code using parallel R and vectorization.
CO3: Interface R with C / C++ and Python for increased speed or functionality.
CO4: Evaluate new packages for text analysis, image manipulation, and perform statistical analysis of the same.
CO5: Develop interfacing R to other Languages.

22ADOE05 PROGRAMMING WITH ASP.NET

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand .Net as simple, modem, object- oriented computer programming language
- To understand CLR Framework
- To design web services
- To design and build interactive web pages and server side logic
- To understand the data access

UNIT-I: INTRODUCTION TO .NET FRAMEWORK AND MANAGED CODE 9

Introduction to .NET Framework: Managed Code and the CLR- Intermediate Language, Metadata and JIT Compilation - Automatic Memory Management

UNIT-II: LANGUAGE CONCEPTS, CLR, AND FRAMEWORK CLASS LIBRARY 9

Language Concepts and the CLR: Visual Studio .NET - Using the .NET Framework. The Framework Class Library: NET objects - ASP .NET - .NET web services – Windows Forms

UNIT-III: ASP.NET FEATURES AND WEB SERVICES 9

ASP.NET Features: Change the Home Directory in IIS - Add a Virtual Directory in IIS- Set a Default Document for IIS - Change Log File Properties for IIS - Stop, Start, or Pause a Web Site

UNIT-IV: WEB CONTROLS AND CREATING WEB FORMS 9

Creating Web Controls: Web Controls - HTML Controls, Using Intrinsic Controls, Using Input Validation Controls, Selecting Controls for Applications - Adding web controls to a Page. Creating Web Forms: Server Controls - Types of Server Controls - Adding ASP.NET Code to a Page.

UNIT-V: ASP.NET DATA ACCESS 9

ASP.NET Data Access: Data Binding Server Controls-Viewing Data Collections in a Grid. ASP.NET Caching Mechanism for caching Dynamic response data. Page Output Caching.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, and Scott Hanselman "Professional ASP.NET 4.5 in C# and VB"
2. Jonas Fagerberg , "ASP.NET Core 5 for Beginners"
3. Alex Homer, Dave Sussman, Professional ASP.NET 1.1, Wrox Publication
4. .NET Framework, OREILY Publication.
5. Deitel and Deitel, Visual Basic.NET How to Program, Pearson Education,2nd edition Greg Buczek, ASP.NET Developer’s Guide, Tata McGraw-Hill, 2002.

COURSE OUTCOMES:

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

CO1: Learn fundamentals of. net framework
CO2: Enrich knowledge about Windows Forms, Controls and ASP.NET based applications.
CO3: Create Web services for web based application.
CO4: Create Web forms for web applications
CO5: Web-based applications and Reports using.net technologies

22CSOE01 COMPUTER GRAPHICS AND SIMULATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Gain knowledge about graphics hardware devices and software used.
- To Understand the two dimensional graphics and their transformations.
- To Understand the three dimensional graphics and their transformations.
- To appreciate illumination and color models.
- To be familiar with understand clipping techniques.

UNIT-I: INTRODUCING **9**

Survey of computer graphics, Overview of graphics systems – Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software; Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

UNIT-II: TWO DIMENSIONAL GRAPHICS **9**

Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; widow-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms

UNIT-III: THREE DIMENSIONAL GRAPHICS **9**

Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.

UNIT-IV: ILLUMINATION AND COLOUR MODELS **9**

Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model - YIQ colour model - CMY colour model - HSV colour model - HLS colour model; Colour selection.

UNIT-V: ANIMATIONS & REALISM **9**

ANIMATION GRAPHICS: Design of Animation sequences – animation function – raster animation – key frame systems – motion specification –morphing – tweening. COMPUTER GRAPHICS REALISM: Tiling the plane – Recursively defined curves – Koch curves – C curves – Dragons – space filling curves – fractals – Grammar based models – fractals – turtle graphics – ray tracing.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. John F. Hughes, Andries Van Dam, Morgan Mc Guire, David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley ,"Computer Graphics: Principles and Practice", , 3rd Edition, Addison Wesley Professional, 2013. (UNIT I, II, III, IV).
2. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007 (UNIT V).
3. Donald Hearn and M. Pauline Baker, Warren Carithers, "Computer Graphics With Open GL", 4th Edition, Pearson Education, 2010.
4. Jeffrey McConnell, "Computer Graphics: Theory into Practice", Jones and Bartlett Publishers, 2006.
5. Hill F S Jr., "Computer Graphics", Maxwell Macmillan", 1990.

COURSE OUTCOMES:

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

CO1: Identify graphics hardware devices and software used.
CO2: Design and apply two dimensional transformations
CO3: Design three dimensional graphics.
CO4: Apply Illumination and color models.
CO5: Apply clipping techniques to graphics and Design animation sequences.

22CSOE02 DATA INTEGRATION AND BIG DATA

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of BI and ETL.
- To inculcate and express knowledge of Talend architecture and its various components.
- To explain the different integration process using advanced components.
- To examine Big Data, Hadoop concepts and the benefits of integrating Talend with Hadoop.
- To focus the various Hadoop Eco systems.

UNIT-I: FUNDAMENTALS OF BI AND ETL **9**

Introduction to Business Problem Analysis – Business Intelligence, Data warehousing, Data Collection and Description, Data Extraction – ETL Process, Schema Integration, Data integration, Data Quality

UNIT-II: INTRODUCTION TO TALEND **9**

Introduction – Architecture of Talend Tool, Starting a Talend Tool, Talend models, Talend Metadata, Managing Metadata, Data Integration features, Data integration Components

UNIT-III: INTRODUCTION TO BIG DATA **9**

Introduction - Historical Interpretation of Big Data - Defining Big Data From 3Vs to 3^2Vs - Big Data Analytics and Machine Learning - Big Data Analytics and Cloud Computing - Real-Time Analytics: Characteristics of Real-Time Systems, Real-Time Processing for Big Data — Concepts and Platforms

UNIT-IV: BASICS OF HADOOP **9**

Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – file-based data structures

UNIT-V: HADOOP ECOSYSTEM **9**

Introduction to Sqoop components – Tables and Databases, Introduction to Pig Components – Load and Store operations, Grouping and joining, Combining and splitting, Filtering and Sorting Spark and Hbase - Basic Concepts.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Domenico Talia, Paolo Trunfio, Fabrizio Marozzo, Loris Belcastro, Riccardo Cantini, Alessio Orsino, “Programming Big Data Applications: Scalable Tools And Frameworks For Your Needs Hardcover”, World Scientific Europe Ltd, 2024.
2. Wilfried Grossmann, Stefanie Rinderle-Ma, “Fundamentals of Business Intelligence”, Springer-Verlag Berlin and Heidelberg GmbH & Co. K, 2016.
3. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, “Big Data Principles and Paradigms”, Morgan Kaufmann, 2016.
4. Marz N and Warren J, “Big Data”, Manning Publications, 2015.
5. Richard Daniel Barton, “Talend Open Studio Cookbook”, Packt Pub Ltd, 2013.
6. Chuck Lam, “Hadoop in Action”, Manning Publications, 2010.

COURSE OUTCOMES:

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

CO1: Gain the basic concepts of BI and ETL schema and architecture.
CO2: Apply Talend tool architecture and suitable components for data analysis.
CO3: Design various integration techniques using different components.
CO4: Compare appropriate Hadoop concepts with integrating Talend to observe Big Data.
CO5: Automate the different Hadoop Eco systems.

22CSOE03 GAME PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment

UNIT-I: 3D GRAPHICS FOR GAME DESIGN 9

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation –Controller Based Animation.

UNIT-II: GAME DESIGN PRINCIPLES 9

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT-III: GAME ENGINE DESIGN 9

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Path finding.

UNIT-IV: OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 9

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games

UNIT-V: GAME DEVELOPMENT USING PYGAME 9

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics Algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based Arcade Games– Puzzle Games.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley, 2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress, 2007.
3. Paul Craven, “Python Arcade games”, Apress Publishers, 2016.

4. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Compute rGraphics”, Second Edition, CRC Press, 2006.
5. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.
6. Y.Narahari, “Game Theory and Mechanism Design”, IISC Press, World Scientific.

COURSE OUTCOMES:

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

CO1: Explain the concepts of 2D and 3D Graphics.
CO2: Design game design documents.
CO3: Implementation of gaming engines.
CO4: Survey gaming environments and frameworks.
CO5: Implement a simple game in Pygame

22CSOE04 STORAGE TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

UNIT I : STORAGE SYSTEMS **9**

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Life cycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II : INTELLIGENT STORAGE SYSTEMS AND RAID **9**

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale out storage Architecture.

UNIT III: STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION **9**

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT IV: BACKUP, ARCHIVE AND REPLICATION **9**

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V: SECURING STORAGE INFRASTRUCTURE **9**

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENECS:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019.
3. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
4. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018
5. https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
6. https://www.coursera.org/specializations/full-stack-react

COURSE OUTCOMES:

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

CO1: Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment

CO2: Illustrate the usage of advanced intelligent storage systems and RAID

CO3: Interpret various storage networking architectures - SAN, including storage subsystems and virtualization

CO4: Examine the different role in providing disaster recovery and remote replication technologies

CO5: Infer the security needs and security measures to be employed in information storage management

22CSOE05 RECOMMENDER SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement attack resisted recommender system.
- To learn about evaluating recommender system

UNIT-I: INTRODUCTION 9

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD) - Applications of recommendation systems, Issues with recommender system.

UNIT-II: CONTENT-BASED RECOMMENDATION SYSTEMS 9

High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, CO1, CO2 Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

UNIT-III: COLLABORATIVE FILTERING 9

A systematic approach, Nearest-neighbour collaborative filtering (CF), user-based and item-based CF, components of neighbourhood methods (rating normalization, similarity weight computation, and neighbourhood selection

UNIT-IV: ATTACK-RESISTANT RECOMMENDER SYSTEMS 9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack –Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT-V: EVALUATING RECOMMENDER SYSTEMS 9

Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics. Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design– Design Issues – Accuracy metrics – Limitations of Evaluation measures

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016

2. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st edition.
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011)
4. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st edition
5. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.
6. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013),1st edition

COURSE OUTCOMES:

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

CO1: Understand the basic concepts of recommender systems.

CO2: Evaluate Types of recommender systems: non-personalized, content based filtering

CO3: Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.

CO4: Design and implement attack resisted recommender system.

CO5: Evaluate the recommender system

22ECOE01 COMPUTATIONAL INTELLIGENCE

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty.
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks.

UNIT-I: PROBLEM-SOLVING 9

Introduction to AI - AI Applications – Problem-solving agents – Search algorithms – Uninformed search strategies – Heuristic search strategies – Local search and optimization problems – Adversarial search – Constraint satisfaction problems (CSP)

UNIT-II: PROBABILISTIC REASONING 9

Acting under uncertainty – Bayesian inference – Naïve bayes models. Probabilistic reasoning – Bayesian networks – Exact inference in BN – Approximate inference in BN – Causal networks.

UNIT-III: SUPERVISED LEARNING 9

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model – Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

UNIT-IV: ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning – Bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT-V: NEURAL NETWORKS 9

Perceptron – Multilayer perceptron, activation functions, network training – Gradient descent optimization – Stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.
3. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007.
4. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008.
5. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.

COURSE OUTCOMES:

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

CO1: Use appropriate search algorithms for problem solving.

CO2: Apply reasoning under uncertainty.

CO3: Build supervised learning models.

CO4: Understand ensembling and unsupervised models.

CO5: Outline the deep learning neural network models.

22ECOE02 WEARABLE DEVICES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the hardware requirement of wearable systems.
- To describe the energy harvesting for wearable devices.
- To know the concepts of BAN in health care.
- To understand the security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT-I: INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems – Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems – Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT-II: SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICE 9

Wearability issues – Physical shape and placement of sensor, Technical challenges – Sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements – Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles

UNIT-III: WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges – System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT-IV: SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study-smart fabric for monitoring biological parameters – ECG, respiration.

UNIT-V: APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods

REFERENCES:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011.
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013.
3. 00Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014.
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.

5. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.

COURSE OUTCOMES:

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

CO1: Describe the concepts of wearable system.

CO2: Explain the energy harvestings in wearable device.

CO3: Use the concepts of BAN in health care.

CO4: Illustrate the concept of smart textile.

CO5: Compare the various wearable devices in healthcare system.

22ECOE03 VLSI TESTING AND DESIGN FOR TESTABILITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Learn fault models and fault simulation techniques.
- To understand faults in combinational logic circuits.
- To Have Knowledge on faults in sequential logic circuits.
- To introduces the different testability methods.
- To understand fault diagnosis approaches.

UNIT-I: FAULT MODELLING AND SIMULATION 9

Introduction to testing – Faults in digital circuits – Modeling of faults – Logical fault models – Fault detection – Fault location – Fault dominance – Single stuck fault model and multiple stuck.

UNIT-II: TESTING FOR SINGLE STUCK AT FAULTS 9

Test generation algorithms for combinational circuits – Fault oriented ATG – D Algorithm – Examples – PODEM – Fault independent ATG – Random Test generation – ATGs for SSFs in sequential circuits – TG using iterative array models – Random test generation.

UNIT-III: DELAY TEST 9

Delay test problem – Path delay test – Test generation for combinational circuits, Number of paths in a circuit– Transition faults – Delay test methodologies – Slow clock combinational test, Enhanced scan test, normal scan sequential test, Variable – Clock Non-scan sequential test, Rated-clock Non-scan sequential test.

UNIT-IV: DESIGN FOR TESTABILITY 9

Testability – Controllability and observability, Ad-hoc design for testability techniques – Controllability and observability by means of scan registers – Storage cells for scan design – Level sensitive scan design (LSSD) – Partial scan using I-Paths – Boundary scan standards.

UNIT-V: FAULT DIAGNOSIS9

Logical level diagnosis – Diagnosis by UUT reduction – Fault diagnosis for combinational circuits – Self-checking design – System level diagnosis.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Abramovici M, Brever A and Friedman D., "Digital Systems Testing and Testable Design", Jaico Publishing House, 2002.
2. Parag K. Lala, “Fault Tolerant and Fault Testable Hardware Design”, BS Publications, 2002.
3. Michael L. Bushnell and Vishwani D. Agarwal, “Essentials of Electronic Testing for Digital, Memory and Mixed Signal Circuits”, Springer, Verlag2000.

4. Stanley L. Hurst, “VLSI Testing: Digital and Mixed Analogue Digital Techniques”, Institute of Electrical Engineers, 1998.
5. Xiaoqing Wen, Cheng Wen Wu and LaungTerng Wang, “VLSI Test Principles and Architectures: Design for Testability”, Cambridge University Press, 2000.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Discuss various fault models and fault simulation techniques.
CO2: Examine faults in combinational logic circuits.
CO3: Analyze faults in sequential logic circuits.
CO4: Explain different testability methods.
CO5: Outline fault diagnosis approaches.

22ECOE04 IOT BASED SYSTEMS DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of IoT.
- To get knowledge about the various services provided by IoT.
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications in IoT.

UNIT-I: INTRODUCTION TO INTERNET OF THINGS 9

Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects – IoT levels and deployment templates – A panoramic view of IoT applications.

UNIT-II: MIDDLEWARE AND PROTOCOLS OF IOT 9

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID, WSN, SCADA, M2M – Interoperability challenges of IoT-Protocols for RFID, WSN, SCADA, M2M – Zigbee, KNX, BACNet, MODBUS – Challenges Introduced by 5G in IoT Middleware.

UNIT-III: COMMUNICATION AND NETWORKING 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks.

UNIT-IV: IOT IMPLEMENTATION TOOLS 9

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor-based applications through embedded system platform, Implementing IoT concepts with Python, Implementation of IoT with Raspberry Pi.

UNIT-V: APPLICATIONS AND CASE STUDIES 9

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods

REFERENCES:

1. Honbo Zhou, “Internet of Things in the cloud: A middleware perspective”, CRC press, 2012.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, VPT, 1st Edition, 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017

4. Constandinos X. Mavromoustakis, George Mastorakis, Jordi Mongay Batalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016..
5. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.

COURSE OUTCOMES:

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

CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.

CO2: Identify the architecture, infrastructure models of IoT

CO3: Analyze the networking and how the sensors are communicated in IoT.

CO4: Analyze and design different models for IoT implementation.

CO5: Identify and design the new models for market strategic interaction

22ECOE05 **DESIGN THINKING**

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- Introduce tools & techniques of design thinking for innovative products.
- Development Illustrate customer-centric product innovation.
- Use cases Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems.

UNIT-I: DESIGN THINKING PRINCIPLES **9**

Exploring Human-centered Design – Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy – Building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] – Case studies.

UNIT-II: ENDUSER-CENTRIC INNOVATION **9**

Importance of customer-centric innovation – Problem Validation and Customer Discovery – Understanding problem significance and problem incidence – Customer Validation. Target user, User persona & user stories. Activity: Customer development process – Customer interviews and field visits.

UNIT-III: APPLIED DESIGN THINKING TOOLS **9**

Concept of Minimum Usable Prototype [MUP] – MUP challenge brief – Designing & Crafting the value proposition – Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design.

UNIT-IV: CONCEPT GENERATION **9**

Solution Exploration, Concepts Generation and MUP design – Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts.

UNIT-V: SYSTEM THINKING **9**

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems.

Contact periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. Steve Blank, (2013), the four steps to epiphany: Successful strategies for products that win, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value.
3. Proposition Design: How to Create Products and Services Customers Want, Wiley.
4. Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.
5. Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

COURSE OUTCOMES:

At the end of each unit, the students will be able to -

CO1: Define & test various hypotheses to mitigate the inherent risks in product innovations.

CO2: Understand customer-centric product innovation.

CO3: Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.

CO4: Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching

CO5: Apply system thinking in a real-world scenario.

22EEOE01 POWER PLANT ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To providing an overview of thermal power plants and detailing the role of mechanical engineers in their operation and maintenance.
- To understand construction and operation of diesel, gas turbine and combined cycle power plants.
- To understand construction and operation of nuclear power plants.
- To learn about power from wind and solar.
- To know about the energy, economic and environmental issues of power plants.

UNIT-I: COAL BASED THERMAL POWER PLANTS 9

Layout of modern coal power plant, super critical boilers, FBC boilers, subsystems of thermal power plants – Fuel and ash handling and draught system, feed water treatment.

UNIT-II: DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Components of diesel and gas turbine power plants - Combined cycle power plants - Integrated gasifier based combined cycle systems.

UNIT-III: NUCLEAR POWER PLANTS 9

Basics of nuclear engineering, layout and subsystems of nuclear power plants, working of nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), breeder, gas cooled and liquid metal cooled reactors. Safety measures for nuclear power plants.

UNIT-IV: POWER FROM RENEWABLE ENERGY 9

Hydroelectric power plants – Classification, typical layout and associated components. Principle, construction and working of Wind, Tidal, Solar thermal and Fuel cell power systems.

UNIT-V: ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, load distribution parameters, load curve, comparison of site selection criteria, relative merits & demerits, capital &operating cost of different power plants. Pollution control technologies including waste disposal options for coal and nuclear power plants.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Nag P. K., "Power Plant Engineering", 4th Edition, Tata McGraw – Hill Publishing Company Ltd., 2014.
2. El -Wakil M. M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
3. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Standard Handbook of Power Plant Engineering", 2nd Edition,McGraw – Hill Professional, 2012.

COURSE OUTCOMES:

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

CO1: Understand the layout, construction and working of the components inside a thermal power plant.

CO2: Acquire knowledge about the layout, construction and working of the components inside a diesel, das and combined cycle power plants.

CO3: Gain the basic knowledgeof construction and working of the components inside nuclear power plants.

CO4: Explore the construction and working of the components inside renewableenergy power plants.

CO5: Analysis and solve energy and economic related issues in power sector.

22 EEOE02 SENSORS AND TRANSDUCERS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various motion, proximity and ranging sensors used to measure various physical parameters.
- To understand the various force, magnetic and heading sensors used to measure various physical parameters.
- To know the various optical, pressure and temperature sensors used to measure various physical parameters.
- To understand the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

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 – Ultrasonic ranging, Laser range sensor (LIDAR).

UNIT III :FORCE, MAGNETIC AND HEADING SENSORS 9

Strain gage, Load cell, Magnetic sensors – Types, principle, requirement and advantages: Magneto resistive – Hall effect – Current sensor, heading sensors – Compass, gyroscope.

UNIT IV :OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

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 – MEMS & Nano 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.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Ernest O. Doebelin, “Measurement Systems - Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th Edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Patranabis D., “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
4. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford SciencePublications, 1999.

5. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd Edition, CRC Press, 2015.

COURSE OUTCOMES:

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

CO1: Expertise in various calibration techniques and signal types for sensors.
CO2: Apply the various sensors in the automotive and mechatronics applications.
CO3: Study the basic principles of various magnetic sensors.
CO4: Study the basic principles of various smart sensors.
CO5: Implement the DAQ systems with different sensors for real time applications.

22 EEOE03 HYBRID ENERGY TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge about different types of hybrid energy systems.
- To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
- To design the power converters used in SPV Systems.
- To analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems.
- To analyze the performance of the various hybrid energy systems

UNIT-I: INTRODUCTION TO HYBRID ENERGY SYSTEMS 9

Hybrid Energy Systems – Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind- Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.

UNIT-II: ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) 9

Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT-III: POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck- boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems.

UNIT-IV: ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS 9

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter – Merits and Limitations.

UNIT-V: CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS 9

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Bahman Zohuri, “Hybrid Energy Systems”, Springer, First Edition, 2018.
2. S.M. Muyeen, “Wind Energy Conversion Systems”, Springer First Edition, 2012

3. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, First Edison, 2021
4. Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3rd Edition.
5. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 7th Impression, 2005.
6. Rashid.M. H "Power electronics Hand book", Academic press,4th Edition, 2018.

COURSE OUTCOMES:

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

CO1: Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.

CO2: Select a suitable Electrical machine for wind energy conversion systems and simulate wind energy conversion system

CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.

CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.

CO5: Interpret the hybrid renewable energy systems

22 EEOE04 BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge about the physical foundations of biological systems.
- To grasp the various electro physiological measurements in the human body.
- To get knowledge on the measurement of non-electrical parameters in the human body.
- To study the various medical imaging techniques and their applications.
- To provide knowledge in medical assisting and therapy equipment.

UNIT-I: PHYSIOLOGY 9

Man instrument system – Problems encountered in measuring a living system – Transducers for biomedical applications – Cell and its structure – Resting and action potential – Propagation of action potentials – The heart and cardiovascular system – Electrophysiology of cardiovascular system – Physiology of the respiratory system – Nervous system – Central nervous system and Peripheral nervous system – Electrode theory – Bio-potential electrodes.

UNIT-II: ELECTRO PHYSIOLOGICAL MEASUREMENT 9

ECG – Vector cardiographs – EEG – EMG – ERG – EOG – Lead system and recording methods – Typical waveforms.

UNIT-III: NON- ELECTRICAL PARAMETER MEASUREMENTS 9

Measurement of blood pressure, blood flow and cardiac output – Plethysmography – Measurement of heart sounds – Gas analysers – Blood gas analysers – Oximeters.

UNIT-IV: MEDICAL IMAGING AND TELEMETRY 9

X-ray machine – Echocardiography – Computer tomography – MRI – Diagnostic ultrasound – PET – SPECT – Electrical impedance tomography – Thermograph – Biotelemetry.

UNIT-V: ASSISTING AND THE RAPEUTIC DEVICE 9

Pacemakers – Defibrillators – Ventilator – Anesthesia machine – Nerve and muscle stimulator – Heart lung machine – Kidney machine – Audiometers – Diathermy –Endoscopes – Lasers in biomedicine.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Leslie Cromwell,"Biomedical Instrumentation and Measurement", PHI, New Delhi, 2015.
2. Khandpur R.S.,"Handbook of Biomedical Instrumentation", 2nd Edition, Tata McGraw Hill 2016.
3. Geddes L. A and Baker L.E.,"Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley, New York, 2015.
4. Richard Aston,"Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company, New York, 2016.
5. Ed.Joseph D. Bronzino, "The Biomedical Engineering Handbook" 2nd Edition, Boca Raton, CRC Press LLC, 2014.

COURSE OUTCOMES:

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

CO1: Understand the physical foundations of biological systems.

CO2: Realize the various electro physiological measurements in the human body.

CO3: Acquire knowledge on the measurement of non-electrical parameters in the human body.

CO4: Analyze the various medical imaging techniques and their applications.

CO5: Apply the concepts on the working of medical assisting and therapy equipment.

22 EEOE05 ELECTRIC AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the operation and architecture of electric and hybrid vehicles
- To identify various energy source options like battery and fuel cell
- To select suitable electric motor for applications in hybrid and electric vehicles.
- To explain the role of power electronics in hybrid and electric vehicles
- To analyze the energy and design requirement for hybrid and electric vehicles.

UNIT-I: DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT-II: ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT-III: MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT-IV: POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT-V: HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

Contact Periods:

Lecture: 45 **Periods** **Tutorial:** 0 **Periods** **Practical:** 0 **Periods** **Total:** 45 **Periods**

REFERENCES:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003
2. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRCPress, 2005.
3. James Larminie and John Lowry, “Electric Vehicle Technology Explained “John Wiley & Sons,2003
4. Lino Guzzella, “Vehicle Propulsion System” Springer Publications,2005
5. Ron Hod Kinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005.

COURSE OUTCOMES:

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

CO1: Learn the operation and architecture of electric and hybrid vehicles
CO2: Classify various energy source options like battery and fuel cell
CO3: Select suitable electric motor for applications in hybrid and electric vehicles.
CO4: Explicate the role of power electronics in hybrid and electric vehicles
CO5: Analyze the energy and design requirement for hybrid and electric vehicles.

22ITOE01 MOBILE ADHOC NETWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understanding of the current topics in MANETs and WSNs, both from an industry and research point of views.
- Understanding of the principles of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks. ·
- Understand how proactive routing protocols function and their implications on data transmission delay and bandwidth consumption.
- Know about routing protocol
- Analyze various routing algorithms

9

UNIT-I: INTRODUCTION

Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

9

UNIT-II:MEDIUM ACCESS PROTOCOLS

MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

9

UNIT-III: NETWORK PROTOCOLS

Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicastrouting algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

9

UNIT-IV: END-END DELIVERY AND SECURITY

Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols

9

UNIT-V: CROSS LAYER DESIGN

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Behrouz A. Forouzan, “Data Communications and Networking”, 5th Edition TMH, 2013.
2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan Kaufmann Publishers Inc., 2012.
3. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2013.
4. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture andProtocols, 2nd edition, Pearson Edition, 2007.
5. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

6. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hocnet working, Wiley-IEEE press, 2004.

COURSE OUTCOMES:

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

CO1: Gain the knowledge of basic layers of adhoc networks.
CO2: Evaluate the performance MAC protocols and standards.
CO3: Understand the functions of routing protocols.
CO4: Know different protocols involved in network security enhancement.
CO5: Analyze the necessity of cross layer designs and Mobile IP networks.

22ITOE02 BLOCKCHAIN TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To assess block chain applications in a structured manner.
- To impart knowledge in block chain techniques and able to present the concepts clearly and structured.
- To understand the modern concepts of blockchain technology.
- To get familiarity with future currencies and to create own crypto token.
- To analyze the market scenario of crypto currency.

UNIT I : BASIC CONCEPTS **9**

Introduction - Decentralized society - Disturbed Database, Byzantine General problem - Fault tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete - P2P network -Private key - Public key - Cryptography - Hash Function - Digital Signature -ECDSA - Memory Hard Algorithm – Zero Knowledge Proof.

UNIT II : BLOCKCHAIN **9**

Introduction - Advantage over conventional distributed database – Network and protocols – Blockchain network - Mining - Mechanism - Life Cycle of Block chain - Distributed consensus - Merkle Patricia Tree - Gas Limit - Transactions and Fee - Anonymity - Reward - Chain policy- Life of Blockchain applications -Soft and Hard Fork - Private and Public blockchain.

UNIT III: DISTRIBUTED CONSENSUS **9**

Nakamoto consensus - Proof of work - Proof of Stake - Proof of Burn -Difficulty level - Sybil Attack - Energy Utilization and alternate – Fabric model - SDKs - Components of Fabric Model - Architecture of Hyper ledger fabric.

UNIT IV: CRYPTO CURRENCY **9**

History - Distributed ledger - Bitcoin protocols - Mining strategy and rewards - Ethereum - construction - Truffle - DAO - dApps - Smart Contract - Boot strapping - GHOST Vulnerability - Attacks - Sidechain – Name coin.

UNIT V: CRYPTOCURRENCY REGULATIONS **9**

Stakeholders - Roots and Bitcoin - Legal Aspects - Crypto currency exchange - Black market and Global economy. Applications: IoT - Medical Record Management system - Domain Name Service and future of Blockchain - Business applications and assessing blockchain projects.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 75 Periods

REFERENECS:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016
3. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014. .

4. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017.

COURSE OUTCOMES:

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

CO1: Understand the various technologies and its business use.
CO2: Analyse the block chain applications in a structure manner.
CO3: Explain the modern concepts of block chain technology systematically.
CO4: Handle the crypto currency.
CO5: Understand the modern currencies and its market usage

22ITOE03 OPEN SOURCE TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To differentiate open source software and commercial software.
- To familiarize with Linux operating system.
- To examine web applications using open source web technologies like Apache, My SQL and PHP (LAMP/XAMP).
- To implement table commands and table joins.
- To learn cookies and sessions with PHP and MySQL.

UNIT-I: OPEN SOURCE **9**

Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Basics of Linux - Linux Kernel – Linux Distributions.

UNIT-II: LINUX **9**

Introduction to Linux Essential Commands - File system Concept - Standard Files - The Linux Security Model - Vi Editor - Partitions creation - Shell Introduction - String Processing - Investigating and Managing Processes - Network Clients – Installing Application.

UNIT-III: APACHE **9**

Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess.

UNIT-IV: MYSQL **9**

Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database.

UNIT-V: PHP **9**

Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code -Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES:

1. Steven Weber, “The success of Open Source”, Harvard University Press October 31, First Edition, 2021.
2. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, OReilly Media, 2009.
3. James Lee and Brent Ware, "Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", Dorling Kindersley (India) Pvt. Ltd, 2008.
4. Eric Rosebrock, Eric Filson, "Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together", Published by John Wiley and Sons, 2004.

COURSE OUTCOMES:

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

CO1: Compare the open source software and commercial software.

CO2: Study, install and run Linux operating system.

CO3: Identify and install open source web technology Apache and manage applications.

CO4: Manage users and privileges in MySQL and to handle SQL functions.

CO5: Design and develop complete website using PHP.

22ITOE04 ANDROID APPLICATION DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To facilitate students to understand android SDK
- To gain a basic understanding of Android application development
- To inculcate working knowledge of creating mobile interface
- To learn about testing of android application
- To create basic android applications

UNIT-I: INTRODUCTION TO ANDROID **9**

The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

UNIT-II: ANDROID APPLICATION DESIGN ESSENTIALS: **9**

Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT-III: ANDROID USER INTERFACE DESIGN ESSENTIALS **9**

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation

UNIT-IV: TESTING ANDROID APPLICATION **9**

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

UNIT-V: ANDROID APPLICATION **9**

Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)
2. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
3. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
4. Android Application Development All in one for Dummies by Barry Burd, Edition: I

COURSE OUTCOMES:

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

CO1: Identify various concepts of mobile programming that make it unique from programming for other platforms,

CO2: Critique mobile applications on their design pros and cons,

CO3: Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CO4: Program mobile applications for the Android operating system that use basic and advanced phone features
CO5: Deploy applications to the Android marketplace for distribution

22ITOE05 DIGITAL AND MOBILE FORENSICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

UNIT I : INTRODUCTION TO DIGITAL FORENSICS **9**

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

UNIT II : DIGITAL CRIME AND INVESTIGATION **9**

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT III: DIGITAL FORENSIC READINESS **9**

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

UNIT IV: iOS FORENSICS **9**

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud

UNIT V: ANDROID FORENSICS **9**

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENECS:

1. Andre Arnes, “Digital Forensics”, Wiley, 2018.
2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.
3. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

COURSE OUTCOMES:

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

CO1: Have knowledge on digital forensics.
CO2: Know about digital crime and investigations.
CO3: Be forensic ready.
CO4: Investigate, identify and extract digital evidence from iOS devices.
CO5: Investigate, identify and extract digital evidence from Android devices.

22MEOE01	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Basic fundamentals of materials and their properties.
- Various mechanical testing methods, processes, properties and applications.
- Different types of NDT testing methods, processes, properties and applications.
- The different methods of materials, their properties, classifications and applications and acquire knowledge to apply on the respective fields.
- Various tests on different materials and know about the failure mechanism.

UNIT I: INTRODUCTION TO MATERIALS TESTING
9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II: MECHANICAL TESTING
9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III: NON-DESTRUCTIVE TESTING
9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV: MATERIAL CHARACTERIZATION TESTING
9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) – Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT-V: OTHER TESTING
9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass spectrometry.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.
4. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.
5. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9thEdition, American Society for Metals, 1978.
6. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA 2000.

COURSE OUTCOMES:

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

CO1: Apply the fundamental concepts of material selection and acquire knowledge on testing.

CO2: Identify the suitable testing methods and process to attain the specified micro structural changes in the metal.

CO3: Choose the different types of methods and testing on the basis of the material and make use of them in their specific application areas.

CO4: Identify the different methods of materials, their properties, classifications and applications and acquire knowledge to apply on the respective fields.

CO5: Select the various tests on different materials and know about the failure mechanism.

22MEOE02	WELDING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the gas and arc welding processes.
- To learn the resistance welding processes.
- To understand the solid state welding processes.
- To study the special welding processes.
- To understanding of inspection methods of welded products and also helps to know the material considerations of this operation.

UNIT-I: GAS AND ARC WELDING PROCESSES **9**

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - Advantages, Limitations and Applications.

UNIT-II: RESISTANCE WELDING PROCESSES **9**

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes –Advantages, Limitations and Applications.

UNIT-III: SOLID STATE WELDING PROCESSES
9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - Advantages, Limitations and Applications.

UNIT-IV: OTHER WELDING PROCESSES **9**

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, Nuclear and surface transport vehicles.

UNIT-V:DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS
9

Various weld joint designs – Welding defects – Causes and remedies – Weldability of Aluminium, Copper, and Stainless steels. Destructive and non-destructive testing of weldments.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. O.P.Khanna, “Welding Technology”, Dhanpat Rai and sons, 2011.
2. Davis A.C., “The Science and Practice of Welding”, Cambridge University Press, Cambridge, 2010.
3. Little R.L., “Welding and welding Technology”, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.

4. Parmer R.S., “Welding Engineering and Technology”, 1st Edition, Khanna Publishers, New Delhi, 2008.
5. Nadkarni S.V., “Modern Arc Welding Technology”, South Asia Books, 2008.
6. Parmer R.S., “Welding Processes and Technology”, Khanna Publishers, New Delhi, 1992

COURSE OUTCOMES:

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

CO1: Understand the construction and working principles of gas and arc welding process.

CO2: Understand the construction and working principles of resistance welding process.

CO3: Understand the construction and working principles of various solid state welding process.

CO4: Understand the construction and working principles of various special welding processes.

CO5: Understand the concepts on weld joint design, Weldability and testing of weldments**.**

22MEOE03	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the safety concept Technical and Managerial roles in the Industries.
- To apply knowledge on investigation and reporting in the working environment.
- To use quality of safety education and training to foresee and solve issues in the industrial situations.
- To learn about the safety management associated with the agencies.
- To familiarize with safety audit and regulation.

UNIT I: SAFETY CONCEPT **9**

Evolution of modern safety concept – History of safety movement – Influence of environmental safety – Hazards – Safety policy – Safety survey, Safety inspection safety culture and Behavioural safety.

UNIT II: ACCIDENT INVESTIGATION AND REPORTING **9**

Concept of an accident, Reportable and non reportable accidents – Principles of accident prevention accident investigation and analysis – Documentation of accidents – Unsafe act and unsafe condition domino sequence – Role of safety committee and cost of accident.

UNIT III: SAFETY EDUCATION AND TRAINING **9**

Importance of training – Training methods – Method of promoting safe practice – Motivation – Role of government agencies and private consulting agencies in safety training – Creating awareness – Safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign.

UNIT IV: SAFETY MANAGEMENT **9**

General concept of safety management – National Safety Council – OSHA, their roles in safety propagation – Evolution of modern safety concept – Planning for safety for optimization of productivity – Line and staff functions for safety – Safety sampling, fault tree analysis.

UNIT-V: SAFETY AUDIT AND SAFETY REGULATION **9**

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – Review of inspection, safety measures in factories act, pollution control act for water, air, and land. OSHAS18001, ISO14001.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Vollman TE., “Manufacturing Planning and Control Systems”, Galgotia Publications, 2002.
2. Elwood S. Buffa, and Rakesh K. Sarin, “Modern Production/Operation Management”, 8th Edition, John Wiley & Sons, 2000.
3. Krishnan N.V, “Safety management in Industry”, Jaico Publishing House, Bombay, 1997.

4. Dan Petersen, “Techniques of Safety Management”, Mc Graw-Hill Company, Tokyo, 1981.
5. “Accident Prevention Manual for Industrial Operations”, N.S.C Chicago, 1980.
6. Heinrich H.W, “Industrial accident Prevention”, McGraw-Hill Company, New york, 1980.

COURSE OUTCOMES:

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

CO1: Anticipate, identify, evaluate, and control workplace hazardous conditions and practices.

CO2: Develop effective safe operating procedures and comprehensive safety and health programs.

CO3: Address identified hazards, conditions, and practices in a cost effective manner.

CO4: Apply the general concept of safety management and planning for safety for optimization of productivity.

CO5: Measure and evaluate occupational safety and health performance.

22MEOE04	MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize with the basic concepts, and techniques of salesmanship.
- To learn and behave about the quality of salesman.
- To create awareness of marketing Remuneration / Compensation.
- To analyse and solve marketing problems in the complex and fast changing business environment.
- To understand the behaviour of consumers.

UNIT I: SALESMANSHIP **9**

Meaning, Definition, Characteristics, Concept, Kinds, Nature – Evolution, and psychology in selling, Scope, Limitations and importance – Sales management: meaning, definition, Characteristics, Principles, Functions and importance, Difference between sales management and marketing management.

UNIT II: SALESMAN **9**

Types, Qualities, Objectives, Duties and responsibilities of good salesman, Recruitment, selection and training of salesman: Sources of recruitment, Principles of selection, Selection procedure, Meaning, Advantages, Disadvantages, Methods, Principles and limitation, Subject matter and Types of good training programme.

UNIT III: REMUNERATION/ COMPENSATION **9**

Essentials of Good Remuneration Plan, Objectives – Methods, Factors determining Remuneration Plan, Comparative study of various plans. Motivating sales force: Meaning, Definition, Objectives, Importance and methods.

UNIT IV: SALES PLANNING **9**

Meaning, Components, Elements, Types, Importance and limitations, Sales fields or territories: Meaning, Definition, Objectives, Factors determining Size, Allocation of sales territories, Steps in setting sales territories. Sales quota: Meaning, Definition, Objectives, Factors determining sales quota, Methods of determining sales quota, Types, Principles of successful sales quota, Advantages and disadvantages of sales quota.

UNIT-V: CONSUMER BEHAVIOUR **9**

Meaning, Definition, Variables and factors affecting Consumer behaviour – Buying Motives: Meaning, Kinds, Chief buying motives – Different types of consumers – Behaviour and customer service.

Contact periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Santoki, “Sales Management”, Kalyani Publisher 2010.
2. Gupta S L., “Sales and Distribution Management”, Excel Books, New Delhi, 2008.
3. Still R and Richard, “Sales Management”, Pearson Prentice Hall, Delhi 2007.
4. Schiffman, Kanuk and Kumar, “Consumer Behaviour”, Pearson, 10th Edition 2005.

5. Kotler and Keller, “Marketing Management”, Pearson Publication 2004.

COURSE OUTCOMES:

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

CO1: Understand the concepts for salesmanship.

CO2: Developed knowledge of salesman responsibilities.

CO3: Understand the concepts for remuneration and compensation methods.

CO4: Developed knowledge of sales planning techniques.

CO5: Understand the use of consumer behaviour concepts.

22MEOE05	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To identify the different maintenance categories like Preventive maintenance and Total Productive Maintenance.
- To illustrate some of the simple instruments used for condition monitoring in industry.
- To learn the fundamental components of mechanical systems functions and predict the faulty locations.
- To study the appropriate repair methods and maintaining records.

UNIT I: PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING
9

Basic principles of maintenance planning – Objectives and principles of planned maintenance – Importance and benefits of sound maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT II: MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE
9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, Repair cycle – Principles and methods of lubrication – TPM.

UNIT III: CONDITION MONITORING
9

Condition monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – Wear debris analysis.

UNIT IV: REPAIR METHODS FOR BASIC MACHINE ELEMENTS
9

Repair methods for beds, slide ways, Spindles, Gears, Lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT-V: REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT
9

Repair methods for material handling equipment – Equipment records – Job order systems –Use of computers in maintenance.

Contact periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Bhattacharya S N., “Installation, Servicing and Maintenance”, S. Chand and Co., 2013.

2. Venkataraman K., “Maintenance Engineering and Management”, PHI Learning Pvt. Ltd. 2010.
3. Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., 2006.
4. Higgins L R., Maintenance Engineering Hand book”, McGraw Hill, 5thEdition, 1994.
5. White E N., “Maintenance Planning”, I Documentation, Gower Press, 1979.
6. Garg M R., “Industrial Maintenance”, S. Chand & Co., 1987.

COURSE OUTCOMES:

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

CO1: Explain basic principle of maintenance and practices the maintenance in organization and economics.

CO2: Practice the various maintenance policies and the various preventive maintenances.

CO3: Describe various aspects of condition monitoring and able to perform estimation Analysis.

CO4: Practice various repairs and able to predict the faulty locations.

CO5: Familiarize various methods of repairing material handling equipments.