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 & SYLLABI

(I to VIII Semester)

REGULATION

2019

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	19CABS001	Engineering Mathematics - I	3	1	0	4
2	19CABS002	Engineering Chemistry	3	0	0	3
3	19CAES001	Basics of Electrical Engineering	3	0	0	3
4	19CAES002	Engineering Graphics	2	0	4	4
PRACTICAL						
5	19CABS005	Chemistry Laboratory	0	0	3	1.5
6	19CAES004	Basics of Electrical Engineering Laboratory	0	0	3	1.5
7	19CAES005	Workshop Practice	0	0	4	2
		Total	**11**	**1**	**14**	**19**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CAHS001	Communicative English	3	0	0	3
2	19CABS007	Engineering Mathematics – II	3	1	0	4
3	19MEBS203	Engineering Physics	3	0	0	3
4	19CAES003	Programming for Problem Solving	3	0	0	3
5	19CAES008	Engineering Mechanics	3	1	0	4
PRACTICAL						
6	19CABS004	Physics Laboratory	0	0	3	1.5
7	19CAES006	Programming in C Laboratory	0	0	3	1.5
		Total	**15**	**2**	**6**	**20**

SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CABS008	Transforms and Partial Differential Equations	3	0	0	3
2	19MEES302	Basic Electronics Engineering	3	0	0	3
3	19MEPC303	Engineering Thermodynamics	3	1	0	4
4	19MEPC304	Fluid Mechanics and Machinery	3	0	0	3
5	19MEPC305	Manufacturing Technology - I	3	0	0	3
6	19MEMC306	Constitution of India	3	0	0	0
PRACTICAL						
7	19MEPC307	Computer Aided Machine Drawing Laboratory	0	0	3	1.5
8	19MEPC308	Fluid Mechanics and Machinery Laboratory	0	0	3	1.5
9	19MEPC309	Manufacturing Technology Laboratory - I	0	0	3	1.5
		Total	**18**	**1**	**9**	**20.5**

SEMESTER IV

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CABS009	Numerical Methods	3	0	0	3
2	19MEPC402	Engineering Materials and Metallurgy	3	0	0	3
3	19MEPC403	Kinematics of Machinery	3	0	0	3
4	19MEPC404	Strength of Materials	3	0	0	3
5	19MEPC405	Manufacturing Technology -II	3	0	0	3
6	19CAHS002	Environmental Science and Engineering	3	0	0	3
PRACTICAL						
7	19CAHS003	Communication Skills Laboratory	0	0	2	1
8	19MEPC408	Strength of Materials Laboratory	0	0	3	1.5
9	19MEPC409	Manufacturing Technology Laboratory - II	0	0	3	1.5
		Total	**18**	**0**	**8**	**22**

SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19MEPC501	Thermal Engineering	3	0	0	3
2	19MEPC502	Metrology and Measurements	3	0	0	3
3	19MEPC503	Dynamics of Machines	3	0	0	3
4	19MEPC504	Design of Machine Elements	3	0	0	3
5	19MEPE5XX	Professional Elective-I	3	0	0	3
6		Open Elective - I	3	0	0	3
PRACTICAL						
7	19MEPC505	Thermal Engineering Laboratory	0	0	3	1.5
8	19MEPC506	Metrology and Measurements Laboratory	0	0	3	1.5
9	19MEPC507	Kinematics and Dynamics Laboratory	0	0	3	1.5
		Total	**18**	**0**	**9**	**22.5**

SEMESTER VI

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CAHS004	Professional Ethics in Engineering	3	0	0	3
2	19MEPC602	Heat and Mass Transfer	3	0	0	3
3	19MEPC603	Design of Transmission Systems	3	0	0	3
4	19MEPC604	Finite Element Analysis	3	0	0	3
5	19MEPE6XX	Professional Elective –II	3	0	0	3
6		Open Elective-II	3	0	0	3
PRACTICAL						
7	19MEEE605	Design and Fabrication Project	0	0	4	2
8	19MEPC606	Heat Transfer Laboratory	0	0	3	1.5
9	19MEPC607	Computer Aided Machining Laboratory	0	0	3	1.5
		Total	**18**	**0**	**10**	**23**

SEMESTER VII

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	19CAHS005	Total Quality Management	3	0	0	3
2	19MEPC702	Mechatronics	3	0	0	3
3	19MEPE7XX	Professional Elective-III	3	0	0	3
4	19MEPE7XX	Professional Elective-IV	3	0	0	3
5		Open Elective-III	3	0	0	3
PRACTICAL						
6	19MEPC703	Mechatronics Laboratory	0	0	3	1.5
7	19MEPC704	Simulation and Analysis Laboratory	0	0	3	1.5
8	19MEEE705	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	19MEPE8XX	Professional Elective-V	3	0	0	3
2	19MEPE8XX	Professional Elective-VI	3	0	0	3
3		Open Elective-IV	3	0	0	3
PRACTICAL						
4	19MEEE801	Project Work	0	0	16	8
		Total	**9**	**0**	**16**	**17**

Total number of credits to be earned for award of the Degree = 164

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CAHS001	Communicative English	3	0	0	3
2	19CAHS002	Environmental Science and Engineering	3	0	0	3
3	19CAHS003	Communication Skills Laboratory	0	0	2	1
4	19CAHS004	Professional Ethics in Engineering	3	0	0	3
5	19CAHS005	Total Quality Management	3	0	0	3

BASIC SCIENCES (BS)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CABS001	Engineering Mathematics – I	3	1	0	4
2	19CABS002	Engineering Chemistry	3	0	0	3
3	19CABS005	Chemistry Laboratory	0	0	3	1.5
4	19CABS007	Engineering Mathematics – II	3	1	0	4
5	19MEBS203	Engineering Physics	3	0	0	3
6	19CABS004	Physics Laboratory	0	0	3	1.5
7	19CABS008	Transforms and Partial Differential Equations	3	0	0	3
8	19CABS009	Numerical Methods	3	0	0	3

ENGINEERING SCIENCES (ES)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CAES001	Basics of Electrical Engineering	3	0	0	3
2	19CAES002	Engineering Graphics	2	0	4	4
3	19CAES004	Basics of Electrical Engineering Laboratory	0	0	3	1.5
4	19CAES005	Workshop Practice	0	0	4	2
5	19CAES003	Programming for Problem Solving	3	0	0	3
6	19CAES008	Engineering Mechanics	3	1	0	4
7	19CAES006	Programming in C Laboratory	0	0	3	1.5
8	19MEES302	Basic Electronics Engineering	3	0	0	3

PROFESSIONAL CORES (PC)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEPC303	Engineering Thermodynamics	3	1	0	4
2	19MEPC304	Fluid Mechanics and Machinery	3	0	0	3
3	19MEPC305	Manufacturing Technology - I	3	0	0	3
4	19MEPC307	Computer Aided Machine Drawing Laboratory	0	0	3	1.5
5	19MEPC308	Fluid Mechanics and Machinery Laboratory	0	0	3	1.5
6	19MEPC309	Manufacturing Technology Laboratory-I	0	0	3	1.5
7	19MEPC402	Engineering Materials and Metallurgy	3	0	0	3
8	19MEPC403	Kinematics of Machinery	3	0	0	3
9	19MEPC404	Strength of Materials	3	0	0	3
10	19MEPC405	Manufacturing Technology -II	3	0	0	3
11	19MEPC408	Strength of Materials Laboratory	0	0	3	1.5
12	19MEPC409	Manufacturing Technology Laboratory-II	0	0	3	1.5
13	19MEPC501	Thermal Engineering	3	0	0	3
14	19MEPC502	Metrology and Measurements	3	0	0	3
15	19MEPC503	Dynamics of Machines	3	0	0	3
16	19MEPC504	Design of Machine Elements	3	0	0	3
17	19MEPC505	Thermal Engineering Laboratory	0	0	3	1.5
18	19MEPC506	Metrology and Measurements Laboratory	0	0	3	1.5
19	19MEPC507	Kinematics and Dynamics Laboratory	0	0	3	1.5
20	19MEPC602	Heat and Mass Transfer	3	0	0	3
21	19MEPC603	Design of Transmission Systems	3	0	0	3
22	19MEPC604	Finite Element Analysis	3	0	0	3
23	19MEPC606	Heat Transfer Laboratory	0	0	3	1.5
24	19MEPC607	Computer Aided Machining Laboratory	0	0	3	1.5
25	19MEPC702	Mechatronics	3	0	0	3
26	19MEPC703	Mechatronics Laboratory	0	0	3	1.5
27	19MEPC704	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	19MEPE501	Composite Materials	3	0	0	3
2	19MEPE502	Design for Manufacturing and Assembly	3	0	0	3
3	19MEPE503	Design of Jigs, Fixtures and Press Tools	3	0	0	3
4	19MEPE504	Automobile Engineering	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – II (SEMESTER VI)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEPE601	Lean Six Sigma	3	0	0	3
2	19MEPE602	Automation in Manufacturing	3	0	0	3
3	19MEPE603	Welding Technology	3	0	0	3
4	19MEPE604	Micro Electro Mechanical Systems	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – III (SEMESTER VII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEPE701	Power Plant Engineering	3	0	0	3
2	19MEPE702	Vibration and Noise Control	3	0	0	3
3	19MEPE703	Entrepreneurship Development	3	0	0	3
4	19MEPE704	Thermal Turbo Machines	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – IV (SEMESTER VII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEPE705	Refrigeration and Air-conditioning	3	0	0	3
2	19MEPE706	Gas Dynamics and Jet Propulsion	3	0	0	3
3	19MEPE707	Design of Heat Exchangers	3	0	0	3
4	19MEPE708	Unconventional Machining Processes	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – V (SEMESTER VIII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEPE801	Design of Pressure Vessels and Piping	3	0	0	3
2	19MEPE802	Additive Manufacturing	3	0	0	3
3	19MEPE803	Computer Integrated Manufacturing Systems	3	0	0	3
4	19MEPE804	Maintenance Engineering	3	0	0	3

PROFESSIONAL ELECTIVES (PE) – VI (SEMESTER VIII)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEPE805	Advanced Finite Element Analysis	3	0	0	3
2	19MEPE806	Applied Hydraulics and Pneumatics	3	0	0	3
3	19MEPE807	Advanced I.C. Engines	3	0	0	3
4	19MEPE808	Process Planning and Cost Estimation	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEEE605	Design and Fabrication Project	0	0	4	2
2	19MEEE705	Project Phase - I	0	0	4	2
3	19MEEE801	Project Work	0	0	16	8

OPEN ELECTIVES (OE)

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19CEOE01	Geographical Information System	3	0	0	3
2	19CEOE02	Green Buildings	3	0	0	3
3	19CEOE03	Planning of Smart Cities	3	0	0	3
4	19CEOE04	Vastu Science for Building Construction	3	0	0	3
5	19CEOE05	Disaster Management and Mitigation	3	0	0	3
6	19CSOE06	Open Source Technologies	3	0	0	3
7	19CSOE07	Ethical Hacking	3	0	0	3
8	19CSOE08	Internet of Things	3	0	0	3
9	19CSOE09	Software Testing	3	0	0	3
10	19CSOE10	User Interface Design	3	0	0	3
11	19ECOE11	Automotive Electronics	3	0	0	3
12	19ECOE12	Hardware Descriptive Language	3	0	0	3
13	19ECOE13	Embedded System Design using ARM Processor	3	0	0	3
14	19ECOE14	Bioinspired Computing Technologies	3	0	0	3
15	19ECOE15	Vehicular Communication and Networking Technology	3	0	0	3
16	19EEOE16	Energy Efficient Lighting System	3	0	0	3

17	19EEOE17	Sensors and Transducers	3	0	0	3
18	19EEOE18	Electrical Safety	3	0	0	3
19	19EEOE19	Electric Vehicles	3	0	0	3
20	19EEOE20	SCADA System and Application Management	3	0	0	3
21	19MEOE21	Testing of Materials	3	0	0	3
22	19MEOE22	Robotics	3	0	0	3
23	19MEOE23	Industrial Engineering	3	0	0	3
24	19MEOE24	Marketing Management	3	0	0	3
25	19MEOE25	Energy Conservation and Management	3	0	0	3

MANDATORY COURSES (MC) (NO – CREDIT)

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEMC306	Constitution of India	3	0	0	0

VALUE ADDED COURSES (VA)

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19MEVA901	Basics of Civil Engineering	1	0	0	1
2	19MEVA902	Metallography	1	0	0	1
3	19MEVA903	Design for Production and Quality Engineering	1	0	0	1
4	19MEVA904	Structural Analysis Using Finite Element Analysis	1	0	0	1
5	19MEVA905	Non Destructive Testing (NDT)	1	0	0	1
6	19MEVA906	Yoga for Youth Empowerment	1	0	0	1
7	19MEVA907	Project Management	1	0	0	1
8	19MEVA908	Six Sigma	1	0	0	1
9	19MEVA909	Professional Skills	1	0	0	1
10	19MEVA910	Industry 4.0	1	0	0	1

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	-	3	-	4	-	3	3	-	13	7.93	13	12
2.	BS	8.5	8.5	3	3	-	-	-	-	23	14.02	23	25
3.	ES	10.5	8.5	3	-	-	-	-	-	22	13.41	22	24
4.	PC	-	-	14.5	15	16.5	12	6	-	64	39.02	64	48
5.	PE	-	-	-	-	3	3	6	6	18	10.98	18	18
6.	OE	-	-	-	-	3	3	3	3	12	7.32	12	18
7.	EE	-	-	-	-	-	2	2	8	12	7.32	12	15
8.	MC	-	-	0	-	-	-	-	-	0	-	0	-
	Total	**19**	**20**	**20.5**	**22**	**22.5**	**23**	**20**	**17**	**164**	**100.00**	**164**	**160**

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

INDUCTION PROGRAMME **SEMESTER I**

Number of Days **21 Days**

Activities:

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

19CABS001 ENGINEERING MATHEMATICS - I SEMESTER I

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- 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 definite and improper integration.
- To acquire the knowledge of multiple integration and related applications.
- To gain methods to solve differential equations with constant and variable coefficients.

UNIT-I: DIFFERENTIAL CALCULUS 9+3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT -II: 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-III: 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-IV: 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.

UNIT-V: 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 - Method of undetermined coefficients.

Contact periods:

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

REFERENCES:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publisher, 43rd Edition, 2010.
2. James Stewart., "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
3. Anton H, Bivens I and Davis S., "Calculus", Wiley, 10th Edition, 2016.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
5. Narayanan, S. and Manicavachagom Pillai, T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.

6. Srimantha Pal and Bhunia, S.C., "Engineering Mathematics" Oxford University Press, 2015.

COURSE OUTCOMES:

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

CO1: Understand the limit definition and rules of differentiation to differentiate functions.

CO2: Apply differentiation to solve maxima and minima problems.

CO3: Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.

CO4: Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

CO5: Apply various techniques in solving differential equations.

19CABS002 ENGINEERING CHEMISTRY SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- The student should be conversant with water characterization, boiler feed water requirements, related problems and water treatment techniques.
- To acquaint the student with concepts of important photo physical and photochemical processes and elemental analysis using spectroscopy.
- To obtain the knowledge on types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- To make the student understand the preparation, properties and applications of engineering materials.
- To accustom the students about the principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.

UNIT-I: WATER TECHNOLOGY 9

Water – Sources – Types of impurities, hardness – Temporary and permanent – Units – ppm and mg/L – Estimation of hardness – EDTA method – Problems – Boiler troubles – Internal treatment – External treatment – Lime soda process and ion exchange process – Drinking water characteristics, colour, odour, turbidity, chloride – Treatment – Preliminary, primary and disinfection methods – Chlorination – Breakpoint chlorination, desalination – Reverse osmosis.

UNIT-II: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS 9

Beer Lambert's law – UV visible spectroscopy and IR spectroscopy – Principle – Instrumentation (block diagram only) – Flame photometry – Principle – Instrumentation (block diagram only) – Estimation of sodium by flame photometry – Atomic absorption spectroscopy – Principle – instrumentation (block diagram only) – Estimation of nickel by atomic absorption spectroscopy.

UNIT-III: FUELS AND COMBUSTION 9

Fuels – Classifications – Calorific value – Gross and Net calorific value – Combustion – Theoretical air – Principle and calculations – Solid fuels – Coal-proximate and ultimate analysis – Significance – Coke – Characteristics – Manufacture by Otto Hoffman method – Liquid fuels – Petroleum fractionation – Petrol and diesel – Knocking of ic engines and diesel engines – Octane and cetane number – Anti-knocking agents – Biogas – Bio diesel.

UNIT-IV: ENGINEERING MATERIALS 9

Refractories - Classification - properties and manufacture of silica and magnesia bricks; Abrasives - Classification, properties - manufacture of SiC; Lubricants - solid lubricants (Graphite and Molybdenum sulphide) hydrodynamic mechanism of lubrication - Cement - manufacture - setting and hardening of cement - special cements - Alumina cement and waterproof cement.

UNIT-V: CORROSION 9

Corrosion - Spontaneity - Chemical corrosion - mechanism, nature of oxides - Pilling Bed worth rule - Electrochemical corrosion- mechanism - Galvanic series and importance -

Prevention methods - design of materials, cathodic protection techniques (sacrificial anode and impressed current cathode), Inhibitors - Protective coatings -Inorganic coating-electroplating - surface preparation and plating method applied to Cr and Ni and galvanizing - Organic coating - paints- constituents and functions.

Contact periods:

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

REFERENCES:

1. Jain. P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publications Pvt. Ltd, New Delhi, 16th Edition, 2017.
2. Vairam.S, Subha Ramesh, "Engineering Chemistry", Wiley India, 2015.
3. Dara. S. S, Umarae, "Text book of Engineering Chemistry", S. Chand Publications, 2004.
4. Agarwal, C.V. "Chemistry of Engineering Materials", 9th Edition, B.S. Publications, 2006.
5. Kuriakose, J.C., and Rajaram J, "Chemistry in Engineering and Technology", Vol.1 & II, Tata McGraw Hill Publishing company Pvt. Ltd, New Delhi, 2001.
6. Sharma Y.R,"Elementary Organic Spectroscopy", S. Chand Publications, 2013.

COURSE OUTCOMES:

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

CO1: Understand the nature of impurities and the effects of various sources of water and apply them in treatment for industrial and domestic purposes.

CO2: Achieve advanced knowledge about the interaction of electromagnetic radiation with matter and their applications for elemental analysis determination.

CO3: Learn the different types of fuels with their compositions, combustion characteristics in engines and apply them in design of combustion chambers.

CO4: Familiar with the various engineering materials, refractories, abrasives, lubricants and cements with their properties and manufacturing methods which are used in engineering applications.

CO5: Gain the knowledge on corrosion of the machinery and also to understand the mechanisms to adopt the preventive measures by various techniques.

19CAES001 BASICS OF ELECTRICAL ENGINEERING SEMESTER I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand and analyze basic electric circuits.
- To study working principles of Electrical Machines and Transformers.
- To study working principles of power converters and Drives.

UNIT-I: DC CIRCUITS 9

Electrical Circuits Elements – Voltage and Current Sources – Source transformation Techniques – Ohm's Law, Kirchhoff's Laws – Analysis of simple circuits with DC Excitation – Superposition, Thevenin and Norton's Theorem. Star and Delta Transformation. Time Domain analysis of first order RL and RC circuits.

UNIT-II:AC CIRCUITS 9

Representation of sinusoidal waveforms, peak, RMS and average value. Real power, Reactive power, Apparent power and Power factor. Analysis of single phase AC circuits consisting of R, L,C, RL, RC, RLC combinations (Series and Parallel) – Resonance in series circuits (study of phenomenon). Three phase circuits - Relation between voltage and current in star and delta connections – Three phase balanced circuits.

UNIT-III:DC MACHINES AND TRANSFORMERS 9

Construction and Principle of operation and speed control of separately excited DC motor – Characteristics of Motor – Applications – Magnetic Materials – BH Characteristics – Single Phase Transformer – Equivalent Circuit – Types of Losses in a Transformer – No Load test and load test – Regulation and Efficiency – Auto transformer – Three Phase Transformer Connections – use of Transformers – Applications.

UNIT-IV: AC MACHINES 9

Construction and Principle of operation of Three phase Induction Motor - Torque slip Characteristics - Starting and Speed Control Methods - Loss component and Efficiency. Construction and Working Principle of single phase Induction Motor. Construction and Working of Synchronous generators and types - Applications of all Machines.

UNIT-V: POWER CONVERTERS AND DRIVES 9

Operation of three phase converter and inverter circuits – Working of chopper and duty ratio control – Chopper control of separately excited DC motor – Stator voltage control of Three phase Induction Motor drives – Rotor resistance control of Three phase Induction motor – Closed loop control of slip power recovery scheme.

Contact Periods:

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

REFERENCES:

1. Kothari. D.Pand Nagrath.I.J., "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. Bimbra.P.S., "Electrical Machinery", Khanna Publishers, 2011.
3. M.H.Rashid.M.H., "Power Electronics: circuits, Devices and Applications", Pearson

Education India, 2009.
4. Dubey. G.K., “Power Semiconductor controlled Drives”, Prentice Hall, 1989.
5. Nagsarkar.T K and Sukhija. M..S., “Basic Electrical Engineering”, Oxford Press, 2005.
6. INagrath.I.J and Kothari. D.P., “Electric Machines”, McGraw Hill Education, 2010.

COURSE OUTCOMES:

Upon completion of this course, student will able to

CO1: Verify Ohm’s law and Kirchhoff’s Law for simple Electrical Circuits.

CO2: Verify simple Network Theorems for Electrical Circuits.

CO3: Solve problems on AC Circuits and Analyze three phase AC circuits.

CO4: Understand the performance of DC Machines and Transformers.

CO5: Basic understanding of Power Electronics Circuits and their application in speed control of AC and DC Machine.

19CAES002 **ENGINEERING GRAPHICS** **SEMESTER I**

L	T	P	C
2	0	4	4

COURSE OBJECTIVES:

- To know the geometrical construction in plane geometry and to draw various curves used in engineering practice.
- To know how to draw orthographic projection from a pictorial view of a solid.
- To practice the projection of points based on quadrants, line and planes in first quadrant.
- To know about solid and its projection and its sectional views on different principle planes.
- To know development of various solid surfaces and to draw isometric projection from available principle plane projections.

UNIT-I: GEOMETRICAL CONSTRUCTIONS **6+12**

Dimensioning – Lettering – Types of Lines – Scaling conventions – Dividing a given straight line in to any number of equal parts – Bisecting a given angle – Drawing a regular polygon given one side – Special methods of constructing a pentagon and hexagon. Curves used in engineering practices: Conics. Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloids – construction of involutes of square and circle. Drawing of tangents and normal to the above curves.

UNIT-II: ORTHOGRAPHIC PROJECTIONS AND SCALES **6+12**

Orthographic projection – Principles – Principal planes – First angle projection – Visualization: concepts and principles – Representation of Three Dimensional objects – Layout of views – Sketching of multiple views from pictorial views of objects – Scales: Construction of Diagonal and Vernier scales.

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

Projectionof points – Projection of straight lines (First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-IV: PROJECTION OF SOLIDS AND SECTION OF SOLIDS **6+12**

Projection of simple solids like prisms, pyramids, cylinder, and cone when the axis is inclined to one of the principal planes by rotating object method and freely suspended solids.Sectioning of simple solids like prisms, pyramids, cylinder, and cone 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.

UNIT-V: DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTION **6+12**

Development of lateral surfaces of simple and sectioned solids – Prisms, Pyramids, cylinder and cone. Principles of isometric projection – Isometric scale – Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinder, cone – Combination of two solid objects in simple vertical positions.

COMPUTER AIDED DRAFTING (Demonstration Only)

Introduction to computer aided drafting package to make 2-D Drawing. Object Construction – Page layout – Layerand Line type – Creating, Editing and selecting the Geometric Objects

– Viewing, Annotating, Hatching and Dimensioning the drawing – Creating Blocks and Attributes, Drafting – Create 2D drawing. A Number of chosen problems will be solved to illustrate the concepts clearly.

Contact Periods:
Lecture: 30 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 90 Periods

REFERENCES:

1. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, NewDelhi, 2015.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P)Limited, 2008.
5. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
6. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.

COURSE OUTCOMES:

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

CO1: Familiarize with the fundamentals and standards of Engineering graphics.

CO2: Perform freehand sketching of basic geometrical constructions and multiple views of objects.

CO3: Project orthographic projections of lines and plane surfaces.

CO4: Draw projections and solids and section of solids.

CO5: Visualize and development the solid surfaces and Projects the Isometric views.

19CABS005 CHEMISTRY LABORATORY SEMESTER I

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
- To provide exposure to the students with hands on experience on the determination of chemical substances present in solution by conductometric and potentiometric experiments.
- To quantify the Copper content by Iodometric method.
- To expose the students to test the Saponification value of an oil.
- To equip the students with the principles of rate constant of a chemical reaction.

LIST OF EXPERIMENTS:

1. Estimation of hardness by EDTA method.
2. Estimation of chloride by Argentometric method.
3. Conductometric titration of mixture of acids and strong base.
4. Estimation of iron content of the given solution using Potentiometer.
5. Determination of Saponification value of oil.
6. Estimation of Iron by Spectrophotometry.
7. Estimation of HCl by pH titration.
8. Determination of the rate constant of reaction.
9. Estimation of Dissolved Oxygen by Iodometry.
10. Conductometric titration of strong acid and strong base.
11. Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.
12. Estimation of copper content of the given solution by Iodometry.

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

CO2: Apply the EMF and conductometric measurements in quantitative analysis of substances.

CO3: Equip with the methods and techniques involved in the Saponification process.

CO4: Comprehend the rate constant of a chemical reaction with respect to time.

CO5: Quantify the metal ion concentration of the given sample.

19CAES004 BASICS OF ELECTRICAL ENGINEERING LABORATORY SEMESTER I

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To familiarize with basic electrical wiring and Measurements.
- To provide basic laboratory experience on Electronic circuits, DC Machines, AC Machines and Transformers.
- To demonstrate internal cut-section view of machines and other advanced measurement devices.

LIST OF EXPERIMENTS

1 Introduction to measuring instruments - Voltmeter, Ammeter, Wattmeter, Multimeter and Digital storage oscilloscope
2 Verification of Laws in Electrical Circuits
3 Measurement of phase difference between voltage and current
4 No load test on single phase transformer and equivalent test
5 Load test on single phase transformer
6 Three phase transformer connections
7 Voltage- Current relations in three phase circuit and three phase power measurement
8 Demonstration of cut out section of machines
9 Swinburne's test, speed control and load test on DC motor
10 Direction change and load test on three phase induction motor
11 Alternator load test and regulation test
12 Demonstration of LT switchgear components
13 Demonstration of AC and DC drives

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: Making electrical connections by wires of appropriate wires. [Usage]

CO2: Acquire exposure to common Electrical Components and Measuring Instruments. [Familiarity]

CO3: Verify simple laws using Electrical Circuits. [Usage]

CO4: Do experiment to understand the characteristics of Transformers and Electrical Machines.[Usage]

CO5: Understand the working of low tension switch gear components, AC and DC drives. [Assessment]

19CAES005 WORKSHOP PRACTICE SEMESTER I

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To provide exposure to the students with hands on various basic engineering practices in Civil, Mechanical and Electrical Engineering.
- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon and Cross-Lap joint.
- To make various Welding joints and sand mould preparation for various patterns
- To prepare electrical wirings.
- To fabricate various parts like tray, frustum of cone and square box in sheet metal.

LIST OF EXPERIMENTS

1. Introduction to use of tools and equipment's in Carpentry, Welding, Foundry and Sheet Metal
2. Safety aspects in Carpentry, Welding and Foundry
3. Half lap Joint and Dove tail Joint in Carpentry
4. Welding of Lap joint, Butt joint and T-joint
5. Preparation of Sand mould for cube, conical bush, pipes and V pulley
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal
7. Electrical wiring – simple house wiring
8. Plumbing
9. CNC Machines demonstration and lecture on working principle.
10. Additive manufacturing demonstration and lecture on working principle.

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: Use a variety of the tools and equipment used in sheet metal, welding, foundries, and carpentry.

CO2: Fabricate basic carpentry prototypes such as the lap joint, lap tee joint, dovetail joint, mortise and Tenon, and cross-lap joint.

CO3: Prepare various Welding joints and sand moulds for various patterns.

CO4: Carry out basic home electrical works and appliances and pipe connections including plumbing woks.

CO5: fabricate the various parts such as tray, frustum of cone, and square box in sheet metal.

19CAHS001 COMMUNICATIVE ENGLISH SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make learners acquire listening skills with correct pronunciation, stress and Intonation.
- To emphasize the development of speaking skills amongst the learners of Engineering.
- To inculcate the habit of reading for effective and efficient communication.
- To equip the learners with writing skills needed for academic as well as work place contexts.
- To enable learners to fine-tune their linguistic skills with appropriate grammatical usage.

UNIT-I: LISTENING 9

Listening Comprehension, Pronunciation, Intonation, Stress, Pause, Rhythm, Listening to Short & Long Conversations/Monologues – Note –Taking.

UNIT-II: SPEAKING 9

Self Introduction, Making Oral & Formal Presentation, Communication at Work Place, Mock Interviews, Role Play Activities, Group Discussions,Debates, Delivering Welcome Address, Proposing Vote of Thanks, Introducing the Chief Guest at a function.

UNIT-III: READING 9

Reading Comprehension, Speed Reading, Interpreting Visual Materials (Signs, Post Cards, Pictures, and Labels Etc), Reading for Specific Information, Reading to identify Stylistic Features (Syntax, Lexis and Sentence Structures), Cloze Test.

UNIT-IV:WRITING 9

Phrase, Clause and Sentence Structures, Punctuation, Discourse Markers, Coherence, Precision in Writing, Graph & Process Description, Definition, Writing E-mail, Paraphrasing, Note-making, Job Application with Resume, Writing Review of a Book/Movie, Creative Writing.

UNIT-V: GRAMMAR AND VOCABULARY 9

Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject-Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices.

Contact periods:

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

REFERENCES:

1. Board of Editors, Using English, Orient Black Swan, 2015.
2. Practical English Usage, Michael Swan, OUP 1995.
3. Cambridge BEC Vantage Practice Tests, Self-study Edition, CUP, 2002.
4. Exercises in Spoken English. Parts 1-II, EFLC, Hyderabad, OUP, 2014.
5. Indlish. Jyothi Sanyal, Viva Books, 2006.
6. Communicative English. J. Anbazhagan Vijay, Global Publishers, Chennai 2018.

WEB REFERENCES:

1. www.cambridgeenglish.org/exams/
2. www.examenglish.com/BEC/BEC_Vantage.html
3. www.splendid-speaking.com/exams/bec_ speaking.html

COURSE OUTCOMES:

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

CO1: Listen and comprehend the contexts delivered in English.

CO2: Speak clearly, confidently, comprehensively and communicate with one or many listeners using appropriate communicative strategies.

CO3: Read different genres of texts adopting various reading strategies.

CO4: Write effectively and persuasively to enhance students' employability.

CO5: Communicate cohesively, coherently and flawlessly avoiding grammatical errors and using a wide vocabulary range in speaking and writing contexts.

19CABS007 ENGINEERING MATHEMATICS - II SEMESTER II

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To obtain the knowledge of Eigen values and diagonalization of a matrix.
- 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 be familiar with techniques of Laplace and Inverse Laplace transformation.

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 matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms

UNIT-II: 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 – Area of a curved surface – Volume integral – Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals

UNIT-III: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-IV: 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-V: LAPLACE TRANSFORMS 9+3

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – 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.

Contact periods:

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

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition,2015.
2. Erwinkreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley &Sons, 2016.

3. Bali N.P , Manish Goyal v and Watkins C., "Advanced Engineering Mathematics",Firewall Media, New Delhi, 7th Edition, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi , 3rd Edition, 2007.
5. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
6. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.

COURSE OUTCOMES:

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

CO1: Understand the concept of Eigen values and eigenvectors, diagonalization of a matrix, symmetric matrices, positive definite matrices and similar matrices.

CO2: Acquire knowledge in Gradient, divergence and curl of a vector point function and related identities.

CO3: Understand the properties and formation of analytic function, mappings of standard functions and bilinear transformation.

CO4: Understand calculus of residues to evaluate contour integration.

CO5: Understand Laplace transform and inverse transform of simple functions, various related theorems and application to differential equations with constant coefficients.

19MEBS203 ENGINEERING PHYSICS SEMESTER II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge on fundamentals of electromagnetism.
- To understand the basic properties and applications of magnetic and superconducting materials.
- To accustom the student about elastic behavior of solids, thermal conduction and applications.
- To gain knowledge about different types of Non-destructive testing methods.
- To acquaint the student about basics of vacuum science, production and measurement.

UNIT-I: ELECTROMAGNETISM 9

Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral – Maxwell Equations (Qualitative) – Differential Form and Integral Form – Wave Equation – Derivation in Vacuum and Homogeneous Isotropic Dielectric Medium – Electromagnetic Waves – Refractive index – Phase velocity – Group velocity, Group index, Wave guide (Qualitative).

UNIT -II: MAGNETIC MATERIALS AND SUPERCONDUCTORS 9

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

UNIT-III: PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity – Hooke's law – Stress – Strain diagram – Factors affecting elasticity – Bending moment – Depression of a cantilever – Young's modulus by uniform bending – I shaped girders.Thermal conductivity – Heat conduction in solids – Rectilinear flow of heat through along a uniform bar – Forbe's and Lee's disc method: theory and experiment.

UNIT-IV: NON-DESTRUCTIVE TESTING 9

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

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. Halmshaw. R, "Industrial Radiography, Applied Science", Publishers Inc., Englewood, NJ,1982.

2. David Griffiths, "Introduction to Electrodynamics", 4th Edition, 2013, Pearson Education.
3. Jearl Walker, "Fundamentals of Physics", Halliday & Resnick, 10th Edition,2014, Wiley.
4. Palanisamy, P.K, "Engineering Physics–II", Scitech Publications (India) Pvt. Ltd, 3rd Edition, 2015.
5. Krautkramer, Josef and Hebert Krautkramer, Ultrasonic Testing of Materials, 3rd Edition, New York, Springer-Verlag, 1983.
6. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non-DestructiveTesting, 3rd Edition, Narosa Publishing House, 2007.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

CO1: Acquire knowledge in basics of Electromagnetism.

CO2: Identify, analyze the properties and applications of magnetic and super conducting materials.

CO3: Acquire knowledge in properties of matter and thermal physics.

CO4: Familiarization of different methods of Non-destructive testing.

CO5: Production and measurement of vacuum.

19CAES003 PROGRAMMING FOR PROBLEM SOLVING SEMESTER II

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 andpointers.
- 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 – Enumeration 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 definition, function declaration, 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 – Example Program using structures and pointers – Self referential structures – Union – Programs using structures and Unions – Enumeration types – Bit fields – typedefs – Dynamic memory allocation – Storage classes.

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. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Reema Theraja "Fundamentals of Computing and Programming in C", Second Edition, Oxford University Press, 2016

3. Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 15th revised edition, 2016.
4. Dawn Griffiths, David Griffiths, “Head First C”, O’Reilly Publishers, 2012.
5. Paul J. Deitel and Harvey Deitel, “C How to Program”, 7th ed., Pearson Education, 2013.

COURSE OUTCOMES:

Upon completion of this course, the student 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.

19CAES008 ENGINEERING MECHANICS SEMESTER I

L	T	P	C
3	1	0	4

OBJECTIVES:

- To understand the various laws of mechanics and vectorial representation of forces.
- To understand the equilibrium of rigid bodies in two and three dimensions.
- To understand the center of gravity and moment of inertia of areas and bodies.
- To understand dynamics of a particle and kinetics of the rigid bodies.
- To understand fundamentals of friction and types.

UNIT I STATICS OF PARTICLES 9+3

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces – additions, subtraction, dot product, cross product – Coplanar Forces – Rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+3

Centroids and centre of mass – Centroids of lines and areas – Rectangular, circular, triangular areas by integration – T section, I section, – Angle section, Hollow section by using standard formula –Theorems of Pappus – Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia – Mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 9+3

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion- Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ITS APPLICATIONS 9+3

Friction force – Laws of sliding friction – characteristics of dry friction –impending motion- free body diagram for equilibrium analysis of simple systems with sliding friction: ladder, screw, belt and wedge friction - Rolling resistance – Applications.

Contact Periods:

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

REFERENCES:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010) Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
3. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
4. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
5. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics – Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
6. Rajasekaran S and Sankar Subramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

OUTCOMES:

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

CO1: Illustrate the vectorial and scalar representation of forces and moments.

CO2: Analyse the rigid body in equilibrium.

CO3: Evaluate the properties of surfaces and solids.

CO4: Calculate dynamic forces exerted in rigid body.

CO5: Determine the friction and the effects by the laws of friction.

19CABS004 PHYSICS LABORATORY SEMESTER II

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVE:

- To understand the physical and thermal properties of matter.
- To calibrate the electrical devices, Laser diffraction and parameters of optical fibers.
- To determine the compressibility of liquids and viscosity of liquids.
- To analyze the band gap energy of semiconductors and thickness of paper.
- To determine the spectral wavelength and dispersive power of prism.

LIST OF EXPERIMENTS

1. Young's Modulus - Cantilever Bending - Koenig's Method
2. Torsional pendulum - Determination of Rigidity Modulus & Moment of Inertia
3. Young's Modulus - Non Uniform bending Method
4. Lee's Disc method - Thermal conductivity of a bad conductor
5. Ammeter and Voltmeter Calibration - Low Range
6. a) Laser - Particle size Determination
   b) Optical fiber - Determination of NA & Acceptance angle
7. Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids
8. Poiseuille's method - Determination of Coefficient of viscosity of a liquid
9. Determination of Bandgap Energy of Semiconductor
10. Air Wedge - Determination thickness of a paper
11. Spectrometer - Diffraction Grating - Normal Incidence Method
12. Spectrometer - Determination of Dispersive power of a prism

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: Determine the physical and thermal properties of matter.

CO2: Calibrate electrical measuring instruments and thereby effectively using it for electronic application and understanding the principle of Laser diffraction and propagation through optical fibers and determine its parameters.

CO3: Understand the ultrasonic wave propagation in liquids and determine the viscosity of liquids for engineering applications.

CO4: Determine the band gap energy of semiconductor materials and thickness of paper.

CO5: Identify the spectral wavelength and determine the dispersive power of prism.

19CAES006	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- 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. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Given a set of numbers like <10, 36, 54, 89, 12, 27>, find sum of weights based on the following conditions:
   5 if it is a perfect cube.
   4 if it is a multiple of 4 and divisible by 6.
   3 if it is a prime number.
   Sort the numbers based on the weight in the increasing order as shown below
   <10,its weight>,<36,its weight><89,its weight>
7. Populate an array with height of persons and find how many persons are above the average height.
8. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
9. Given a string ―a$bcd./fg‖ find its reverse without changing the position of special characters.
   (Example input:a@gh%;j and output:j@hg%;a)
10. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
11. From a given paragraph perform the following using built-in functions:
    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.
12. Solve towers of Hanoi using recursion.
13. Sort the list of numbers using pass by reference.
14. Generate salary slip of employees using structures and pointers.
15. Compute internal marks of students for five different subjects using structures and functions.
16. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
17. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
18. **Mini project**
    Create a - Railway reservation system‖ with the following modules
    - Booking

- Availability checking
- Cancellation
- Prepare chart

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

OUTCOMES:

Upon completion of this course, the student will 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.

19CABS008 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS **SEMESTER III**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS **9**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous and non - homogeneous types.

UNIT -II: FOURIER SERIES **9**

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

UNIT-III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9**

Classification of PDE – Method of separation of variables - 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-IV: FOURIER TRANSFORMS **9**

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**

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: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.

2. Narayanan S., Manicavachagom Pillay T.K and Ramanaiah G., "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3. Andrews L.C and Shivamoggi B, "Integral Transforms for Engineers" SPIE Press, 1999.
4. Bali N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
5. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
6. James G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.

COURSE OUTCOMES:

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

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

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

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

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.

19MEES302 BASIC ELECTRONICS ENGINEERING SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the semiconductor devices and its applications.
- To be exposed to the simple circuits constructed using BJT.
- To study the working and applications of op-amp.
- To realize the working of basic digital logic circuits and their applications.
- To be familiar with the basics of memory and programming logic devices.

UNIT-I: SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Classification of solids based on energy band theory – Intrinsic semiconductors – Extrinsic semiconductors – P-type and N-type – PN junction – Zenar effect – Zenar diode characteristics – Half wave and full wave rectifiers – Voltage regulation. PN diode applications: Clippers – Clampers –Voltage regulators.

UNIT -II: ANALOG ELECTRONIC CIRCUITS 9

Bipolar junction transistor – CB, CE, CC configuration and characteristics – Biasing circuits – Class A, B and C amplifiers – Field effect transistor – Configuration and characteristic of FET amplifier – SCR, Diac, Triac, UJT – Characteristics and simple applications – Switching transistors – Concept of feedback – Negative feedback application in temperature and motor speed control.

UNIT-III: OP-AMP AND ITS APPLICATIONS 9

OP-Amp: Introduction, Basics, Ideal OP-Amp – Open loop and feedback in OP-Amp operation, Inverting and non-inverting amplifier. Voltage follower and differential amplifiers – Difference mode, Common mode gain, CMRR – Operation amplifier internal circuit – Example of OP – AMP IC's (IC 741) – OP – AMP D.C characteristics. Applications: Multiplier, Divider, Integrator and differentiator.

UNIT-IV: DIGITAL ELECTRONICS FUNDAMENTALS 9

Difference between analog and digital signals – Boolean algebra – Basic and Universal Gates – Symbols, Truth tables, Logic expressions, Logic simplification using K-map – Logic ICs – Half and Full adder/subtractor – Multiplexers and demultiplexers – Flipflops – R,S,J,K,T,D.

UNIT-V: MEMORY AND PROGRAMMING LOG 9

Classification of memories – RAM organization – Memory decoding – Memory expansion – Static RAM cell – Dynamic RAM cell – ROM organization – Types of ROM – Programmable logic array – Field programmable Gate arrays – Races – Hazards.

Contact periods:

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

REFERENCES:

1. Sedra and Smith, "Micro Electronic Circuits", 6th Edition, Oxford University Press, 2011.
2. Salivahanan S, Sureshkumar N and Vallavaraj A., "Electronic Devices and Circuits", 3rd Edition, Tata McGraw Hill, 2012.

3. Roy Choudhry D, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 5th Edition, 2018.
4. Robert L.Boylestad, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education, 2009.
5. Morris M, ManoR and Michael D. Ciletti, “Digital Design” 4th Edition, Pearson Education, 2011.
6. Donald D.Givone “Digital Principles and System Design”, 2nd Edition, Tata McGraw Hill Higher Education (Pvt). Ltd, 2003.

COURSE OUTCOMES:

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

CO1: Illustrate the semiconductor devices and its applications.

CO2: Analyze the simple circuits constructed using BJT.

CO3: Recognize working and applications of op-amp.

CO4: Design basic digital logic circuits.

CO5: Describe the basics of memory and programming logic devices.

19MEPC303 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 basic conversion principles of mass and energy to closed and open systems.
- To introduce the second law of thermodynamics with applications.
- To understand various gas laws, equations of state and apply them to solve problems 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, Tdsequations, 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 Mollierchart. 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, Preheater, 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", 5th Edition, McGraw Hill Education, 2013.
2. Rajput R.K., "Engineering Thermodynamics", 4th Edition, Laxmi Publications, 2007.
3. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", AnuragamPublications, 2012.
4. Holman J.P., "Thermodynamics", 10th Edition, McGraw Hill Education, 2011.
5. Arora C.P., Thermodynamics, 1st Edition, Tata McGraw - Hill Education, 2001.
6. Moran, Shapiro andBoettner, Bailey "Principals of Engineering Thermodynamics", 7thEdition, Wiley India Pvt Ltd-2013.
7. Michael A. Boles, Yunus A. Cengel, "Thermodynamics: An Engineering Approach", 7th Edition, Tata McGraw - Hill Education, 2011.
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 psychometric processes.

19MEPC304 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 and 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, Vapor 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. Bansal R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi – 2010.
2. Modi P.N and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2013.
3. Graebel W.P., "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.
4. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd., New

Delhi, 2016.
5. Robert W. Fox, Alan T. McDonald and Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.
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: Analyse and calculate major and minor losses associated with pipe flow in piping networks.

CO3: Mathematically predict the nature of physical quantities.

CO4: Critically analyse the performance of pumps.

CO5: Critically analyse the performance of turbines.

19MEPC305 MANUFACTURING TECHNOLOGY – I SEMESTER III

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

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.

19MEMC306 **CONSTITUTION OF INDIA** **SEMESTER III**

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To know about Indian constitution.
- To know about central and state government functionalities in India.
- To know about Indian society.

UNIT-I: INTRODUCTION **9**

Constitution meaning of the term, 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, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: 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. Durga Das Basu, "Introduction to the Constitution of india", Prentice Hall of India, New Delhi, 2018.
2. Agarwal R.C., "Indian Political System", S. Chand and Company, New Delhi, 2004.
3. Laxmikanth M., "Indian Polity", Mcgraw Hill Education (India) Private Limited, 2016.
4. Sharma and Brij Kishore, "Introduction to the Consitution of India," Prentice Hall of India, New Delhi, 2018.

COURSE OUTCOMES:

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

CO1: Understand the concepts of constitution assembly.
CO2: Develope knowledge of union government and its administration.
CO3: Develope knowledge of state government and its administration.
CO4: Develope knowledge of local administration**.**
CO5: Learn to use the function of election commission.

19MEPC307 COMPUTER AIDED MACHINE DRAWING LABORATORY SEMESTER III

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To study basic conventions, abbreviations and symbols used in engineering drawings.
- To develop the assembly drawing for given components using CAD package.

UNIT-I: CONVENTIONS, ABBREVIATIONS, AND SYMBOLS

Interrupted views, Partial views of symmetrical objects, Conventional representation of the continuous square and circular rod ends, Adjacent parts, Common machine elements, abbreviations, Description of tolerances and grades, Types of fits and their descriptions, selection of fits from standard tables – Fits for different applications – Example – Geometrical tolerances – Surface finish conventions.

UNIT -II: AUTOCAD

Basic tools and commands of AutoCAD, Line types, Dimensioning, 2D drawing of machine components, 3D models, Importing and exporting files to other software.

UNIT-III: PREPARATION OF ASSEMBLY DRAWING

Cotter joint, Knuckle joint, Flange coupling, Universal coupling, Footstep bearing, Plummer block, Screw jack, Machine vise, Connecting rod end, Lathe tailstock, Stop valves – Study on industrial drawings.

Contact periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 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 part drawings, 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.

19MEPC308 FLUID MECHANICS AND MACHINERY LABORATORY SEMESTER III

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To verify the principles studied in Fluid Mechanics theory by performing experiments in laboratory.

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 Rota meter
4. Determination of friction factor for a given set of pipes
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submersible 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
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.

19MEPC309 MANUFACTURING TECHNOLOGY LABORATORY-I SEMESTER III

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- 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.

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. Sheet metal wok
III. Welding
IV. Foundry

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.

19CABS009 NUMERICAL METHODS SEMESTER IV

L	T	P	C
3	0	0	3

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 this 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

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

UNIT -II: INTERPOLATION AND APPROXIMATION 9

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

UNIT-III: NUMERICAL DIFFERENTIATION AND INTEGRATION 9

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

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 DIFFERENTIAL EQUATIONS 9

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: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

1. Burden R.L and Faires J.D., "Numerical Analysis", 9th 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. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
4. Gerald C. F and Wheatley P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
5. Mathews J.H., "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
6. Sankara Rao. K, "Numerical Methods for Scientist and Engineers", Prentice Hall of India Pvt. Ltd., 3rd Edition, New Delhi, 2007.

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.

19MEPC402 **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 so as to identify and select suitable materials for various engineering applications.

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. Avner S.H., “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 1997.
2. Williams D. Callister, “Material Science and Engineering” Wiley India Pvt. Ltd, Revised Indian Edition 2014.

3. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.
4. Raghavan V., "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 2015.
5. Jindal U.C., Material Science and Metallurgy, "Engineering Materials and Metallurgy", 1st Edition, Dorling Kindersley, 2012.
6. Upadhyay G.S and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.

COURSE OUTCOMES:

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

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

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

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

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

CO5: Explain the testing of mechanical properties.

19MEPC403 KINEMATICS OF MACHINERY SEMESTER IV

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge on the concept of simple mechanisms.
- To provide knowledge on kinematic analysis of simple mechanisms.
- To study and construct the cam profile for the various types of follower motion.
- To learn the kinematics terminologies of spur gear and calculate speed ratio of various types of gear train.
- To learn the concept of friction drives in kinematic of machines.

UNIT-I: BASICS OF MECHANISMS 9

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal joint – Rocker mechanisms.

UNIT -II: KINEMATICS OF LINKAGE MECHANISMS 9

Displacement, Velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Velocity analysis using instantaneous centres – Kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.

UNIT-III: KINEMATICS OF CAM MECHANISMS 9

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

UNIT-IV: GEARS AND GEAR TRAINS 9

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

UNIT-V: FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Sliding and rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes – Band and block brakes.

Contact periods:

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

REFERENCES:

1. Sayyad F.B., "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
2. Rattan S.S., "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.

3. UickerJ.J, Pennock G.R and Shigley J.E., “Theory of Machines and Mechanisms”, 4th Edition, Oxford University Press, 2014.
4. Allen S. Hall Jr, “Kinematics and Linkage Design”, Prentice Hall, 1961.
5. Cleghorn W. L., “Mechanisms of Machines”, Oxford University Press, 2014.
6. Ghosh A and Mallick A.K., “Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
7. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
8. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

COURSE OUTCOMES:

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

CO1: Discuss the basics of mechanism.

CO2: Calculate velocity and acceleration in simple mechanisms.

CO3: Develop CAM profiles.

CO4: Solve problems on gears and gear trains.

CO5: Examine friction in machine elements.

19MEPC404 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 determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- 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: TORSION 9

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, carriage springs.

UNIT-IV: DEFLECTION OF BEAMS 9

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

UNIT-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. James M. Gere, "Mechanics of Materials", Cengage Learning, India, 2012.
3. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009.
4. Ferdinand P. Been, Russell Johnson J.R and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing co. Ltd., New Delhi, 2005.

5. Hibbeler R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013.
6. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

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

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

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

19MEPC405 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. Sharma P.C., "Manufacturing Technology – II", S.Chand & Company Limited. New Delhi, 2012.
2. Dr.Vijayaraghavan G.K., "Manufacturing Technology-II", Lakshmi publications,

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

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.

19CAHS002 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **SEMESTER IV**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand what constitutes the environment.
- To conserve the natural resources.
- To learn and understand the role of a human being in maintaining a clean and useful environment for the future generations.
- To acquire knowledge about ecological balance and preservation of biodiversity.
- To get an idea about the role of government and non-government organization in environment management.

UNIT-I: ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY **14**

Definition, scope and importance of environment – Need for public awareness – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values – Biodiversity at global, National and local levels – India as a mega – Diversity nation – Hot-spots of biodiversity – Threats to biodiversity: Habitat loss, Poaching of wildlife, Man- wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, Insects, Birds; Field study of simple ecosystems – Pond, River, Hill slopes, etc.

UNIT -II: ENVIRONMENTAL POLLUTION **8**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: Causes, Effects and Control measures of municipal solid wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT-III: NATURAL RESOURCES **10**

Forest resources: Use and over – Exploitation, Deforestation, Case studies –Timber extraction, mining, Dams and their effects on forests and tribal people – Water resources: Use and over – Utilization of surface and ground water, Floods, Drought, Conflicts over water, dams – Benefits and problems – Mineral resources: Use and exploitation, Environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, Changes caused by agriculture and overgrazing, Effects of modern agriculture, Fertilizer– pesticide problems, Water logging, Salinity, Case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, Use of alternate energy sources. Case studies – Land resources: Land as a resource, Land degradation, Man induced landslides, Soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.

UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT **7**

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, Watershed management – Resettlement and rehabilitation of people; Its problems and concerns, Case studies – Role of non-governmental organization –Environmental ethics: Issues and possible solutions – Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and holocaust, Case studies. – wasteland reclamation – Consumerism and waste products – Environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act– Forest conservation act – Enforcement machinery involved in environmental legislation – Central and state pollution control boards – Public awareness.

UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT **6**

Population growth, variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health – Case studies.

Contact periods:

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

REFERENCES:

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 2004.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt. Ltd., New Delhi, 2007.
4. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt. Ltd., Hydrabad, 2015.
5. Rajagopalan R., "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
6. Tyler Miller G and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd., Delhi, 2014.

COURSE OUTCOMES:

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

CO1: Understand how to conserve the natural resources.

CO2: Understand what constitutes the environment and how to conserve biodiversity.

CO3: Create awareness about environmental pollution and disaster management.

CO4: Gain adequate knowledge about the social issues of the environment and the role of government and non government organization in environment management.

CO5: Understand about human population and the environment and the role of information technology in environment and human health.

19CAHS003 COMMUNICATION SKILLS LABORATORY SEMESTER IV

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To equip students with the English language skills required for the successful academic studies on speaking and listening skills.
- To provide guidance and practice in basic general and classroom conversation.
- To strengthen the reading skills of students of engineering.
- To enhance their writing skills with specific reference to technical writing.
- To develop effective communication skills.

UNIT-I: 6

Listening – Listening & answering – Listening to a lecture & pronunciation – **Speaking** – Giving & asking personal information – **Reading** – Strategies for effective reading and Reading comprehension – **Writing** – Develop a paragraph: topic sentence, Supporting sentences and concluding sentence – Descriptive paragraph writing.

UNIT-II: 6

Listening – Listening to process information – Stress & intonation patterns – **Speaking** – Small talk – Converse with reasonable accuracy over a wide range of everyday topics – **Reading** – Read for details – Use of graphic organizers to review and aid comprehension – **Writing** – State reasons and examples to support ideas in writing – Write a paragraph with reasons and examples – Opinion paragraph writing.

UNIT-III: 6

Listening – Lexical chunking for accuracy and fluency – Factors influence fluency – Listen for and follow the gist – Listen for details – **Speaking** – Informal talk – Describing health & symptoms – **Reading** – Connectors and Pronouns in a passage – Speed reading techniques – **Writing** – Elements of a good essay – Types of essays – Descriptive, narrative, issue – Based, argumentative and analytical.

UNIT-IV: 6

Listening – Active listening – **Speaking** – Giving verbal and non-verbal feedback – Listening & participating in conversations – Strategies for presentations: group/pair presentations – **Reading** – Genre and Organization of ideas – **Writing** – Email writing – visumes – Job application – Project writing – Writing convincing proposals.

UNIT-V: 6

Listening – Listening & responding to explanations in academic & business contexts – **Speaking** – Participating in a group discussion – **Reading** – Critical reading and thinking – understanding how the text positions the reader – **Writing** – Statement of Purpose – Letter of recommendation – Vision statement.

Contact periods:

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

REFERENCES:

1. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.
2. Hughes, Glyn and Josephine Moate., Practical English Classroom. Oxford University

Press: Oxford, 2014.
3. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
4. Debra Daise, Charl Norloff and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011.
5. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004.
6. Robert M Sherfield and et al. "Developing Soft Skills" 4th edition, New Delhi: Pearson Education, 2009.

COURSE OUTCOMES:

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

CO1: Listen and respond appropriately.

CO2: Make effective presentations and participate in group discussions.

CO3: Read and evaluate texts critically.

CO4: Write winning job applications.

CO5: Display critical thinking in various professional contexts.

19MEPC408 STRENGTH OF MATERIALS LABORATORY SEMESTER IV

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads.

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 – Brinnell 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 and
   c) Quenched and tempered specimen
10. Microscopic Examination of
    a) Hardened samples and
    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.

19MEPC409 MANUFACTURING TECHNOLOGY LABORATORY-II SEMESTER IV

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

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

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 / Turning process
9. V-slot in planner machine
10. 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.

19MEPC501 THERMAL ENGINEERING SEMESTER V

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 into various thermal application like IC engines.
- To apply the thermodynamic concepts for Nozzles and Turbines.
- To study the thermodynamic concepts for Air-compressors, Refrigeration and Air conditioning systems.

UNIT-I: GAS POWER CYCLES 8

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

UNIT -II: INTERNAL COMBUSTION ENGINES 10

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. Rajput R. K., "Thermal Engineering", Laxmi Publications Pvt Limited, 10th Edition 2017
2. Kothandaraman C.P, Domkundwar S and Domkundwar A.V., "A Course in Thermal Engineering", 5th Edition, Dhanpat Rai & Sons, 2002.

3. Ganesan V., “Internal Combustion Engines”, 4th Edition, Tata Mcgraw-Hill 2012.
4. Arora C.P., “Refrigeration and Air Conditioning”, 4th Edition Tata McGraw-Hill Publishers 2020.
5. Ramalingam K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2nd Edition, 2018.
6. Sarkar B.K., “Thermal Engineering” Tata McGraw-Hill Publishers, 2007.
7. Rudramoorthy R., “Thermal Engineering”, Tata McGraw-Hill, New Delhi, 2003.

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.

19MEPC502 METROLOGY AND MEASUREMENTS SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on various metrological equipment's available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

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. Jain R.K., "Engineering Metrology", Khanna Publishers, 2009.
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., "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 2004.

6. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th Edition, Cengage Learning EMEA, 1990.
7. Beckwith, Marangoni and Lienhard, “Mechanical Measurements”, Pearson Education, 2014.

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.

19MEPC503 DYNAMICS OF MACHINES SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To learn the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To study the effect of dynamics of undesirable vibrations.
- To learn the principles in mechanisms used for speed control and stability control.

UNIT-I: FORCE ANALYSIS 9

Free body diagrams – Static equilibrium conditions – Static force analysis in simple mechanisms like four bar mechanism, slider crank mechanism – Dynamic force analysis – Inertia force and inertia torque – D‟Alemberts principle – Principle of superposition – dynamic force analysis of four bar and slider crank mechanism – Graphical method – Turning moment diagrams – Fly wheel.

UNIT -II: BALANCING 9

Static and dynamic balancing – Balancing of rotating masses – Balancing of reciprocating masse – Primary and secondary unbalanced forces – Partial balancing of unbalanced primary force – Partial balancing of locomotives – Variation of tractive force, Swaying couple and hammer blow.

UNIT-III: FREE VIBRATION 9

Basic features of vibratory systems – Degrees of freedom – Free vibration – Equations of motion – Natural frequency – Types of damping – Damped vibration – Critical speeds of simple shaft – Torsional systems: single, two rotor systems.

UNIT-IV: FORCED VIBRATION 9

Response to periodic forcing – Harmonic forcing – Unbalanced forcing – Force transmissibility and amplitude transmissibility – Vibration isolation. Selection of vibration measuring instruments – Accelerometer – Dynamic properties and selection of structural materials for vibration control.

UNIT-V: MECHANISM FOR CONTROL 9

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

Contact periods:

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

REFERENCES:

1. Rattan S S., “Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
2. Khurmi R.S., “Theory of Machines", 14th Edition, S Chand Publication, 2005.

3. Thomas Bevan, "Theory of Machines", 3rd Edition CBS Publishers and Distributors, 2005.
4. Ghosh A and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East West Press Pvt. Ltd., New Delhi, 2008.
5. John J. Uicker, Gordon R. Pennock & Joseph E. Shigley., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.
6. Rao J.S and Dukkipati R.V., "Mechanism and Machine Theory", 2nd Edition, Wiley-Eastern Limited, New Delhi, 2007.
7. John Hannah and Stephens R.C., "Mechanics of Machines", Viva low-Priced Student Edition, 2005.
8. Sadhu Singh, "Theory of Machines", Pearson Education, 2011.

COURSE OUTCOMES:

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

CO1: Perform the force analysis on mechanical engineering systems.

CO2: Apply balancing principles on mechanical engineering systems.

CO3: Analyse the vibrations occurring in various mechanical systems.

CO4: Selection of vibration measuring instruments and selection of structural materials for vibration.

CO5: Analysis of gyroscopic effects in real life applications and apply the principle of Governors**.**

19MEPC504 **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 study proper materials for different machine elements depending on their physical and mechanical properties and gain knowledge on design of various machine elements experiencing different theories of failures.

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 and selection of rolling and sliding contact bearing.

Contact periods:

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

REFERENCES:

1. Bhandari V., "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2017.
2. Sundararajamoorthy T.V and Shanmugam N., "Machine Design", Anuradha Publications, Chennai, 2018.
3. Gope P.C., "Machine Design – Fundamental and Application", PHI learning private ltd, New Delhi, 2012.
4. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett, "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2011.
5. Patel R.B., "Design of Machine Elements", MacMillan Publishers India P. Ltd., Tech-Max Educational resources, 2018.

6. Alfred Hall, Halowenko A and Laughlin H., “Machine Design”, Tata McGraw-Hill BookCo. (Schaum’s Outline), 2010.
7. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley, 2011.
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 and selection of couplings and bearings for industrial applications.

19MEPC505 THERMAL ENGINEERING LABORATORY SEMESTER V

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS

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

19MEPC506 METROLOGY AND MEASUREMENTS LABORATORY SEMESTER V

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To familiar with various measuring equipments and is used in industries for quality inspection.

LIST OF EXPERIMENTS

1. Vernier caliper, Micrometer
2. Vernier Height Gauge
3. Bore diameter measurement using telescope gauge
4. Bore diameter measurement using micrometer
5. Comparator
6. Tool Maker's Microscope
7. Sine Bar
8. Bevel Protector
9. Gear Tooth Vernier Caliper
10. Floating gauge Micrometer
11. Surface finish measuring equipment
12. Autocollimator
13. Force measurement
14. Torque measurement
15. Temperature 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: Demonstrate linear and angular measurement using precision instruments.

CO3: Make use of gear tooth Vernier and floating gauge Micrometer for measuring thread and gear parameters.

CO4: Measure straightness, Flatness and surface roughness.

CO5: Apply the load cell and thermo couple to measure the force, Torque and temperature.

19MEPC507 KINEMATICS AND DYNAMICS LABORATORY SEMESTER V

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To supplement the principles learned in kinematics and dynamics of machinery.
- To study the certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. Study of gear parameters, velocity ratios of simple, compound and epicyclic gear trains
2. Study of Kinematics of four bar, Slider Crank mechanisms
3. Determination of Mass moment of inertia of Fly wheel and Axle system
4. Determination of mass moment of inertia of axis symmetric bodies using Turn table apparatus
5. Determination of mass moment of inertia using bifilar suspension and compound pendulum
6. Motorized gyroscope – Study of gyroscopic effect and couple
7. Governor – Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors
8. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
9. Single degree of freedom spring mass system – Determination of natural frequency.
10. Determination of torsional natural frequency of single and double rotor systems- Undamped and Damped natural frequencies
11. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads
12. Balancing of rotating masses and balancing of reciprocating masses
13. Transverse vibration of Free-Free beam – with and without concentrated masses
14. Determination of transmissibility ratio using vibrating table

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 knowledge about kinematics models.

CO2: Determine the mass moment of inertia of dynamic bodies.

CO3: Do the experiment on gyroscopic concepts and governors.

CO4: Construct the cam profile and determine the natural frequency of vibrating systems.

CO5: Determine the transmissibility ratio for forced vibrations systems.

19CAHS004 PROFESSIONAL ETHICS IN ENGINEERING SEMESTER VI

L	T	P	C
3	0	0	3

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. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
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. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics –

Concepts and Cases", Cengage Learning, 2009.
5. John R. Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
6. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility," Mc Graw Hill education, India Pvt.
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.

19MEPC602 **HEAT AND MASS TRANSFER** **SEMESTER VI**

(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. Kothandaraman C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2006.
3. Holman J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000.
4. Sachdeva R.C., "Fundamentals of Engineering Heat & Mass Transfer", New Age International Publishers, 2009.
5. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015.

6. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 6th Edition, 2006.
7. Nag P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 3rd Edition, 2011.

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.

19MEPC603 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 study power transmitting and power controlling elements.

UNIT-I: DESIGN OF POWER TRANSMISSION ELEMENTS 9

Selection of ropes, Flat belt – V belt – Ribbed V belt – Selection of chains and sprockets – Ratchet and pawl mechanism.

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 crossed – Helical gears.

UNIT-III: BEVEL AND WORM GEARS 9

Straight bevel gear: Tooth terminology, Tooth forces and stresses, Equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, Materials – Forces and stresses, Efficiency, estimating the size of the worm gear pair.

UNIT-IV: 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: CAMS, CLUTCHES AND BRAKES 9

Cam Design: Types – Pressure angle and under cutting base circle determination – Forces and surface stresses. Design of plate clutches – Axial clutches – Cone clutches – Internal expanding rim clutches – Electromagnetic clutches. Band and Block brakes – External shoe brakes – Internal expanding shoe brake.

Contact periods:

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

REFERENCES:

1. Bhandari V., "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 5th Edition, Wiley, 2011.
4. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.
5. Orthwein W., "Machine Component Design", Jaico Publishing Co, 2013.
6. Sundararajamoorthy T.V, Shanmugam N., "Machine Design", Anuradha Publications, Chennai, 2015.

7. Prabhu T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.

COURSE OUTCOMES:

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

CO1: Select flexible transmission elements for machinery and equipments.

CO2: Understand kinematics of gears and can design spur and helical gears for engineering use.

CO3: Understand kinematics of gears and can design bevel and worm gears for engineering use.

CO4: Design and develop gear box for various machinery and equipments.

CO5: Design Cams, friction clutches and brake components.

19MEPC604 FINITE ELEMENT ANALYSIS SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT-I: RELEVANCE OF FEM 9

Historical background – Basic concept of FEM – Discretization of 1D, 2D and 3D Domains, mesh refinement, Convergence requirements – Gradient and divergence theorems – Boundary and initial value problems.

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 – Buckling of columns.

UNIT-IV: TWO DIMENSIONAL PROBLEMS 9

Derivation of shape functions for CST and LST triangular and rectangular elements, Stiffness Matrices and force vectors – Pascal's triangle- concept of plane stress and plane strain and Axisymmetry – Structural and heat transfer application – Introduction to coupled field analysis.

UNIT-V: HIGHER ORDER ELEMENTS 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Jacobian transformation – Serendipity and Lagrangian elements – Numerical integration – Matrix solution techniques.

Contact periods:

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

REFERENCES:

1. Reddy J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005.
2. J Seshu P., "Textbook of Finite Element Analysis", Prentice Hall of India, 2003.
3. Rao S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2010.
4. Logan D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 5th Edition, 2011.
5. David V.Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Inc, Newyork, 2004.
6. Chandrupatla and Belagundu, "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall College Div, 2011.

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 structural and heat transfer problems.

CO4: Analyze two dimensional problems in mechanical engineering.

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

19MEEE605	DESIGN AND FABRICATION PROJECT	SEMESTER VI

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

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 mechanical engineering.

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.

19MEPC606 HEAT TRANSFER LABORATORY SEMESTER VI

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To learn the heat transfer phenomena and predict the relevant coefficient.
- To study the concepts of heat transfer with convective mode in engineering components.
- To determine the thermal conductivity and heat transfer coefficient through various materials.
- 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 this course, the student will be able to

CO1: Evaluate heat transfer coefficients for natural and forced convection.

CO2: Determine thermal conductivity and heat transfer coefficient in various materials.

CO3: Conduct the performance tests on heat exchangers.

CO4: Conduct the performance tests on refrigeration and Air conditioning systems.

CO5: Conduct the performance test on reciprocating air compressor.

19MEPC607 COMPUTER AIDED MACHINING LABORATORY SEMESTER VI

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To study the CNC programming codes.
- To write the part programmes for CNC turning and machining centre.
- To know the applications of various CNC machines like CNC lathe, CNC vertical machining centre.

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. CL Data and Post process generation using CAM packages
    10. Application of CAPP in Machining and Turning Centre

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: Understand the CNC part programming codes.

CO2: Develop manual part programs for CNC machining centre.

CO3: Develop manual part programs for CNC turning centre.

CO4: Make the components using codes in CNC turning and machining centre.

CO5: Generate CNC program for turning and milling component using CAM packages.

19CAHS005 TOTAL QUALITY MANAGEMENT SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the basic concept of TQM.
- To understand the quality management principles.
- To analyze the TQM tool.
- To learn the tools and techniques of quality management to manufacturing.
- To introduce the quality systems.

UNIT-I: INTRODUCTION 9

Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, and Customer retention – Cost of Quality.

UNIT -II: TQM PRINCIPLES 9

Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circle – Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT-III: TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT-IV: TQM TOOLS AND TECHNIQUES II 9

Control Charts – Process Capability – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

UNIT-V: QUALITY MANAGEMENT SYSTEM 9

Need for ISO 9000 – ISO 9000 – 2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in Manufacturing and Service Sector

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

REFERENCES:

1. Dale H.Besterfiled, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

4. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
5. ISO 9001-2015 standards.

COURSE OUTCOMES:

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

CO1: Understand the quality concepts and philosophies of TQM.

CO2: Apply TQM principles and concepts of continuous improvement.

CO3: Explain quality tools, management tools and statistical fundamentals to improve quality.

CO4: Clarify the TQM tools as a means to improve quality.

CO5: Remember the quality systems and procedures adopted.

19MEPC702 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. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International 4th Edition, 2012.
2. Bolton, "Mechatronics", Prentice Hall, 2008
3. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Prentice Hall, 2013
4. Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
5. Smaili.A and Mrad.F , "Mechatronics Integrated Technologies for Intelligent Machines",

Oxford University Press, 2008
6. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2nd 2010.
7. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.

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 the concept of peripheral interface.

CO4: Explain architecture of PLC.

CO5: Solve simple problems using mechatronics system.

19MEPC703 MECHATRONICS LABORATORY SEMESTER VII

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & Pneumatic Systems which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modeling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Study of PLC and its applications.
9. Study of image processing technique

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: Write ALP Programmes for Arithmetic operations using microprocessor.

CO2: Interface different I/Os with processor.

CO3: Study of various types of transducers.

CO4: Implementation of hydraulic, pneumatic and electro-pneumatic circuits.

CO5: Simulate basic operations using PLC.

19MEPC704 SIMULATION AND ANALYSIS LABORATORY SEMESTER VII

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS

A. SIMULATION:

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables.
2. Use of MATLAB to solve simple problems in vibration.
3. Mechanism Simulation using Multibody Dynamic software.

B. ANALYSIS

1. Force and stress analysis in trusses
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axisymmetric component.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Modal analysis of beams.
9. Harmonic and transient analysis of simple systems

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: Simulate the simple system using MATLAB software tools.

CO2: Perform the force, deflection and stress analysis on one dimensional problems using analysis software tools.

CO3: Perform the stress analysis on simple two 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.

19MEEE705 **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.

19MEEE801 **PROJECT WORK** **SEMESTER VIII**

L	T	P	C
0	0	16	8

COURSE OBJECTIVES:

- Opportunity to apply the knowledge learned throughout the program.
- Undertake problem identification, formulation and solution.
- Facilitate technical, project management and presentation spheres.
- Work cooperatively in small team environment.
- 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.

19MEPE501 COMPOSITE MATERIALS SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

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

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.

19MEPE502 DESIGN FOR MANUFACTURE AND ASSEMBLY SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Understand modern manufacturing operations their capabilities, limitations and how to design for lowest cost.
- Gain insight into how designers influence manufacturing schedule and cost.
- Learn how to analyze products and able to improve their manufacturability and lower costs.
- Understand the relationship between customer desires, functional requirements, 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, chart. 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. Matousek R., "Engineering Design" Blackie and Son Limited, Glasgow, 2015.
2. Dieter G.E., "Engineering Design: A Materials and processing Approach", McGraw Hill Co. Ltd, 5th Edition, 2012.
3. Eggert R.J., "Engineering Design" Pearson Education, Inc. New Jersey, 2014.
4. Peck H., "Designing for Manufacture", Pitman Publications, London, 2013.
5. Kalandar Saheb S.D and Prabhakar O., "Engineering Design for Manufacture", ISPE 2014.
6. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, "Product design for manufacture and assembly", 2nd Edition, Taylor and Francis 2019.

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. Prepare project or report to illustrate applied DFM principles per an example from industry.

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

19MEPE503 DESIGN OF JIGS, FIXTURES & PRESS TOOLS SEMESTER V

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the functions and design principles of Jigs, fixtures and press tools.
- To gain proficiency in the development of required views of the final design.

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.

Note:
(Use of P S G Design Data Book is permitted in the University examination)

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

REFERENCES:

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

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.

19MEPE504 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.

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), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

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, 13th Edition 2014.
2. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012
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, 2012.
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: Summarize the various fuel injection, ignition and electrical systems of an automobile.

CO3: Describe the working principle of various components in transmission systems.

CO4: Discuss the various steering mechanisms and suspension systems.

CO5: Discuss the usage of various alternate energy sources in automobiles.

19MEPE601 **LEAN SIX SIGMA** **SEMESTER VI**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain insights about the importance of lean manufacturing and six sigma practices.

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 – Assessment questions.

UNIT-II: THE SCOPE OF TOOLS AND TECHNIQUES 9

Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, TRIZ innovative problem solving – Tools for improvement – 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 – Stakeholder.

UNIT-IV: SIX SIGMA IMPLEMENTATION AND CHALLENGES 9

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

UNIT-V: EVALUATION AND CONTINUOUS IMPROVEMENT METHODS 9

Evaluation strategy – The economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – Continuous improvement – Lean manufacturing – Value, customer focus, Perfection, focus on waste, overproduction – Waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen– 5S.

Contact periods:

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

REFERENCES:

1. Michael L.George, David Rownalds, Bill Kastle, “What is Lean Six Sigma”, McGraw – Hill 2003.
2. Thomas Pyzdek, “The Six Sigma Handbook”, McGraw-Hill, 2000.

3. Fred Soleimannejed, “Six Sigma, Basic Steps and Implementation”, AuthorHouse, 2004.
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, “Managing Six Sigma: A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success”, John Wiley & Sons, 2000.
5. James P. Womack, Daniel T.Jones, “Lean Thinking”, Free Press Business, 2003.

COURSE OUTCOMES:

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

CO1: Understand the Lean flow and six sigma concepts.

CO2: Relate the tools and techniques of lean six sigma to increase productivity.

CO3: Collect relevant data to define the processes.

CO4: Apply the six sigma tools and techniques.

CO5: Apply six sigma concepts in industries for continuous improvement.

19MEPE602 AUTOMATION IN MANUFACTURING SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on automation of Plant Layout, Production concepts and mathematical models.
- To learn about analysis of automated flow lines, assembly systems and line balance.
- To learn about automation of material handling systems.

UNIT-I: FUNDAMENTALS OF MANUFACTURING AUTOMATION 9

Basic Principles of automation, types of automated systems, degrees of automation, automation reasons, Production operations and automation strategies, Plant Layout, Production concepts and mathematical models, design the parts for automation, Automatic loading systems.

UNIT-II: HIGH VOLUME PRODUCTION SYSTEMS 9

Automated flow lines. Methods of work flow, transport transfer mechanism buffer storage, Control functions, Automation for machining operations Design and fabrication considerations.

UNIT-III: ANALYSIS OF AUTOMATED FLOW LINES 9

Analysis of transfer lines without storage, partial automation automated flow lines with storage buffers implementing of automatic flow lines, Line balancing problems, Considerations in assembly line design.

UNIT-IV: ASSEMBLY SYSTEMS AND LINE BALANCE 9

Manual assembly lines, line balancing problem, methods of line balancing, ways to improve line balancing, flexible manual assembly lines, automated assembly systems, analysis of multi station assembly, manufacturing Cells, Automated Cells, Analysis of single station cells.

UNIT-V: AUTOMATED MATERIAL HANDLING 9

Types of equipment and functions, design and analysis of material handling system, conveyor system. Automated guided vehicle system, components operation, types, design of automated guided vehicles and applications. Automated storage and Retrieval systems, types, basic components and applications. Transfer lines, Design for Automated Assembly, Partial Automation, Communication Systems in Manufacturing.

Contact periods:

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

REFERENCES:

1. Mikel P.Grower, "Automation, Production Systems and CIM", PHI Pvt, Ltd, 2012.
2. Radha Krishan P, Subrahamanyan S and Raju "CAD/CAM/CIM", New Age International Pub, 2003.
3. Singh, "System Approach to Computer Integrated Design and manufacturing", John Wiely, 1996.
4. American Soc. For Metals, Metals Handbook, 10th Edition, Vol. 15, on Metal Forming,

ASM, Metals Park, Ohio, 1989.
5. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/ 2009.

COURSE OUTCOMES:

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

CO1: Develop an understanding for the major automation theories, approaches and methodologies used in manufacturing.

CO2: Build up the skills in the actual implementation of automation methods.

CO3: Demonstrate the use of different sensors for automation.

CO4: Design automation systems for a given application.

CO5: Understand the circuit optimization techniques.

19MEPE603 WELDING TECHNOLOGY SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the welding processes, understanding of inspection methods of welded products and also helps to know the material considerations of this operation.

UNIT-I: GAS, ARC AND RESISTANCE WELDING PROCESSES 9

Classification and characteristics – Welding processes and Methods – Gas Welding – Gas welding equipments, flame characteristics – Arc welding processes – SMAW – Electrodes – Gas metal arc welding – Flux cored arc welding – Submerged arc welding – GTAW – Principles of Resistance welding – Spot Welding – Seam welding, Seamless welding – Percussion welding.

UNIT-II: SPECIAL WELDING PROCESSES 9

Ultrasonic welding – Explosive welding – Diffusion welding – Friction welding – Plasma – Transferred welding – Electron beam welding – Laser beam welding – Friction stir welding – Allied welding processes – Brazing and Soldering.

UNIT-III: WELDING METALLURGY 9

Weld thermal cycles – Heat Affected Zone (HAZ) – Weldability of carbon steels, Cast Iron, Stainless steel, aluminum and its alloys, Copper, Titanium alloys, low alloy steels and Magnesium – Hydrogen embrittlement – Pro and post weld heat treatments.

UNIT-IV: WELDING OF SIMILAR AND DISSIMILAR METALS 9

Welding similar and dissimilar metals – Welding of ceramics, composites, micro welding of thin components – Defects in weldments, mechanism – Reasons and remedies of cold cracking – Hot cracking – Reheated cracking and lamellar tearing.

UNIT-V: DESIGN OF WELD JOINTS, WELDABILITY, INSPECTION AND TESTING OF WELDMENTS 9

Design of weld joints and problems – Welding symbols – Testing of welds – Quality in weldment – Weldability assessment and weldability tests – Destructive and NDT evaluation of weldments – Procedure for destructive testing – Tensile, bending and toughness tests – Magnetic particle test – X Ray, gamma, ultrasonic and acoustic tests.

Contact periods:

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

REFERENCES:

1. Parmer R.S., “Welding Engineering & Technology”, Khanna Publishers, New Delhi, 2007.
2. Nadkarni S.V., “Modern Arc Welding Technology”, South Asia Books, 2008.
3. Little R.L., “Welding and welding Technology”, Tata McRaw Hill Publishing Co., Ltd., New Delhi, 2008.
4. Davis A.C., “The Science and Practice of Welding”, Cambridge University Press, Cambridge, 2010.
5. O.P.Khanna, “Welding Technology”, Dhanpat Rai and sons, 2011.

COURSE OUTCOMES:

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

CO1: Provide the principle of the welding process for joints production to the machine products.

CO2: Operate the latest and special welding process for uncommon new and specialized components.

CO3: Evaluate the physical and chemical properties change due to the welding.

CO4: Join the different dissimilar materials as per the requirements.

CO5: Inspect the quality of welded portion of machine component.

19MEPE604 MICRO ELECTRO MECHANICAL SYSTEM SEMESTER VI

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To study the various concepts of sensors, actuators and the different materials used for MEMS.
- To educate the applications of MEMS in Mechanical engineering.

UNIT-I: INTRODUCTION 9

Intrinsic characteristics of MEMS – Energy domains and transducers – Sensors and actuators – Introduction to Micro fabrication – Silicon based MEMS processes – New materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending – Torsional deflection.

UNIT-II: SENSORS AND ACTUATORS 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated finger capacitor – Comb drive devices – Micro Grippers – Micro motors – Thermal sensing and actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Applications – Magnetic actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators – Actuation using shape memory alloys.

UNIT-III: SENSORS AND ACTUATORS-II 9

Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – Piezoelectric effects – Piezoelectric materials – Applications to Inertia, Acoustic, Tactile and flow sensors.

UNIT-IV: MICROMACHINING 9

Silicon anisotropic etching – Anisotrophic wet etching – Dry etching of Silicon – Plasma etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas phase etchants – Case studies – Basic surface micro machining processes – Structural and sacrificial materials – Acceleration of sacrificial etch – Striction and antistriction methods – LIGA process – Assembly of 3D MEMS – Foundry process

UNIT-V: POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS – Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application to acceleration, Pressure, Flow and tactile sensors – Optical MEMS – Lenses and mirrors – Actuators for active optical MEMS.

Contact periods:

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

REFERENCES:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D. Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
4. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
5. Mohamed Gad-el-Hak, Editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
6. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD, 2002.
7. James J. Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2005.
8. Thomas M. Adams and Richard A. Layton, "Introduction MEMS, Fabrication and Application", Springer, 2010.

COURSE OUTCOMES:

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

CO1: Understand and apply the basic science and concepts of MEMS.

CO2: Understand the linear and digital electronic circuits, sensors and actuators.

CO3: Analyze the linear and digital electronic circuits, sensors and actuators.

CO4: Understand micromachining process like Bulk, surface and LIGA.

CO5: Understand the use of polymers and optical MEMS.

19MEPE701 POWER PLANT ENGINEERING SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide an overview of power plants and detailing the role of Mechanical Engineers in their operation and maintenance.

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), CANada deuterium- Uranium reactor (CANDU) Nuclear power plants.

UNIT-IV: POWER FROM RENEWABLE ENERGY 9

Hydro electric power plants, Principle, Construction and working of wind, Tidal, Solar Photo Voltaic (SPV), Solar thermal, 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. Nag P K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. El-Wakil M M., "Power Plant Technology", Fifth Edition Tata McGraw – Hill Publishing Company Ltd., 2013.
3. Black & Veatch, Springer, "Power Plant Engineering", 1996.
4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", 2nd Edition, Standard Handbook of McGraw – Hill, 1998.
5. 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.

19MEPE702 VIBRATION AND NOISE CONTROL SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components.

UNIT-I: BASICS OF VIBRATION 9

Introduction, Classification of vibration: Free and forced vibration, Undamped and damped vibration, Linear and non linear vibration, Response of damped and undamped systems under harmonic force, Analysis of single degree and two degree of freedom systems, Torsional vibration, Determination of natural frequencies.

UNIT-II: BASICS OF NOISE 9

Introduction, Amplitude, Frequency, Wavelength and sound pressure level, Addition, Subtraction and averaging decibel levels, Noise dose level, legislation, Measurement and analysis of noise, Measurement environment, Equipment, Frequency analysis, Tracking analysis, Sound quality analysis.

UNIT-III: AUTOMOTIVE NOISE SOURCES 9

Noise Characteristics of engines, Engine overall noise levels, Assessment of combustion noise, Assessment of mechanical noise, Engine radiated noise, Intake and exhaust noise, Engine necessary contributed noise, Transmission noise, Aerodynamic noise, Tire noise, Brake noise.

UNIT-IV: CONTROL TECHNIQUES 9

Vibration isolation, Tuned absorbers, Un-tuned viscous dampers, Damping treatments, Application dynamic forces generated by IC engines, Engine isolation, Crank shaft damping, Modal analysis of the mass elastic model shock absorbers.

UNIT-V: SOURCE OF NOISE AND CONTROL 9

Methods for control of engine noise, Combustion noise, Mechanical noise, Predictive analysis, Palliative treatments and enclosures, Automotive noise control principles, Sound in enclosures, Sound energy absorption, Sound transmission through barriers.

Contact periods :

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

REFERENCES:

1. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 2st Editon, Cengage Learning, 2009.
2. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007.
3. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book", 2nd Edition, SAE International, 1999.
4. David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice", 4th Edition, E and FN Spon, Taylore & Francise e-Library, 2009.
5. Grover G T., "Mechanical Vibrations", Nem Chand and Bros., 2009.
6. Singiresu S. Rao, "Mechanical Vibrations", 6th Edition, Pearson Education, 2016.

COURSE OUTCOMES:

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

CO1: Understand the basics of vibration.

CO2: Understand the basics of noise.

CO3: Explain the sources of automotive noise.

CO4: Discuss the control techniques for vibration.

CO5: Describe the sources of noise and control.

19MEPE703 ENTREPRENEURSHIP DEVELOPMENT SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT-I: ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic growth, Factors affecting Entrepreneurial growth.

UNIT-II: MOTIVATION 9

Major motives influencing an entrepreneur – Achievement motivation training, Self rating, Business games, Thematic apperception test – Stress management, Entrepreneurship development programs – Need, Objectives.

UNIT-III: BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership structures – Project formulation – Steps involved in setting up a business – Identifying, selecting a good business opportunity, Market survey and research, Techno economic feasibility assessment – Preparation of preliminary project reports – Project appraisal – Sources of information – Classification of needs and agencies.

UNIT-IV: FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term loans, Capital structure, Financial institution, Management of working Capital, Costing, Break even analysis, Taxation – Income Tax, Excise duty – Sales tax.

UNIT-V: SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and consequences, Corrective measures – Business incubators – Government Policy for small scale enterprises – Growth strategies in small industry – Expansion, Diversification, Joint venture, Merger and sub contracting.

Contact periods:

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

REFERENCES:

1. Khanka. S S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Ram Chandran, "Entrepreneurial Development" Tata McGraw Hill, New Delhi, 2008.
3. Hisrich R D & Peters M P., "Entrepreneurship" 10th Edition, Tata McGraw-Hill, 2018.
4. Badhai B., "Entrepreneurship for Engineers" Dhanpat Rai & Co (P) Ltd, 2103.
5. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.

COURSE OUTCOMES:

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

CO1: Estimate the level of knowledge request to be an entrepreneur and to understand the role of entrepreneurship to the country economic growth.

CO2: Analyze the various motivational and leadership theories.

CO3: Know the role of creativity in entrepreneurial development and to develop business models.

CO4: Predict financial needs and source of financial based on market research.

CO5: Summarize knowledge on managing the industry for growth and expansion.

19MEPE704 THERMAL TURBO MACHINES SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT-I: PRINCIPLES 9

Energy transfer between fluid and rotor – Classification of fluid machinery – Dimensionless parameters – Specific speed – Applications – Stage velocity triangles – Work and efficiency.

UNIT-II: CENTRIFUGAL FANS AND BLOWERS 9

Types – Stage and design parameters – Flow analysis in impeller blades – Volute and diffusers, losses, – Characteristic curves and selection, fan drives and fan noise.

UNIT-III: CENTRIFUGAL COMPRESSOR 9

Construction details, Impeller flow losses, slip factor, Diffuser analysis, Losses and performance curves.

UNIT-IV: AXIAL FLOW COMPRESSOR 9

Stage velocity diagrams, Enthalpy – Entropy diagrams, Stage losses and efficiency, Work done simple stage design problems and performance characteristics.

UNIT-V: AXIAL AND RADIAL FLOW TURBINES 9

Stage velocity diagrams, Reaction stages, Losses and coefficients, Blade design principles, Testing and performance characteristics.

Contact periods:

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

REFERENCES:

1. Ganesan, V., "Gas Turbines", Tata McGraw Hill Pub. Co., Third Edition, 2010.
2. Yahya S H., Turbines, Compressor and Fans, Tata McGraw Hill Publishing Company, 2nd 2003.
3. Gopalakrishnan G and Prithvi Raj D., "A Treatise on Turbo Machines", SciTech Publications (India) Pvt. Ltd., 2002.
4. Earl Logan Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1995.
5. Dixon S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 2005.
6. Shepherd D.G., "Principles of Turbomachinery", Macmillan, 1995.

COURSE OUTCOMES:

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

CO1: Understand the principles of thermal turbo machines.

CO2: Discuss the design of centrifugal fans and blowers.

CO3: Understand the concept of centrifugal compressor.

CO4: Illustrate the velocity diagram of axial flow compressor.

CO5: Explain the stages of axial and radial flow turbines.

19MEPE705 REFRIGERATION AND AIR CONDITIONING SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems.

UNIT-I: INTRODUCTION 9

Introduction to Refrigeration – Unit of Refrigeration and C.O.P. – Ideal cycles – Refrigerants desirable properties – Classification – Nomenclature – ODP & GWP.

UNIT-II: VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

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

UNIT-III: OTHER REFRIGERATION SYSTEMS 9

Working principles of vapour absorption systems and adsorption cooling systems – Steam jet refrigeration – Ejector refrigeration systems – Thermoelectric refrigeration – Air refrigeration – Magnetic – Vortex and Pulse tube refrigeration systems.

UNIT-IV: PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT-V: AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, Internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, Effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, 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. Roy J. Dossat, "Principles of Refrigeration", 4th Edition, Pearson Education Asia, 2009,
3. ASHRAE Hand book, Fundamentals, 2010.
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.

19MEPE706 GAS DYNAMICS AND JET PROPULSION SEMESTER VII

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. Anderson J D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2012.
2. Yahya S M., "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2002.
3. Cohen. H, Rogers G E C and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd., 1980.
4. Ganesan V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
5. Shapiro A.H.," Dynamics and Thermodynamics of Compressible Fluid Flow", John wiley, New York, 1953.
6. Sutton G P., "Rocket Propulsion Elements", John wiley, New York, 2010.
7. Zucrow N J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.

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.

19MEPE707 **DESIGN OF HEAT EXCHANGERS** **SEMESTER VII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the thermal and stress analysis on various parts of the heat exchangers.
- To analyze the sizing and rating of the heat exchangers for various applications.

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: PROCESS DESIGN OF HEAT EXCHANGERS **9**

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

UNIT-III: 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-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. Sadik Kakac and Hongtan Liu, “Heat Exchangers Selection, Rating and Thermal Design”, CRC Press, 2002.
2. Shah R K and Dušan P. Sekulić, “Fundamentals of Heat Exchanger Design”, John Wiley & Sons, 2003.
3. Robert W. Serth, “Process Heat Transfer Principles and Applications”, Academic press, Elesevier, 2007.
4. John E. Hesselgreaves, “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: Understand the design concepts of shell and the tube Heat exchangers.

CO3: Apply the mathematical knowledge for thermal and stress analysis on Heat exchangers components.

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

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

19MEPE708 UNCONVENTIONAL MACHINING PROCESS SEMESTER VII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.

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 - Equipments – 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 – Equipments – 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, Equipments, effect of process parameters, Applications, Advantages and limitations.

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

Recent developments in non-traditional machining processes, Their working principles, equipments, 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. Benedict G F., “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.
4. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.

5. 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.

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.

19MEPE801 DESIGN OF PRESSURE VESSELS AND PIPING SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the industrial related problems, procedures and design principles for pressure vessels and enhance the understanding of design procedure of pressure vessel and design of piping layout.

UNIT-I: INTRODUCTION 9

Methods for determining stresses – Terminology and ligament efficiency – Applications.

UNIT-II: STRESSES IN PRESSURE VESSELS 9

Introduction – Stresses in a circular ring, cylinder – Membrane stress analysis of vessel shell components – Cylindrical shells, Spherical sheels, Torispherical heads, Conical heads – Thermal stresses – Discontinuity stresses in pressure vessels.

UNIT-III: DESIGN OF VESSELS 9

Design of tall cylindrical self supporting process columns – Supports for short vertical vessels – Stress concentration – At a variable thickness transition section in a cylindrical vessel, about a circular hole, Elliptical openings. Theory of reinforcement – Pressure vessel design.

UNIT-IV: BUCKLING AND FRACTURE ANALYSIS IN VESSELS 9

Buckling phenomenon – Elastic buckling of circular ring and cylinders under external pressure – Collapse of thick walled cylinders or tubes under external pressure – Effect of supports on elastic buckling of cylinders – Buckling under combined external pressure and axial loading – Control and significance of fracture mechanics in vessels – FEM application.

UNIT-V: PIPING 9

Introduction – Flow diagram – Piping layout and piping stress analysis.

Contact periods:

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

REFERENCES:

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 2007.
2. Stanley and Wales M., "Chemical Process Equipment, Selection and Design. Buterworths Series in Chemical Engineering", 1990.
3. William J and Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1997.

COURSE OUTCOMES:

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

CO1: Illustrate the basics of stresses and applications.

CO2: Analyze the stresses in pressure vessels.

CO3: Illustrate the design concepts of piping.

CO4: Calculate the buckling and fracture analysis in vessels.

CO5: Explain the Piping layout and piping stress analysis.

19MEPE802 ADDITIVE MANUFACTURING SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the principle, methods, possibilities and limitations as well as environmental effects of Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing technologies.

UNIT-I: INTRODUCTION 9

Overview – Need – Development of additive manufacturing technology – Principle – AM Process chain – Classification – Rapid prototyping – Rapid tooling – Rapid manufacturing – Applications & benefits – Case studies.

UNIT-II: DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing – CAD model preparation – Part orientation and support structure generation – Model slicing – Tool path generation- Design for additive manufacturing: Concepts and objectives – AM unique capabilities – DFAM for part quality improvement – Customised design and fabrication for medical applications.

UNIT-III: PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA – Photo curable materials – Process – Advantages and applications. Powder bed fusion: SLS – Process description – Powder fusion mechanism – Process parameters – Typical materials and application. Electron beam melting.

UNIT-IV: EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion based system: FDM – Introduction – Basic principle – Materials – Applications and limitations – Bioextrusion. Sheet lamination Process : LOM – Gluing or adhesive bonding – Thermal bonding.

UNIT-V: PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies – Continuous mode – Drop on demand mode – Three dimensional printing – Advantages – Bioplotter – Beam deposition process: LENS – Process description – Material delivery – Process parameters – Materials – Benefits – Applications.

Contact periods:

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

REFERENCES:

1. Chua C K, Leong K F and Lim C S., "Rapid Prototyping: Principles and Applications", 3rd Edition, World Scientific Publishers, 2010.
2. Ian Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
3. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication 2011.
4. Kamrani A K and Nasr E A., "Rapid Prototyping: Theory and Practice", Springer, 2006.
5. Liou L W and Liou F W., "Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development", CRC Press, 2019.
6. Tom Page "Design for Additive Manufacturing", LAP Lambert Academic Publishing, 2012.

COURSE OUTCOMES:

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

CO1: Develop knowledge on additive manufacturing technology and their applications.

CO2: Understand the concepts of design for additive manufacturing.

CO3: Analyse the suitable photo polymerization and powder bed fusion processes.

CO4: Develop the concepts in extrusion based and sheet lamination processes.

CO5: Understand the Printing processes and beam deposition processes.

19MEPE803 **COMPUTER INTEGRATED MANUFACTURING SYSTEMS** **SEMESTER VIII**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the application of computers in various aspects of manufacturing viz., Design, proper planning, Manufacturing cost, layout & material handling system.
- To obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.
- To describe the integration of manufacturing activities into a complete system.

UNIT-I: INTRODUCTION **9**

Brief introduction to CAD and CAM – Manufacturing planning, Manufacturing control – Introduction to CAD/CAM – Concurrent Engineering – CIM concepts – Computerised elements of CIM system – Types of production – Manufacturing models and metrics – Mathematical models of production performance – Simple problems – Manufacturing control – Simple problems – Basic elements of an automated system – Levels of automation – Lean production and Just-In-Time production.

UNIT-II: PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING **9**

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate production planning and the master production schedule – Material requirement planning – Capacity planning – Control systems - Shop floor control – Inventory control – Brief on manufacturing resource planning – II (MRP-II) & Enterprise Resource Planning (ERP) – Simple problems.

UNIT-III: CELLULAR MANUFACTURING **9**

Group Technology(GT), Part families – Parts classification and coding – Simple problems in opitz part coding system – Production flow analysis – Cellular manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in cellular manufacturing – Rank order clustering method – Arranging machines in a GT cell – Hollier method – Simple problems.

UNIT-IV: FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) **9**

Types of flexibility – FMS – FMS components – FMS application & benefits – FMS planning and control – Quantitative analysis in FMS – Simple problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle guidance technology – Vehicle management & safety.

UNIT-V: INDUSTRIAL ROBOTICS **9**

Robot anatomy and related Attributes – Classification of Robots – Robot control systems – End effectors – Sensors in Robotics – Robot accuracy and repeatability – Industrial Robot applications – Robot part programming – Robot accuracy and repeatability – Simple problems.

Contact periods:

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

REFERENCES:

1. Mikell P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2019.
2. Radhakrishnan P, Subramanyan S and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2009.
3. Kant Vajpayee S., "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
4. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 2003.
5. Rao P N Tewari and Kundra T K., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2008.

COURSE OUTCOMES:

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

CO1: Develop and understand the CAD/CIM Systems of graphical modeling concepts.

CO2: Acquire knowledge on data bases and numerical analysis related to CIM.

CO3: Prepare logic diagram for differentiate application of automation techniques.

CO4: Identify application of PPC, JIT, MRPI, MRP-II, and Expert system to CAM.

CO5: Describe Robot for preliminary industrial applications like pick and place.

19MEPE804 MAINTENANCE ENGINEERING SEMESTER VIII

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 explain the different maintenance categories like Preventive maintenance, condition monitoring, repair of machine elements and material handling equipments.

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. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 2006.
2. Venkataraman K., "Maintenance Engineering and Management", PHI Learning Pvt. Ltd. 2010.
3. Bhattacharya S N., "Installation, Servicing and Maintenance", S. Chand and Co., 2013.
4. White E N., "Maintenance Planning", I Documentation, Gower Press, 1979.
5. Garg M R., "Industrial Maintenance", S. Chand & Co., 1987.
6. Higgins L R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1994.

COURSE OUTCOMES:

Upon completion of this course, the students 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.

19MEPE805 ADVANCED FINITE ELEMENT ANALYSIS SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the advanced finite element analysis techniques with an ability to effectively use the tools of the analysis for solving practical problems arising in engineering design.

UNIT-I: BENDING OF PLATES AND SHELLS 9

Review of elasticity equations – Bending of plates and shells – Finite element formulation of plate and shell elements – Conforming and Non-conforming elements – C0 and C1 continuity elements – Degenerated shell elements – Application and examples.

UNIT-II: NON-LINEAR PROBLEMS 9

Introduction – Iterative techniques – Material non-linearity – Elasto plasticity – Plasticity – Visco plasticity – Geometric non linearity – Large displacement formulation – Solution procedure – Application in metal forming process and contact problems.

UNIT-III: DYNAMIC PROBLEM 9

Direct formulation – Free, Transient and forced response – Solution procedures – Eigen solution – Subspace iterative technique – Response analysis – Houbolt, Wilson, Newmark – Methods – Explicit & Implict methods – Lanchzos, Reduced method for large size system equations.

UNIT-IV: FLUID MECHANICS AND HEAT TRANSFER 9

Governing equations of Fluid Mechanics – Solid structure interaction – Inviscid and incompressible Flow – Potential formulations – Slow non-Newtonian flow – Metal and Polymer forming – Navier Stokes equation – Steady and transient solution.

UNIT-V: ERROR ESTIMATES AND ADAPTIVE REFINEMENT 9

Error norms and convergence rates – h-refinement with adaptivity – Adaptive refinement.

Contact periods:

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

REFERENCES:

1. Bathe K J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1996.
2. Cook R D., "Concepts and Applications of Finite Element Analysis", John Wiley and Sons Inc., New York, 4th Edition 2007.
3. Zienkiewicz O C and Taylor R L., "The Finite Element Method", 4th Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics Services, 2000.
4. Reddy J N., "An introduction to Nonlinear Finite Element Analysis", 1st Indian Edition, Oxford university press 2014.

COURSE OUTCOMES:

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

CO1: Understand the finite element formulation of plate and shell elements and its application.

CO2: Gain knowledge in material & geometric non-and plasticity.

CO3: Solve problems under dynamic conditions by applying various techniques.

CO4: Derive the solutions for fluid mechanics and heat transfer problems.

CO5: Acquire knowledge in error norms, convergence rates and refinement.

19MEPE806 APPLIED HYDRAULICS AND PNEUMATICS SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on various types of hydraulic pumps and actuators.
- To learn about various hydraulic components and its functions.
- To provide knowledge about the selection of hydraulic components.
- To study about various types of pneumatic components and servo systems.
- To learn fluid power circuit design methods and its applications.

UNIT-I: HYDRAULIC PUMPS AND ACTUATORS 9

Introduction to fluid power system – Applications of Pascal's Law – Hydraulic pumps – Pumping theory, classification – Gear pump, Vane pump, piston pump, Lobe pump, Construction and working principles – Fluid power actuators – Single acting, Double acting, cushioning and Telescopic cylinder, Construction and working principles. Gear Motors, Vane motors.

UNIT-II: HYDRAULIC COMPONENTS 9

Direction control valve – Check valve, shuttle valve, 3/2, 4/2 and 4/3 way valve and solenoid valve – Actuation methods. Pressure control valves – Pressure relief valve, compound pressure relief valve, pressure reducing valve, Unloading valve, Sequence valve, counterbalance valve. Flow control valves – Types. Accumulators and intensifier – Types.

UNIT-III: SELECTION OF HYDRAULIC COMPONENTS 9

Selection factors – Selection of pumps. Actuators – Cylinders, motors versus load – Piston rod buckling. Selection of Hydraulic pipe and hoses, valves, reservoir, filters, Accumulators and intensifiers.

UNIT-IV: PNEUMATIC COMPONENTS 9

Compressors – Filter, Regulator, Lubricator (FRL) unit, mufflers. Valves – Direction control valves – Shuttle valve, two way air piloted valve, push button valve, quick exhaust valve, lever control valve and solenoid valve – Pneumatic actuators. Servo system – Hydro mechanical, Electro hydraulic and proportional valve.

UNIT-V: DESIGN OF FLUID POWER CIRCUIT 9

Fluid power circuits – Speed control circuits, Synchronizing circuit, Sequential circuit and design for simple application using cascade and stepper sequencer method. Application of Accumulator and Intensifier circuit.

Contact periods:

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

REFERENCES:

1. Srinivasan R., "Hydraulics and Pneumatics Controls", 3rd Edition, Vijay Nicole imprints Pvt. Ltd., Chennai 2019.
2. Dr. Jayakumar V., "Applied Hydraulics and Pneumatics", Lakshmi Publications, Chennai – 2018.
3. Anthony Esposito, "Fluid power with Applications", Pearson Education, New Delhi, 2011.

4. Majumdar S R., “Oil hydraulics”, Tata McGraw Hill publishing company Pvt. Ltd. New Delhi, 2017.
5. Majumdar S R., “Pneumatic Systems - Principles and Maintenance”, Tata McGraw Hill publishing company Pvt. Ltd., New Delhi, 2017.
6. Ilango S., “Introduction to Hydraulics and Pneumatics”, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
7. Andrew Parr, “Hydraulics and Pneumatics”, Jaico Publishing House, 2011.

COURSE OUTCOMES:

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

CO1: Identify suitable hydraulic pumps and actuators for different applications.

CO2: Choose the suitable hydraulic components for various applications.

CO3: Select the suitable fluid power components for various applications.

CO4: Choose the suitable pneumatic components for different applications.

CO5: Design fluid power circuit for given application.

19MEPE807 ADVANCED I.C. ENGINES SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know about the combustion process in SI engine and CI engine and emissions formation during the combustion cycle and their treatment.
- To study about various types of alternative fuels.
- To study about 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. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
5. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.

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.

19MEPE808 PROCESS PLANNING AND COST ESTIMATION SEMESTER VIII

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about the process planning concepts to make cost estimation for various products after process planning.

UNIT-I: INTRODUCTION TO PROCESS PLANNING 9

Introduction – Methods of process planning – Drawing interpretation – Material evaluation – steps in process selection – Production equipment and tooling selection.

UNIT-II: PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes – Selection jigs and fixtures – Set of documents for process planning – Economics of process planning.

UNIT-III: INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation – Methods of costing – Elements of cost estimation –Types of estimates – Estimating procedure – Estimation labor cost, Material cost – Allocation of over head charges.

UNIT-IV: PRODUCTION COST ESTIMATION 9

Estimation of different types of Jobs – Estimation of forging shop, Estimation of welding Shop, Estimation of foundry shop.

UNIT-V: MACHINING TIME CALCULATION 9

Estimation of machining time – Importance of machine time calculation – Calculation of machining time for lathe operations, Drilling and boring – Machining time calculation for milling and shaping – Machining time calculation for grinding.

Contact periods:

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

REFERENCES:

1. Chitale AV and Gupta R C., "Product Design and Manufacturing", 6th Edition, PHI, 2013.
2. Ostwalal P F and Munez J., "Manufacturing Processes and systems", 9th Edition, JohnWiley, 2008.
3. Russell R S and Tailor B W., "Operations Management", 4th Edition, PHI, 2016.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", 4th Pearson Education 2016.
5. Jain K C and Aggarwal L N., "Production Planning Control and Industrial Management", Khanna Publishers 2002.

COURSE OUTCOMES:

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

CO1: Select the process, equipment and tools for various industrial products.

CO2: Prepare process planning activity chart.

CO3: Explain the concept of cost estimation**.**

CO4: Compute the job order cost for different type of shop floor.

CO5: Calculate the machining time for various machining operations.

19CEOE01 GEOGRAPHICAL INFORMATION SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVE:

- To introduce the fundamentals and components of Geographic Information System.
- To provide details of spatial data structures and input, management and output processes.

UNIT- I: FUNDAMENTALS OF GIS 9

Introduction to GIS – Basic spatial concepts – Coordinate Systems – GIS and Information Systems – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software – Types of data – Spatial, Attribute data – Types of attributes – Scales/ levels of measurements.

UNIT- II: SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – ER diagram – Spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster vs Vector Models – TIN and GRID data models – OGC standards – Data Quality.

UNIT- III: DATA INPUT AND TOPOLOGY 9

Scanner – Raster Data Input – Raster Data File Formats – Vector Data Input – Digitizer – Topology – Adjacency, Connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS – Concept GPS based mapping.

UNIT- IV: DATA ANALYSIS 9

Vector Data Analysis tools – Data Analysis tools – Network Analysis – Digital Education models – 3D data collection and utilization.

UNIT- V: APPLICATIONS 9

GIS Applicant – Natural Resource Management – Engineering – Navigation – Vehicle tracking and fleet management – Marketing and Business applications – Case studies.

Contact periods:

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

REFERENCES:

1. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver and Srinivasa Raju, "An Introduction to Geographical Information Systems", Pearson Education, 2nd Edition, 2007.

COURSE OUTCOMES:

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

CO1: Have basic idea about the fundamentals of GIS.
CO2: Understand the types of data models.
CO3: Get knowledge about data input and topology.
CO4: Gain knowledge on data quality and standards.
CO5: Understand data management functions and data output.

19CEOE02	GREEN BUILDINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project.

UNIT- I: INTRODUCTION **9**

Life Cycle impacts of materials and products – Sustainable design concepts – Strategies of Design for the Environment – The sun-earth relationship and the energy balance on the earth's surface, climate, wind – Solar radiation and solar temperature – Sun shading and solar radiation on surfaces – Energy impact on the shape and orientation of buildings – Thermal properties of building materials.

UNIT- II: ENERGY EFFICIENT BUILDINGS **9**

Passive cooling and day lighting – Active solar and photovoltaic – Building energy analysis methods - Building energy simulation – Building energy efficiency standards – Lighting system design – Lighting economics and aesthetics – Impacts of lighting efficiency – Energy audit and energy targeting – Technological options for energy management.

UNIT- III: INDOOR ENVIRONMENTAL QUALITY MANAGEMENT **9**

Psychrometry – Comfort conditions – Thermal comfort – Ventilation and air quality – Air-conditioning requirement – Visual perception – Illumination requirement – Auditory requirement – Energy management options – Air conditioning systems – Energy conservation in pumps – Fans and blowers – Refrigerating machines – Heat rejection equipment – Energy efficient motors – Insulation.

UNIT- IV: GREEN BUILDING CONCEPTS **9**

Green building concept – Green building rating tools – Leeds and IGBC codes – Material selection Embodied energy – Operating energy – Façade systems – Ventilation systems – Transportation – Water treatment systems – Water efficiency – Building economics.

UNIT- V: GREEN BUILDING DESIGN CASE STUDY **9**

Students to work through a controlled process of analysis and design to produce drawings and models of their own personal green building project. Topics include building form, orientation and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget – Case Study on green construction and design.

Contact periods:

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

REFERENCES:

1. Kibert C., "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2005.
2. Edward G. Pita, "An Energy Approach - Air - Conditioning Principles and Systems", Pearson Education, 2003.
3. Colin Porteous, "The New Eco–Architecture", Spon Press, 2002.

4. Energy Conservation Building Codes: www.bee–india.nic.in.
5. Lever More G J., "Building Energy Management Systems", E and FN Spon, London, 2000.
6. Ganesan T P., "Energy Conservation in Buildings", ISTE Professional Center, Chennai, 1999.
7. John Littler and Randall Thomas, "Design with Energy: The Conservation and Use of Energy in Buildings", Cambridge University Press, 1984.

COURSE OUTCOMES:

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

CO1: Describe the concepts of sustainable design.

CO2: Familiarize with green building techniques including energy efficiency management.

CO3: Understand the indoor environmental quality management in green building.

CO4: Perform the green building rating using various tools.

CO5: Create drawings and models of their own personal green building project.

19CEOE03	PLANNING OF SMART CITIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To have an exposure on development of smart cities considering various fields related and their challenges.

UNIT- I: SMART CITIES DEVELOPMENT POTENTIALS AND CHALLENGES **9**

Perspectives of smart cities: Introduction and overview – Implementation challenges – Methodological issues – Spatial distribution of startup cities – Re imagining post industrial cities – Implementation challenges for establishing smart urban information and knowledge management system.

UNIT- II: ROLE OF ICT, REMOTE SENSING, AND GEOGRAPHICAL INFORMATION SYSTEM **9**

Optimizing green spaces for sustainable urban planning – 3D city models for extracting urban environmental quality indicators – Assessing the rainwater harvesting potential – The strategic role of green spaces – Monitoring urban expansion.

UNIT- III: ENVIRONMENT, ENERGY, DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT **9**

Alternatives for energy stressed cities – Social acceptability of energy – Efficient lighting – Energy management – Urban dynamics and resource consumption – Issues and challenges of sustainable tourism – Green buildings: Eco-friendly technique for modern cities.

UNIT- IV: MULTIFARIOUS MANAGEMENT FOR SMART CITIES **9**

An Assessment of domestic water use practices – An issue of governance in urban water supply – Assessment of water consumption at urban household level – Water sustainability – Socio-economic determinants and reproductive healthcare system – Problems and development of slums.

UNIT- V: INTELLIGENT TRANSPORT SYSTEM **9**

Introduction to Intelligent Transportation Systems (ITS) – The range of ITS applications – Network optimization – Sensing traffic using virtual detectors - In-vehicle routing, and Personal route information – The smart car-commercial routing and delivery – Electronic toll collection – The smart card – Dynamic assignment – Traffic enforcement. urban Mobility and economic development.

Contact periods:

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

REFERENCE:

1. Poonam Sharma and Swati Rajput, “Sustainable Smart Cities in India Challenges and Future Perspectives”, Springer 2017 Co.(P) Ltd. 2013.
2. Ivan Nunes Da Silva, “Rogerio Andrade Flauzino-Smart Cities Technologies” – ExLi4EvA, 2016.
3. Stan McClellan, Jesus A. Jimenez and George Koutitas (eds.), “Smart Cities Applications, Technologies, Standards, and Driving Factors”, Springer International

Publishing, 2018.
4. Stan Geertman, Joseph Ferreira, Jr. Robert Goodspeed and John Stillwell., "Planning Support Systems and Smart Cities" , Springer, 2015.

COURSE OUTCOME:

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

CO1: Identify the potential and challenges in smart city development.
CO2: Apply the different tools for sustainable urban planning.
CO3: Understand the concepts of environment, energy and disaster management.
CO4: Identify the proper methods for water and waste water management.
CO5: Familiarize with the intelligent transport systems.

19CEOE04	VASTU SCIENCE FOR BUILDING CONSTRUCTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To impart basic knowledge of Vastu science and its impact on human well being.

UNIT- I: INTRODUCTION **9**

Traditional definition – Meaning of Vastu and Vaastu - its classification – Relationship to earth – Concept of existence and manifestation – Placatory influence on earth.

UNIT- II: SPACE THEORY IN VASTU **9**

Features of good building site – Good building shapes – Macro, micro, enclosed and material spaces – Relationship between built space, living organism and universe – Impact of built space on human psyche. Flow of energy within built space and outside – Zoning of functional areas – Fitting of components in the building – Significance of water bodies and energy – The cube as the basic structure.

UNIT- III: COSMOGRAM & SETTLEMENT CONCEPTS **9**

Orientation of building, site, layout and settlement – Positive and negative energies – importance of cardinal and ordinal directions – The celestial grid or- mandala and its type. The Vaastu Purusha Mandala and its significance in creation of patterns, and lay-outs, extension of this to aural and visual fields.

UNIT- IV: INTERFACE OF TIME, VIBRATION AND RHYTHM **9**

Theory of vibration and energy transfer – Equation of time and space – Manifestation in living organism – Human beings – Measurement of the energy – Kirlian energy of various forms – Documentation of objects – Filaments and streamers.

UNIT- V: MEASUREMENTS & MATERIALS **9**

Units of measurement – Mana shastra – Ayadi techniques – Tala system and Hasta system of measures – Musical measurements compared to space measurements – Resultant ambience in built space. Use of wood, stone, metal, brick and time – Making technology, corbelling technology, jointing technology – Foundations for heavy and light structures – Landscaping in and around buildings – Aesthetic in Indian Architecture.

Contact periods:

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

REFERENCES:

1. Dr. Prasanna Kumar Acharya, “Manasara”, Oxford1 University Press, (English version), 1927.
2. Subramanya Sastri K.S., “Maya Matam”, Thanjavur Maharaja Sarjoji Saraswathil Mahal Library, Thanjavur, 1966.
3. Stella Kramresh, “The Hindu Temple Vol.1 & II”, Motital Banarsidass Publishers Pvt. Ltd., Delhi, 1994.
4. Bruno Dagens, “ Mayamatam, Vol.1 & IIIGNCA and Motilal Bamarsidars Publishers Pvt. Ltd–s Delhi –1994.
5. George Birdsall – Feng Shui: The Key Concepts , January 2011.

COURSE OUTCOMES:

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

CO1: Obtain exposure on various concepts of Vastu.

CO2: Understand the theories in Vastu.

CO3: familiarize with the Cosmo gram and settlement concepts of Vastu.

CO4: Understand the role of Vasthu in energy flow manifestation in living beings.

CO5: Plan a structure considering various Vastu techniques.

19CEOE05 DISASTER MANAGEMENT AND MITIGATION	L	T	P	C
	3	0	0	3

COURSE OBJECTIVE:

- To give knowledge about basics of disaster management.
- To impart knowledge about Hazards and Vulnerability.
- To give knowledge about mitigation and preparedness.
- To teach about response and recovery.
- To impart knowledge about the participants involved in the disaster management activity.

UNIT- I: INTRODUCTION 9

Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, The Hyogo framework for action, Post 2015 framework, Disaster trends.

UNIT- II: HAZARDS AND RISK VULNERABILITY 9

Hazard identification and hazard profiling, Hazard analysis, Types of hazards – Natural and technological components of risk – Likelihood and consequence, Trends and computation of likelihood and consequence. Risk evaluation – purpose, Risk acceptability Alternatives, Personnel. Political/ social, Economic vulnerability – Physical profile, Social profile, Environmental profile, Economic profile. Factors influencing vulnerability, Risk perception.

UNIT- III: MITIGATION AND PREPAREDNESS 9

Mitigation – Types of mitigation, Obstacles in mitigation, Assessment and selection of mitigation options, Emergency response capacity as incorporating mitigation into development and relief projects. Preparedness – Government preparedness, Public preparedness, Media as a public educator. Obstacles to public education and preparedness.

UNIT- IV: RESPONSE AND RECOVERY 9

Response the Emergency – Pre disaster, post disaster, Provision of water, Food and shelter, Volunteer management, Command, Control and Coordination. Recovery – short term and long term recovery components of recovery – Planning, coordination, information, money and supplies, Allocation of relief funds, personnel. Types of recovery – Government, infrastructure, Debris removal disposal and processing, Environment, housing, economic and livelihood, individual, family and social recovery special considerations in recovery.

UNIT- V: PARTICIPANTS 9

Governmental disaster management agencies – Fire, law, Emergency management, Emergency medical service, Military and other resources. Structures – Local, regional, National. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance. Nongovernmental organizations – Operations, NGO/ military coordination, standard of conduct. The role of private sector and academia. Multilateral organizations – UN agencies and programmers', Regional & International organizations. International financial institutions – The world bank, IMF, ADB, IADB. Special considerations.

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

REFERENCES:

1. Brassard, Caroline, Giles, David W and Howitt, Arnold M., "Natural Disaster Management in the Asia–Pacific", Policy and Governance.
2. "Disaster Management", Global Challenges and Local Solutions, Universities Press, 2009.
3. Jack Pinkowski, "Disaster Management Handbook", CRC Press, January 22, 2008.
4. Disaster Management Guidelines, GOI–UNDP Disaster Risk Reduction Programme (2009 -2012).

COURSE OUTCOMES:

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

CO1: Able to get knowledge about basics of Disaster management.
CO2: Able to impact knowledge about Hazards and vulnerability.
CO3: Able to know about Mitigation and preparedness.
CO4: Able to attain knowledge about response and recovery.
CO5: Able to learn about the participants involved in the disaster management activity.

19CSOE06	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 develope web applications using open source web technologies like Apache, My Sql and PHP (LAMP/XAMP).

UNIT-I: OPEN SOURCE **9**

Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Where I can use 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. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, OReilly Media, 2009.
2. James Lee and Brent Ware ,"Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", , Dorling Kindersley(India) Pvt. Ltd, 2008.
3. 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 completion of this course, the students will be able to

CO1: Differentiate the open source software and commercial software.

CO2: Identify, 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.

19CSOE07	ETHICAL HACKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand numerous methods of real-world information intelligence.
- To learn about vulnerability scanners.
- To understand techniques used to sniff traffic across a network.
- To familiarize with the methodologies that can be used to hack into a target.
- To appreciate the wide variety of attacks that can be performed against a wireless network.

UNIT-I: INTRODUCTION TO HACKING **9**

Terminologies, Categories of penetration test, Writing reports, Structure of a penetration Testing report, Vulnerability assessment summary, Risk assessment, Methodology, Linux basics: File structure, Cron Job, Users, Common applications, Back track, Services.

UNIT-II: INFORMATION GATHERING, TARGET ENUMERATION AND PORT SCANNING TECHNIQUES **9**

Active, Passive and sources of information gathering, Copying Websites locally, Neo Trace, Cheops-ng, Intercepting a response, What Web, Net craft, Basic parameters, Xcode Exploit scanner, Interacting with DNS servers, Fierce, Zone transfer with host command and automation, DNS Cache snooping – Attack scenario, Automating attacks, SNMP – Problem, Sniffing passwords, Solar winds Toolset, Sweep, Brute Force and Dictionary – Tools , Attack, Enumeration, Intelligence gathering using shodan, Target enumeration and Port scanning techniques.

UNIT-III: VULNERABILITY ASSESSMENT & NETWORK SNIFFING **9**

Introduction to vulnerability assessment – Pros and cons, NMap, Updation of database, Testing SCADA environments with Nmap, Nessus, Sniffing: Types, Hubs versus Switches, Modes, MITM attacks, ARP protocol basics – working, Attacks, DoS attacks, Dsniff tool, Using ARP spoof to perform MITM attacks, Sniffing the Traffic with Dsniff, Sniffing pictures with Drifnet, Urlsnarf and Webspy, Sniffing with Wireshark, Ettercap – ARP poisoning, Hijacking session with MITM attack, ARP poisoning with CAIN and Abel, Sniffing session Cookies with Wire shark, Hijacking the session, SSL strip: Stripping HTTPS traffic, Requirements, Automating man in the middle attacks, DNS spoofing, DHCP spoofing.

UNIT-IV: BASICS OF EXPLOITATION **9**

Remote exploitation : Understanding network protocols, Attacking network remote services, Common target protocols, Tools for cracking network remote services, Attacking SMTP, Attacking SQL servers, Client side exploitation methods: E-Mails leading to malicious attachments and malicious links, Compromising client side update, Malware loaded on USB sticks, Post exploitation: Acquiring situation awareness, Privilege escalation, Maintaining access, Data mining, Identifying and exploiting further targets, Windows exploit development basics.

UNIT-V: WIRELESS & WEB HACKING **9**

Wireless hacking : Requirements, Air cracking, Hidden SSIDs, Monitor mode, Monitoring tool – Beacon frames on Wire shark, Airodump-ng, Wireless adapter in monitor mode, Determining the target, Cracking a WPA/WPA2 wireless network Using Air cracking, Capturing packets and Four-Way handshake, Web hacking : Attacking the authentication, Brute force and dictionary attacks, Types of authentication, Crawling restricted links, Testing

for the vulnerability, Authentication bypass with insecure cookie handling, SQL Injection, XSS – DOM based, BeEF, CSRF, Bypassing CSRF and BeEF with XSS, Vulnerability in FCK editor, Efront.

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

REFERENCES:

1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2015.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Media, 2nd Revised Edition, 2013.
3. Michael T. Simpson, Kent Backman, James E. Corley, "Hands On Ethical Hacking and Network Defense", Cengage Learning, 2012.

COURSE OUTCOMES:

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

CO1: Comprehend the basic concepts of hacking.
CO2: Know the core concepts related to malware, hardware and software vulnerabilities and their causes.
CO3: Recognize ethics behind hacking and vulnerability disclosure.
CO4: Appreciate the Cyber Laws and impact of hacking.
CO5: Exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies.

19CSOE08	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand smart objects and IoT architectures.
- To learn about various IoT-related protocols.
- To build simple IoT systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To develop IoT infrastructure for popular applications.

UNIT-I: FUNDAMENTALS OF IoT **9**

Evolution of internet of things –Enabling technologies – IoT architectures: oneM2M, IoT World Forum (IoTWF) and alternative IoT models – Simplified IoT architecture and core IoT functional stack – fog, Edge and cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart objects and Connecting smart objects.

UNIT-II: IOT PROTOCOLS **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 – Application transport methods: Supervisory control and data acquisition – Application layer protocols: CoAP and MQTT.

UNIT-III: DESIGN AND DEVELOPMENT **9**

Design methodology – Embedded computing logic – Microcontroller, System on chips –IoT system building blocks – Arduino – Board details, IDE programming – Raspberry Pi - Interfaces and raspberry Pi with Python programming.

UNIT-IV: DATA ANALYTICS AND SUPPORTING SERVICES **9**

Structured Vs Unstructured data and data in motion Vs data in rest – Role of machine learning – No SQL databases – Hadoop ecosystem – Apache Kafka, Apache spark – Edge streaming analytics and network analytics – Xively cloud for IoT, Python Web application framework – Django – AWS for IoT – System management with NETCONF – YANG.

UNIT-V: CASE STUDIES AND INDUSTRIAL APPLICATIONS **9**

Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged plant wide Ethernet model (CPwE) – Power utility industry – Grid blocks reference model – Smart and connected cities: Layered architecture, Smart lighting, Smart parking architecture and Smart traffic control.

Contact Periods:

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

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
3. Olivier Hersent, David Boswarthick and Omar Elloumi , "The Internet of Things – Key

applications and Protocols", Wiley, 2012 .
4. Jan Ho ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, Springer, 2011.
6. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

COURSE OUTCOMES:

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

CO1: Explain the concept of IoT.
CO2: Analyze various protocols for IoT.
CO3: Design a PoC of an IoT system using Rasperry Pi/Arduino.
CO4: Apply data analytics and use cloud offerings related to IoT.
CO5: Analyze applications of IoT in real time scenario.

19CSOE09	SOFTWARE TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements.

UNIT-I: INTRODUCTION **9**

Testing as an engineering activity – Testing as a process – Testing maturity model- Testing axioms – Basic definitions – Software testing principles – The tester's role in a software development organization – Origins of defects – Cost of defects – Defect classes – The defect repository and test design – Defect examples - developer/tester support of developing a defect repository.

UNIT-II: TEST CASE DESIGN STRATEGIES **9**

Test case design strategies – Using black box approach to test case design – Boundary value analysis – Equivalence Class partitioning – State based testing – Cause-effect graphing – Compatibility testing – User documentation testing – Domain testing - Random testing – Requirements based testing – Using white box approach to test design – Test adequacy criteria – Static testing vs. structural testing – Code functional testing – Coverage and control flow graphs – Covering code logic – Paths – Code complexity testing – Additional white box testing approaches- Evaluating test adequacy criteria.

UNIT-III: LEVELS OF TESTING **9**

The need for levels of testing – Unit test – Unit test planning – Designing the unit tests – The test harness – Running the unit tests and recording results – Integration tests – Designing integration tests – Integration test planning – Scenario testing – Defect bash elimination system Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Adhoc testing – Alpha, Beta tests – Testing OO systems – Usability and accessibility testing – Configuration testing –Compatibility testing – Testing the documentation- Website testing.

UNIT-IV: TEST MANAGEMENT **9**

People and organizational issues in testing – Organization structures for testing teams – Testing services – Test Planning – Test plan components – Test plan attachments – Locating test items – test management – test process – Reporting test results – Introducing the test specialist – Skills needed by a test specialist – Building a testing group- The structure of testing group, The technical training program.

UNIT-V: TEST AUTOMATION **9**

Software test automation – Skills needed for automation – Scope of automation – Design and architecture for automation – Requirements for a test tool – Challenges in automation – Test metrics and measurements – Project, Progress and Productivity metrics.

Contact Periods:

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

REFERENCES:

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006.
2. Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007.
3. Iene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
4. Edward Kit," Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
5. Boris Beizer," Software Testing Techniques" , 2nd Edition, Van Nostrand Reinhold, New York, 1990.
6. Aditya P. Mathur, "Foundations of Software Testing Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

COURSE OUTCOMES:

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

CO1: Design test cases suitable for a software development for different domains.
CO2: Identify suitable tests to be carried out.
CO3: Prepare test planning based on the document.
CO4: Document test plans and test cases designed.
CO5: Use automatic testing tools, develop and validate a test plan.

19CSOE10	USER INTERFACE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts user interface design.
- To design Menus and GUI.
- To understand the components of windows control.
- To visualize web controls.

UNIT-I: INTRODUCTION **8**

Human-Computer interface - Characteristics of graphics interface - Direct manipulation Graphical system - Web user interface – Popularity – Characteristic & principles.

UNIT-II: HUMAN COMPUTER INTERACTION **10**

User Interface design process – Obstacles – Usability – Human characteristics in design – Human Interaction speed – Business functions – Requirement analysis – Direct – indirect methods – Basic business functions – Design standards – System timings – Human consideration in screen design – Structures of menus – Functions of menus – Contents of menu – Formatting – Phrasing the menu – Selecting menu choice – Navigating menus – Graphical menus.

UNIT-III: WINDOWS **9**

Characteristics - Components - Presentation styles - Types - Managements - organizations - Operations - Web systems - Device-based controls Characteristics - Screen-based controls - Operate control – Text boxes – Selection control - Combination control - Custom control – Presentation control.

UNIT-IV: MULTIMEDIA **9**

Text for web pages - Effective feedback - Guidance and Assistance - Internationalization - Accessibility – Icons - Image – Multimedia - Coloring.

UNIT-V: WINDOWS LAYOUT-TEST **9**

Prototypes - Kinds of tests – Retest – Information search - Hypermedia - WWW -Software tools -Visualizations to present and explore big data -Visualization of text data and protein sequences.

Contact Periods:

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

REFERENCES:

1. Wilbent O. Galitz,"The Essential Guide To User Interface Design", John Wiley & Sons, 2001.
2. Ben Sheiderman, "Design The User Interface", Pearson Education, 1998.
3. Alan Cooper, "The Essential of User Interface Design", Wiley Dream Tech, 2002.

COURSE OUTCOMES:

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

CO1: Design the GUI components.

CO2: Design the Menu components.

CO3: Design the windows based controls.

CO4: Realize multimedia components.

CO5: Design windows layout for big data.

19ECOE11 AUTOMOTIVE ELECTROICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of Automotive Electronics and its evolution.
- To introduce overview of automotive systems and subsystems.
- To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
- To understand, design and model various automotive control systems using Model based development technique.
- To understand role of Embedded in various communication systems, wired and wireless protocols used in vehicle networking.

UNIT-I: AUTOMOTIVE MECHANICAL SYSTEMS: VEHICLE SYSTEMS 9

Power train system (Air system, Fuel system (carburetor and diesel fuel injection, Ignition system, Exhaust system and other auxiliary systems (cooling, lubrications and electrical systems), Transmission system (Front, rear and 4 wheel drive, manual, automatic transmission, differential). Braking system (drum, disc, hydraulic, pneumatic), Steering system (rack and pinion, power steering).

UNIT-II: ELECTRONICS IN AUTOMOTIVE SYSTEMS 9

Need for electronics in automotive systems: Performance (speed, power, and torque), Control (emission, fuel economy, drivability, and safety) and legislation (environmental legislation for pollution and Safety Norms). Overview of vehicle electronic systems: Basic electrical components and their operation in an automobile: Power train subsystem (Starting systems, Charging systems – Ignition systems – Electronic fuel control), Chassis subsystem (ABS, TCS, and ESP) – Comfort and safety subsystems (Night vision, Airbags, Seatbelt Tensioners, Cruise control– Lane– Departure– Warning, Parking).

UNIT-III: INTEGRATED DEVELOPMENT ENVIRONMENT 9

Introduction to integrated development environment (IDE) – Getting started, HW / SW configuration (boot service, Host – Target interaction) – Booting reconfiguration – Managing IDE – Target servers, agents, Cross development, debugging – Introduction to an IDE for lab board – RTOS, PC based debugger.

UNIT-IV: EMBEDDED SYSTEM IN AUTOMOTIVE APPLICATIONS 9

Engine management systems – Gasoline / Diesel systems, various sensors used in system – Electronic transmission control – Vehicle safety system – Electronic control of braking and traction – Body electronics – Infotainment systems – Navigation systems – System level tests – Software calibration using engine and vehicle dynamometers – Environmental tests for electronic control unit – Application of control elements and control methodology in automotive system.

UNIT-V: EMBEDDED SYSTEM COMMUNICATION PROTOCOLS 9

Introduction to control networking – Communication protocols in embedded systems – SPI, I2C, USB – Vehicle communication protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000.

Contact periods:

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

REFERENCES:

1. JoergSchaeuffele, Thomas Zurawka, "Automotive Software Engineering Principles, Processes, Methods and Tools", SAE International, 2005.
2. Robert Bosch, "Automotive Handbook", John Wiley and Sons, 6th Edition, 2014. Denton. T., "Automobile Electrical and Electronic Systems", 4th Edition, 2012.
3. Ronald K. Jurgen, "Automotive Electronics Handbook", McGraw Hill Publications, 1999. Nicholas Navit, "Automotive Embedded System Handbook", CRC Press, Taylor and Francis Group, 2009.
4. Knowles D., "Automotive Electronic and Computer Controlled Ignition Systems", Prentice Hall, 1998.
5. William B. Ribbens, "Learning Automotive Electronics", Newnes Publishing, 6th Edition 2003.

COURSE OUTCOMES:

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

CO1: Describe various mechanical systems in an automobile.

CO2: Illustrate different types of electronic systems in an automobile.

CO3: Outline the various stages of integrated development environment to design an embedded system.

CO4: Explain the various embedded systems used in automotive applications.

CO5: Compare Vehicle Communication Protocols.

19ECOE12 HARDWARE DESCRIPTIVE LANGUAGE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the skill in various modeling in Verilog.
- To understand the basics of Verilog HDL.
- To learn the features in Verilog HDL.
- To understand the branching in Verilog,
- To be familiar with programming in digital circuits.

UNIT-I: OVERVIEW OF DIGITAL DESIGN WITH VERILOG HDL 9

Overview of Digital Design with Verilog HDL, Evolution of CAD, emergence of HDLs, typical HDL-flow, Trends in HDLs. Hierarchical Modeling Concepts Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.

UNIT-II: BASIC CONCEPTS 9

Basic Concepts, Lexical conventions, data types, system tasks, compiler directives. Modules and Ports, Module definition, port declaration, connecting ports, hierarchical name referencing.

UNIT-III: GATE-LEVEL MODELING 9

Gate-Level Modeling - Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. Dataflow Modeling, Continuous assignments, delay specification, expressions, operators, operands, operator types.

UNIT-IV: BEHAVIORAL MODELING 9

Behavioral Modeling, Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks.

UNIT-V: LOGIC DESIGN USING VERILOG 9

Basic concepts – Identifiers – Procedural assignments – Design of combinational and sequential circuits using data flow – Structural gate level – Switch level modeling and behavioral modeling – Test benches.

Contact periods:

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

REFERENCES:

1. Bhasker J., “Verilog HDL”, Prentice Hall, 2000.
2. Stephen Brown, “Fundamental of Digital logic with Verilog Design”, Tata McGraw Hill, 2008.
3. Samir Palnitkar, “Verilog HDL”, Pearson, 2nd Edition, 2003.
4. Zainalabedin Navabi, “Verilog digital systems design”, McGraw Hill, 2nd Edition, 1999.
5. Charles H Roth Jr., “Digital System Design using VHDL”, Thomson learning, 2004.

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of Verilog HDL.

CO2: Gain the knowledge about various modeling in Verilog HDL.

CO3: Be familiar with features in Verilog HDL.

CO4: Understand the fundamentals branching Verilog HDL.

CO5: Analyze the logic design using Verilog HDL.

19ECOE13 EMBEDDED SYSTEM DESIGN USING ARM PROCESSOR

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand ARM7TDMI assembly instructions and their formats and usage.
- To be very good in writing ARM7 based assembly level programs.
- To understand how various coprocessors are interfaced in a SoC.
- To be very conversant and knowledgeable in cache design, virtual memory and memory protection concepts and their implementation details in a typical SoC designs.
- To know about various families of ARM and different case studies.

UNIT-I: ARM ARCHITECTURE 9

Advanced RISC machine – Architecture inheritance – ARM programming model – ARM development tools – 3 and 5 stages pipeline ARM organization – ARM instruction execution and implementation – ARM Co-Processor interface.

UNIT-II: ASSEMBLY LANGUAGE PROGRAMMING 9

ARM instruction types – Data transfer, Data processing and control flow instructions – ARM instruction set – Co-processor instructions – Data processing instruction – Data transfer instruction – Control flow instructions.

UNIT-III: THE THUMB INSTRUCTION SET 9

Thumb bit in the CPSR – Thumb programmer‘s model – Thumb branch instructions – Thumb software interrupt instruction – Thumb data processing instructions – Thumb single register data transfer instructions – Thumb multiple register data transfer instructions – Thumb breakpoint instructions – Thumb implementation – Thumb applications.

UNIT-IV: MEMORY HIERARCHY 9

Memory size and speed – On-chip memory – Caches – Cache design – Memory management – Examples and exercises. Abstraction in software design – Date type – Floating point data type and architecture – Expressions – Conditional statement – Loops – Functions and procedures – Use of memory.

UNIT-V: ARM PROCESSOR AND CPU CORES. 9

ARM cores – ARM architecture – ARM7TDMI, ARM8, ARM9TDMI, ARM10TDMI, ARM710T – ARM810 – ARM920T AND ARM940T – ARM1020E – Case study.

Contact periods:

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

REFERENCES:

1. Steve Furber, “ARM System on Chip Architecture‖ Addison”, Wesley Professional, 2nd Edition, Aug 2000.
2. Andrew N. Sloss, Dominic Symes and Chris Wright, “ARM System Developer‘s Guide Designing and Optimizing System Software”, Morgan Kaufmann Publishers, Elsevier, 2004.
3. Ricardo Reis, “Design of System on a Chip: Devices and Components”, Springer, 1st Edition, July 2004.
4. Jason Andrews-Co, “Verification of Hardware and Software for ARM System on Chip

Design (Embedded Technology)", Newnes, BK and CD– ROM (Aug 2004).
5. Rashinkar P., Paterson and Singh L., "System on a Chip Verification – Methodologies and Techniques", Kluwer Academic Publishers, 2001.
6. David Seal, "ARM Architecture reference Manual", Addison – Wesley Professional; 2nd Edition, 2001.
7. Alan Clement, "The principle of computer Hardware", 3rd Edition, Oxford University Press.

COURSE OUTCOMES:

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

CO1: Explain ARM architecture.

CO2: Illustrate special features of ARM instruction set.

CO3: Make use of thumb instruction set to write assembly language program.

CO4: Explain memory and I/O management with ARM processor.

CO5: Review different ARM CPU cores.

19ECOE14 BIO-INSPIRED COMPUTING TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of Genetic algorithm.
- To learn the operators in Genetic algorithm.
- To understand the concept of PSO algorithm.
- To introduce advanced optimization algorithm.
- To know about hybrid optimization algorithm.

UNIT-I: INTRODUCTION **9**

Features of Evolutionary Computation –Advantages of Evolutionary Computation – Applications of Evolutionary Computation.

Genetic Algorithms: Introduction –Conventional Optimization and Search Techniques – Advantages andLimitations of Genetic Algorithm–Terminologies and Operators of GA

UNIT-II: OPERATORS AND APPLICATIONS **9**

Advanced Operators and Techniques in Genetic Algorithm–Classification of Genetic Algorithm –Application of GA in solving combinatorial optimization problems

UNIT-III: PSO ALGORITHM **9**

PSO Algorithm –Accelerated PSO – Implementation –Convergence Analysis –Binary PSO – Applications. Ant Colony Optimization–Characteristics- Algorithm –Applications

UNIT-IV: ADVANCED OPTIMIZATION ALGORITHM **9**

Cuckoo Life Style – Flowchart – Algorithm, Bat Algorithm (Binary Bat Algorithm)– Echolocation of Bats – Flowchart– Algorithm, Bee-Inspired Algorithm(Artificial Bee Colony)– Flowchart – Algorithm

UNIT-V: HYBRID OPTIMIZATION ALGORITHM **9**

Teacher-Learner Based Optimization algorithm –Jaya Algorithm–Hybrid Optimization Algorithm: Hybrid Swarm Intelligence Optimization Algorithm.

Contact periods:

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

REFERENCES:

1. Sivanandam S. N. and Deepa S.N., "Introduction to Genetic Algorithms", 1st Edition, Springer, USA, 2008.
2. OmidBozorg - Haddad, "Advanced Optimization by Nature-Inspired Algorithms", Springer, Volume 720, Singapore, 2018.
3. SrikantaPatnaik, Xin-She Yang and Kazumi Nakamatsu, "Nature-Inspired Computing and Optimization Theory and Applications", Springer, Volume 10,USA, 2017.
4. Nancy Arana-Daniel, Carlos Lopez-Franco, Alma Y Alanis, "Bio-inspired Algorithms for Engineering", Butterworth-Heinemann 2018.
5. David E. Goldberg, "Genetic Algorithm in search, Optimization and Machine Learning" Pearson Education India, 2008.

COURSE OUTCOMES:

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

CO1: Explain concept of Genetic algorithm.

CO2: Illustrate operators in Genetic algorithm.

CO3: Gain knowledge on the concept of PSO algorithm.

CO4: Explain the concepts on advanced optimization algorithm.

CO5: Review about hybrid optimization algorithm.

19ECOE15 VEHICULAR COMMUNICATION AND NETWORKING TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the vehicle-to-x (v2x) communication.
- To conceptualize standards and technologies.
- To understand the basics wireless propagation and channel characteristics. .
- To learn Medium access control (MAC). .
- To introduction to vehicular networks. .

UNIT-I: VEHICLE-TO-X (V2X) COMMUNICATION 9

Vehicle-to-X (V2X) Communication for Intelligent Transportation Systems (ITS) - safety and non-safety applications, use cases, network service requirements of different applications, V2X communication regimes.

UNIT-II: STANDARDS AND TECHNOLOGIES 9

Standards and Technologies - layered architecture, infrastructure-based vs. infrastructure-less technologies, Long-Term Evolution (LTE), Dedicated Short Range Communication (DSRC), Wireless Access in Vehicular Environments (WAVE).

UNIT-III: WIRELESS PROPAGATION AND CHANNEL CHARACTERISTICS 9

Wireless Propagation and Channel Characteristics - path loss, shadowing, small-scale fading, delay spread and Doppler spread, coherence bandwidth and coherence time, techniques for combating wireless channel impairments; Physical Layer - digital modulation schemes in DSRC, design of OFDM in DSRC (symbol time, sub-carrier spacing, pilot spacing).

UNIT-IV: MEDIUM ACCESS CONTROL (MAC) 9

802.11p EDCA, multi-channel operation in the WAVE MAC; Routing - flooding, broadcast storm problem, Geocast; Security and Privacy in Vehicular Networks; Vehicular Network Simulation - mobility models, bidirectionally coupled road traffic and communication network simulators for vehicular network simulation.

UNIT-V: INTRODUCTION TO VEHICULAR NETWORKS

Introduction to Vehicular Networks: Controller Area Networks (CAN) , Field of application, Physical layer and bit coding, Frame types and format, Bit stuffing and synchronization, Error management, Overview of Other communication protocols: LIN, Flex ray.

Contact periods:

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

REFERENCES:

1. Christophe Sommer and Falko Dressler, “Vehicular Networking”, Cambridge University Press, 2014.
2. Hannes Hartenstein and Kenneth Laberteaux(eds.), “VANET Vehicular Applications and Inter-networking Technologies”, John Wiley & Sons, 2009.
3. Claudia Campolo, Antonella Molinaro and Riccardo Scopigno, “Vehicular ad hoc Networks: Standards, Solutions, and Research”, Springer, 2015.

4. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Second Edition, Prentice Hall, 2001.
5. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
6. Dominique Paret, “Multiplexed Networks for Embedded Systems: CAN, LIN, FlexRay, Safe–by–Wire”, First Edition, Wiley, 2007.

COURSE OUTCOMES:

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

CO1: Define vehicle-to-x (v2x) communication.

CO2: Solve specific problems with standards and technologies.

CO3: Gain knowledge of the basics wireless propagation and channel characteristics**.**

CO4: Review on Medium Access Control (MAC).

CO5: Explain about vehicular networks.

19EEOE16 ENERGY EFFICIENT LIGHTING SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the importance of lightning.
- To known the fundamentals of illumination and its methods.
- To familiar lighting control methods for various applications.
- To understand energy efficient lighting in building management system.
- To study the renewable energy methods for energy efficient lighting.

UNIT I : LIGHTING 9

Lighting - Importance of lighting in buildings - Interior designing, Photography, Architecture - Difference between good and bad lighting - Challenges in lighting - Types of lighting.

UNIT II : ILLUMINATION FUNDAMENTALS & VARIOUS ILLUMINATION METHODS 9

Introduction - Terms used in illumination - Laws of illumination - Polar curves - Photometry - Integrating sphere - Sources of light - Discharge lamps - Incandescent lamps - MV and SV lamps.

UNIT III: ENERGY EFFICIENT LIGHTING 9

Smart lighting - Fluorescent lamps - Comparison between Tungsten filament lamps and Fluorescent tubes - Basic principles of light control - Types and design of lighting and flood lighting - CFL - LED - High Intensity Discharge lamps.

UNIT IV: BUILDING MANAGEMENT SYSTEM 9

Energy efficient landscape design - Natural lighting - Choice of building materials for energy efficient lighting - Light pipes - Light fixtures - Green buildings - Construction techniques.

UNIT V: CASE STUDY 9

Solar lighting techniques - Lighting using wind power - Energy conservation building code - Energy efficient buildings in the country.

Contact Periods:

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

REFERENCES:

1. Philip Gordon., "Principles and Practices of Lighting Design: The Art of Lighting Composition", Blue Matrix Productions, 2011.
2. Jerry Yudelson, "Green Building Through Integrated Design" The McGraw - Hill Companies, Inc., 2009.
3. Derek Phillips, "Daylighting: Natural Light in Architecture", Elsevier, 2004.
4. Jerry Yudelson , "Greening Existing Buildings", The McGraw - Hill Companies, Inc.,1st Edition, 2010.
5. Sam Kubba,"Handbook of Green Building Design and Construction", Elsevier Inc.,2012.
6. Solanki.C.S, "Solar Photovoltaic Technology and Systems", PHI, 2013.
7. J. F. Manwell, J.G. MC Gowan and A.L. Rogers, "Wind Energy Explained: Theory, Design

and Application", Wiley, 2nd Edition, 2010.

COURSE OUTCOMES:

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

CO1: Understand the properties of light, importance of lighting in various fields and types of lighting.

CO2: Understand the properties and laws of illumination, working of discharge lamps, fluorescent lamps, tungsten filament lamps and light control techniques.

CO3: Compare the various lighting techniques and employ suitable lighting control methods for various applications.

CO4: Choose the building materials and construction techniques for energy efficient lighting.

CO5: Employ renewable energy methods for energy efficient lighting.

19EEOE17	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 – RF beacons, Ultrasonic ranging, Reflective beacons, 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, inclinometers.

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 – Film sensor, MEMS & Nano sensors, LASER sensors.

UNIT V : SIGNAL CONDITIONING and DAQ SYSTEMS **9**

Amplification – Filtering – Sample and hold circuits – Data acquisition: single channel and multi channel data acquisition – Data logging – Applications – Automobile, aerospace, Home appliances, Manufacturing, Environmental monitoring.

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.

19EEOE18	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the presence of electrical hazards and measures to minimize risks.
- To determining the cause of electrical accidents, fires and explosions.
- To apply various grounding and bonding techniques.
- To adequate safety method for low, medium and high voltage equipment.
- To know the various fundamentals and provide solutions to a practical case study.

UNIT I : INTRODUCTION AND HAZARDS OF ELECTRICITY 9

Introduction – Hazard analysis: Primary and secondary hazards – Arc, blast, shocks – Causes and effects – Summary of causes – Protection and precaution – Injury and death protective strategies – IE Rules 1956 – Basic rules for new installations: Power system, domestic and industry (Qualitative treatment only).

UNIT II : ELECTRICAL SAFETY EQUIPMENT 9

General inspection and testing procedure for electrical safety equipment – Electrical safety equipment for external protection: Flash and thermal protection – Head and eye protection – Insulation protection. Electrical safety equipment for internal protection: Over voltage, short circuit, earth fault, leakage current, high/low frequency – Single line diagram of industrial power system with safety control – Electrician's safety kit and materials.

UNIT III : SAFETY PROCEDURES 9

Introduction – Six-step safety method – Job briefings – Energized or De-energized – Safe switching of power systems – General energy control programs – Lockout – Tag out – Voltage measurement techniques – Placement of safety grounds – Flash hazard calculations and approach distances – Calculating the required level of arc protection (flash hazard calculations) – Barriers and warning signs – Tools and test equipment – Field marking of potential hazards – Shock avoidance techniques – One-minute safety audit.

UNIT IV : GROUNDING AND ELECTRICAL MAINTENANCE 9

Need for electrical equipment grounding – System grounding – Equipment grounding – Types of Earthing – Earth testing for electrical equipment's in power house and industry – Eight step maintenance program – Maintenance requirements for specific equipment and location – IEC and UL standard.

UNIT V : VOLTAGE SAFETY SYNOPSIS AND MEDICAL SAFETY MANAGEMENT 9

Safety equipment's and safety procedures for low voltage and high voltage system – Electrical safety around electronic circuits – Electrical safety for medical equipment like over current safety, isolation, EMI and harmonics – Battery maintenance procedure – Stationary battery safety – Accident prevention – Accident investigation – First aid – Rescue techniques – Electrical safety program structure and development – Safety meetings – Safety audits.

Contact Periods:

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

REFERENCES:

1. John Cadick, Mary Capelli-Schellpfeffer and Dennisneitzel, “Electrical Safety Handbook”,

Mcgraw Hill Publishing Company Ltd., 4th Edition, 2012.
2. Dennis Neitzel and Al Winfield, "Electrical Safety Handbook", McGraw – Hill Education, 4th Edition, 2012.
3. Mohamed A El-Sharkawi, "Electric safety: Practice and Standards", CRC press, New York, 2013.
4. Martha J. Boss and Gayle Nicoll, "Electrical Safety: Systems, Sustainability and Stewardship", CRC press, New York, 2014.
5. Ray A. Jones and Jane G. Jones, "The Electrical Safety Program Guide", National fire protection association, Quincy, 2011.
6. James H and Wiggins JR., "Managing Electrical Safety", Abs Consulting, Maryland, 2011.

COURSE OUTCOMES:

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

CO1: Expand skills in identifying the presence of electrical hazards, implementing measures to minimize risks.

CO2: Develop skills in investigative techniques for determining the cause of electrical accidents, fires and explosions.

CO3: Analyze and apply various grounding and bonding techniques.

CO4: Select appropriate safety method for low, medium and high voltage equipment.

CO5: Assess and provide solutions to a practical case study.

19EEOE19	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To anderstand the basics of electric vehicle components and configuration.
- To analyze suitable drive scheme for developing an electric trains.
- To analyze energy storage system.
- To identify a energy management system.
- To understand the infrastructure for electric vehicles and business potential.

UNIT I : INTRODUCTION **9**

Conventional vehicles: Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics and mathematical models to describe vehicle performance. Introduction to hybrid electric vehicles: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies. Hybrid electric drive-trains: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT II : ELECTRIC TRAINS **9**

Electric drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, Power flow control in electric drive-train topologies, fuel efficiency analysis. Electric propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC motor drives, Induction motor drives, permanent magnet motor drives, switch reluctance motor drives – Drive system efficiency.

UNIT III : ANALYSIS OF ENERGY STORAGE **9**

Energy storage: Introduction to energy storage requirements in hybrid and electric vehicles, Battery based energy storage and its analysis, Fuel cell based energy storage and its analysis, super capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Communications, supporting subsystems.

UNIT IV : ENERGY MANAGEMENT STRATEGIES **9**

Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies, implementation issues of energy management strategies.

UNIT V : BUSINESS PERSPECTIVE OF ELECTRIC VEHICLE **9**

Design of a hybrid electric vehicle (HEV) – Design of a battery electric vehicle (BEV), hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles. Business: E-mobility business, electrification challenges, Connected mobility and autonomous mobility – Case study: E-mobility Indian roadmap perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, Social dimensions of EVs.

Contact Periods:

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

REFERENCES:

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design”, CRC press, 2004.
2. Mi C, Masrur M A and Gao D W., “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2017.
3. Onori S, Serrao L and Rizzoni G., “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
4. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Butterworth - Heinemann, 2002.
5. Ronald K. Jurgen, “Electric and Hybrid - Electric Vehicles”, SAE, 2010.

COURSE OUTCOMES:

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

CO1: Understand the basics of electric vehicle components and configuration.

CO2: Analyze suitable drive scheme for developing an electric vehicle.

CO3: Analyze a proper energy storage system.

CO4: Opt a proper energy management system.

CO5: Understand the infrastructure for electric vehicles and business potential.

19EEOE20	SCADA SYSTEM AND APPLICATION MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge about the SCADA system.
- To provide knowledge about the SCADA components.
- To grasp knowledge about SCADA communication.
- To understand the concepts of SCADA monitoring and control.
- To understand the concepts of SCADA application in power system.

UNIT I : INTRODUCTION TO SCADA **9**

Evolution of SCADA, SCADA definitions, SCADA functional requirements and components, SCADA hierarchical concept, SCADA architecture, General features, SCADA applications, benefits.

UNIT II : SCADA SYSTEM COMPONENTS **9**

Remote terminal unit (RTU), Interface units, human-machine interface units (HMI), Display monitors/data logger systems, Intelligent electronic devices (IED), Communication network, SCADA server, SCADA control systems and control panels.

UNIT III : SCADA COMMUNICATION **9**

SCADA communication requirements, Communication protocols: Past, present and future, structure of a SCADA communications protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like fiber optic, PLCC etc. Interface provisions and communication extensions, Synchronization with NCC, DCC.

UNIT IV : SCADA MONITORING AND CONTROL **9**

Online monitoring the event and alarm system, Trends and reports, Locking list, Event disturbance recording. Control function: Station control, Bay control, Breaker control and disconnector control.

UNIT V : SCADA APPLICATIONS IN POWER SYSTEM **9**

Applications in generation, Transmission and distribution sector, Substation SCADA system functional description, System specification, system selection such as substation configuration, IEC61850 ring configuration, SAS cubicle concepts, Gateway interoperability list, Signal naming concept. System installation, Testing and commissioning.

Contact Periods:

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

REFERENCES:

1. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2016.
2. Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA Systems", PennWell Books, 2006.
4. David Bailey and Edwin Wright, "Practical SCADA for Industry", Newnes, 2003.
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT Systems for Electric Power", PennWell 1999.

6. Dieter K. Hammer, Lonnie R. Welch and Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2002.

COURSE OUTCOMES:

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

CO1: Understand the concepts of SCADA system.
CO2: Acquire knowledge about the SCADA components.
CO3: Acquire knowledge about SCADA communication.
CO4: Understand the concepts of SCADA monitoring and control.
CO5: Understand the concepts of SCADA application in power system.

19MEOE21	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply knowledge of mechanics of materials for designing mechanical elements including design process, failure prevention under static & variable loadings.

UNIT I: INTRODUCTION **9**

Strength of materials – Basic assumptions – Elastic and plastic behaviour – Average stress and strain – Concept of stress, Strain and the types of stresses and strains.

UNIT II: PLASTIC DEFORMATION OF CRYSTALS **9**

Deformation by slip – Slip in a perfect lattice – Slip by dislocation movement – Critical resolved shear stress for slip – Deformation of single crystals – Polycrystalline materials – Deformation by twinning, stacking faults, strain hardening.

UNIT III: FRACTURE MECHANICS AND HARDNESS TESTING **9**

Types of fracture, Griffith theory and modified Griffith – Orowan theory, metallographic aspects of fracture, crack propagation, concept of fracture curve. Concept of fracture curve – Fracture toughness KIC Testing. R-curve, J-Integral, drop weight test – Brinell hardness testing, Rockwell hardness testing, Vickers hardness testing and knoop hardness testing, Nano indentation, Problems.

UNIT IV: TENSION TESTING **9**

ASTM Standards and specification, Engineering stress & strain, True stress strain curves, Holloman – Ludwig equation – Plastic Instability (Necking) – Testing machines – Types, testing procedures, Properties measured, Specimen dimensions, Problems.

UNIT-V: TORSION, SHEARING AND IMPACT TEST **9**

ASTM Standards and specification Testing Machines and procedures. Impact testing: Principle – Izod and Charpy Impacts tests, ASTM Standards and specification. Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT – Determination of DBTT.

Contact periods:

Lecture: 45 Periods Lecture: 45 Periods Lecture: 45 Periods Lecture: 45 Periods

REFERENCES:

1. George E. Dieter, “Mechanical Metallurgy” 3rd Edition, Mc Graw Hill, 2013.
2. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
3. P. Field Foster, The Mechanical Testing of Metals and Alloys 7th Edition, Cousens Press, 2007.
4. Hull D and Bacon D J., “Introduction to dislocations”, Butterworth Heinemann, Oxford, 2001.
5. Wullf et al, Vol. III “Mechanical Behavior of Materials", John Wiley and Sons, New York, 1983.

COURSE OUTCOMES:

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

CO1: Understand the static force and inertia forces and their effect that exist in materials.

CO2: Perform balancing, vibration and critical speeds with respect to material.

CO3: Understand the standards, concepts and terminology of material testing.
CO4: Select the appropriate measuring device based on measuring requirements.
CO5: Gain knowledge regarding impacts and testing of materials.

19MEOE22	ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the functions of the basic components of a robot.
- To study the use of various types of end effectors and sensors.
- To impart knowledge in robot kinematics and programming.
- To learn robot safety issues and economics.

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, Pay load – 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 – D.C. Servo motors, Stepper motors, A.C. Servo motors – Salient features, Applications and comparison of all these drives, End effectors – 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 the following types of sensors – Position sensors – Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors, Range sensors – Triangulations principles, Structured, Lighting approach, Time of flight, Range finders, Laser range meters, Touch sensors, Binary sensors., Analog sensors, Wrist sensors, Compliance sensors, Slip sensors, Camera, Frame grabber, Sensing and Digitizing image data – Signal conversion, Image storage, Lighting techniques, Image processing and analysis – Data deduction, Segmentation, Feature extraction, Object recognition, Other algorithms, Applications – Inspection, Identification, Visual serving and navigation.

UNIT IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING **9**

Forward kinematics, Inverse kinematics and Difference; Forward kinematics and Reverse kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of Freedom (in 3 Dimension) Jacobians, Velocity and Forces – Manipulator dynamics, Trajectory generator, Manipulator mechanism design – Derivations and Problems. Lead through programming, Robot programming languages – VAL Programming – Motion commands, Sensor commands, End effectors commands and Simple programs.

UNIT-V: IMPLEMENTATION AND ROBOT ECONOMICS **9**

RGV, AGV; Implementation of robots in industries – Various steps; Safety considerations for robot operations – Economic analysis of robots.

Contact periods:

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

REFERENCES:

1. Groover M P., “Industrial Robotics – Technology Programming and Applications”, McGraw Hill, 2012.
2. Klafter R D., Chmielewski T A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
3. Craig JJ., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
4. Deb S R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
5. Fu.KS, Gonzalz R C and Lee C S G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
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 student will be able to

CO1: Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.

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.

19MEOE23	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To assume Technical and Managerial roles in the Industries.
- To apply Engineering Principles to the working environment.
- To use quality tools to foresee and solve issues in the industrial situations.
- To work collaboratively.

UNIT I: FORECASTING **9**

Characteristics and principles – Qualitative methods, Delphi technique, Market research – Time series methods – Moving average, Exponential smoothing, Box Jenkins method – Autoregressive moving average (ARMA) or autoregressive integrated moving average (ARIMA) models – Fitting regression models – Measurement of forecast errors, Coefficient of correlation – Problem solving.

UNIT II: FACILITIES PLANNING AND WORK STUDY **9**

Factors affecting site location decisions – Principles and types of layout – Layout planning – Layout tools and computerized layout techniques – Design of group technology layout – Line balancing – Line balancing methods – Objectives of work study – Method study procedure, Recording techniques – Motion study – Principles of motion Economy – Techniques of work measurement – Time study – Synthesis method – Analytical estimating – Predetermined Motion Time System (PMTS) – Work sampling techniques.

UNIT III: LEAN MANUFACTURING **9**

Elements of Just In Time (JIT) – Pull and push system, Kanban system – Optimized production technology and synchronous manufacturing – Implementation of Six sigma – Single Minute Exchange of Die (SMED) 5S concept – Concurrent engineering – Cellular manufacturing – Enablers of agile manufacturing – Rapid manufacturing - Business Process Reengineering (BPR) – Enterprises Resources Planning (ERP) – Role of KAIZEN, Quality circles and POKA YOKE in modern manufacturing – Seven wastes in lean manufacturing.

UNIT IV: AGGREGATE PRODUCTION PLANNING **9**

Objectives of aggregate planning – Capacity Requirement Planning (CRP) process – Types of capacity planning – Strategies for aggregate capacity planning – Master production scheduling – Procedure for developing MPS – Materials Requirements Planning (MRP-I), Issues in MRP, Designing and Managing the MRP System, Evaluation of MRP – Manufacturing Resources Planning (MRP-II).

UNIT-V: SCHEDULING OF OPERATIONS **9**

Operations planning and scheduling – Scheduling techniques – Stages in scheduling – Loading, dispatching, Expediting – Finite loading and infinite loading – Load charts and machine loading charts – Priority sequencing – Dynamic sequencing rules – Batch scheduling – Economic Batch Quantity (EBQ) or Economic Run Length (ERL) – Scheduling in repetitive, Batch and job shop manufacturing – Allocation of units for a single resource, Allocation of multiple resources – Resource balancing - Flexible manufacturing system.

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

REFERENCES:

1. Panneerselvam R., "Production & Operations Management", 3rd Edition, PHI Learning Private Limited, New Delhi, 2012.
2. Elwood S. Buffa, and Rakesh K. Sarin, "Modern Production/Operation Management", 8th Edition, John Wiley & Sons, 2000.
3. Dilworth B. James, "Operations Management Design, Planning and Control for Manufacturing and Services", Mcgraw Hill Inc., New York, 1992.
4. Vollman TE., "Manufacturing Planning and Control Systems", Galgotia Publications, 2002.

COURSE OUTCOMES:

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

CO1: Apply the knowledge of Engineering and Sciences to improve the productivity of industries.

CO2: Design a system to meet the desired needs within realistic constraints.

CO3: Function in multidisciplinary teams.

CO4: Use the techniques, skills, and modern Engineering tools in manufacturing practice.

CO5: Perform as an effective industrial Engineer integrating high and low levels of management.

19MEOE24	MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart elementary knowledge to the students regarding the various aspects of sales management.

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.
2. Gupta S L., "Sales and Distribution Management", Excel Books, New Delhi, 2008.
3. Still R and Richard, "Sales Management", Pearson Prentice Hall, Delhi.
4. Schiffman, Kanuk and Kumar, "Consumer Behaviour", Pearson, 10th Edition.
5. Kotler and Keller, "Marketing Management", Pearson Publication.

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 behavior concepts.

19MEOE25	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the energy data, energy accounting and balancing of industries.

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. Witte LC, Schmidt P S and Brown D R., "Industrial Energy Management and Utilisation", Hemisphere Publ, Washington, 1988.
2. Callaghn P W., "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
4. Dryden I G C., "The Efficient Use of Energy", Butterworths, London, 1982.
5. Turne W C., "Energy Management Hand book", Wiley, New York, 1982.
6. 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.

19MEVA901	BASICS OF CIVIL ENGINEERING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To make the students aware of basic concepts of Civil Engineering by exposing the students about the building materials and construction methods followed.

UNIT I: BUILDING MATERIALS **7**

Qualities of good building stone – Qualities of good brick – Cement composition, types and uses – Properties and uses of tor steel, structural steel sections, timber – Concrete – Grade of concrete – Properties of reinforced concrete.

UNIT II: BUILDING CONSTRUCTION **8**

Foundation functions – Failures – Bearing capacity of soil – Different types of foundation.Masonry – Points to be observed in construction - Brick masonry – Types of bond – Stone masonry – Random rubble and Ashlar masonry. Flooring – Various types of floor finishing for Residential,Industrial buildings.

Contact periods:

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

REFERENCES:

1. Punmia B.C., “Basic Civil Engineering”, Lakshmi Publications, 2003.
2. Bhavikatti S. S., “Basic Civil Engineering”, New Age International Publishers, 2018.
3. Rangwala S .C, “Engineering Materials”, Charotar Publishing House, 2014.
4. Punmia B. C., “Building Construction”, Lakshmi Publications, 2016.

COURSE OUTCOMES:

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

CO1: Know the qualities and properties for building materials used in the field.

CO2: Apply the knowledge of construction practices in real life situation in the societal context.

19MEVA902	METALLOGRAPHY	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To understand the preparation of metallographic specimens for micro examination and analyze the microstructures of metals and metallic alloys.

UNIT I: PREPARATION OF METALLOGRAPHIC SPECIMENS 5

Microscopic and macroscopic examination, Polishing techniques for different metals and alloys, Sectioning – Fracturing, Shearing, Sawing, Abrasive cutting, Electric discharge machining, Mounting – Adhesive mounting, Plastic mounting, Grinding and Etching techniques – Electrolytic etching, Potentiostat etching, Chemical etching.

UNIT II: MICROSTRUCTURES OF FERROUS AND NON FERROUS METALS 5

Crystalline structure of metals, Phase changes of metals and alloys, Crystal defects in metals, Microstructures of plain carbon steel, tool steel, grey C.I, SG iron, Brass, Bronze and composites.

UNIT III: IMAGE ANALYSING TECHNIQUES 5

Light microscopy, SEM, TEM, XRD, Quantitative microscopy – Grain size measurement, Inclusion rating methods, Measurements of structural gradients – Decarburization, Case depth, Coating thickness, Quantitative fractography, Image analysis.

Contact periods:

Lecture: 15 Periods Tutorial: 00 Periods Practical: 00 Periods Total: 15 Periods

REFERENCES:

1. O.P. Khanna "Material Science & Metallurgy", Dhanpat Rai Publication, 2011
2. Sydney H. Avner "Introduction to Physical Metallurgy", Tata McGraw Hill Book Company, 26th 2009.
3. R.C. Gifkins, "Optical Microscopy of Metals", American Elsevier Pub. Co., 1970
4. S.Telansky, "Multiple beam interference Microscopy of Metals", Academic Press, New York, 1970.
5. Kay Geels, "Metallographic and Materialographic Specimen Preparation, Light Microscopy, Image Analysis and Hardness Testing", ASTM International, U.S.A. ASTM Stock No. MNL46.

COURSE OUTCOMES:

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

CO1: Apply the specimen preparation methods in metallographic inspection.

CO2: Identify the phase changes of microstructures and defects in metals and metallic alloys.

CO3: Analyze the microstructures and defects in metals and metallic alloys.

19MEVA903	DESIGN FOR PRODUCTION AND QUALITY ENGINEERING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To design the product using CAD concepts.
- To make documentation for process planning activities.
- To understand the quality equipment's needed for checking the quality of product.

UNIT I: DESIGN FOR PRODUCTION ENGINEERING 9

Product design – CAD Concepts and Design – Sketching, Part modeling, Surface modeling, Assembly, Detailing, Sheet metal design – Concepts, Sheet metal tools, Assembly, Detailing, Mold design – Concepts, Mold design process, Assembly, Production Planning-Production documentation, Efficiency calculation.

UNIT II: DESIGN FOR QUALITY ENGINEERING 6

Quality – Types of role, Responsibility of quality engineer – Basic quality to handle equipment's – Quality documentation – Quality equipment's.

Contact periods:

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

REFERENCES:

1. K.S. Krishnamoorthi, "A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality", 6th Edition, CRC Press, 2018.
2. K. Chitale, R. C. Gupta, "Product Design and Manufacturing", 6th Edition, PHI Learning Pvt. Ltd., 2013.
3. Peter Groche, Enrico Bruder, Sebastian Gramlich, "Manufacturing Integrated Design: Sheet Metal Product and Process Innovation", Springer, 2017.

COURSE OUTCOMES:

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

CO1: Design real product with assistance of CAD concepts.

CO2: Develop the process planning documentation for given product design details.

CO3: Use the suitable quality equipment's for measure the quality of product.

19MEVA904	STRUCTURAL ANALYSIS USING FINITE ELEMENT METHOD	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To learn to develop geometric models and to use finite element modeling for simulating structural engineering applications.

UNIT I: INTRODUCTION TO STRUCTURAL ANALYSIS 10

Introduction to Finite Element Analysis (FEA) – Element types – 2D Element – 3D Element – Plane Stress – Plane Strain – Axisymmetry – General procedure for Modeling and Meshing – Bottom-up Construction, Top-down Construction – Loading and Post processing – Working with Symmetry BC's – Basic linear static structural analysis – Truss Member, Effect of self-weight on a beams, bicycle frame, Rectangular L bracket, Axi symmetric Analysis, Cyclic Symmetric analysis, Analysis of Plate with Hole, Dynamic Analysis – Overview of FEM applied to Basic Dynamics – Modal analysis - Harmonic analysis – Transient analysis.

UNIT II: POSTPROCESSING AND GENERATING THE REPORT 5

Post processing the Result – POST1 (General Postprocessor) – POST26 (Time-history Postprocessor) – Displaying the Deformed Shape of the Model – Displaying the Minimum and Maximum Stresses – Capturing Images for the Report – Capturing Animations for the Report – Capturing Data Tables for the Report – Capturing Lists for the Report – Prepare final report.

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

REFERENCES:

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005.
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
3. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013).
4. http://www.ansys.com/Industries/Academic/Tools/Support+Resources.

COURSE OUTCOMES:

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

CO1: Understand the use of simulation software to solve structure engineering problems.

CO2: Discretize complex engineering structures or machine parts by suitable element types.

CO3: Simulate structural engineering problems.

19MEVA905	NON-DESTRUCTIVE TESTING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To make the students to test the components using the non-destructive testing procedure.

UNIT I: LIQUID PENETRANT TESTING **4**

Introduction of NDT – Methods, LPT – Principle, Equipment's used, penetrant, Developer, testing procedure, Inspection and Evaluation, Report generation.

UNIT II: MAGNETIC PARTICLE TESTING **4**

MPT – Introduction, Principle, Types of testing tools, Equipment's needed, testing procedure, Inspection and Evaluation, Report generation.

UNIT III: RADIOGRAPHIC TESTING **4**

RT – Introduction, Principle, Radioactive properties, Equipment's needed, testing procedure – Types of Rays – Film screen cassette – Operating methods, Safety precaution Inspection and Evaluation, Report generation.

UNIT IV: ULTRASONIC TESTING **3**

UT – Introduction, Principle, Methods of testing, Probe – selection, types, Couplant, testing procedure, Inspection and Evaluation, Report generation.

Contact periods:

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

REFERENCES:

1. Louis Cartz., "Nondestructive testing: radiography, ultrasonics, liquid penetrant, magnetic particle, eddy current", ASM International, 1995.
2. Baldev Raj, T. Jayakumar, M. Thavasimuthu, "Practical Non-destructive Testing", Woodhead Publishing, 2002.

COURSE OUTCOMES:

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

CO1: Conduct the liquid penetrant test on the testing components.

CO2: Conduct the magnetic particle test on the testing components.

CO3: Conduct the radiographic test on the testing components.

CO4: Conduct the ultrasonic test on the testing components.

19MEVA906	YOGA FOR YOUTH EMPOWERMENT	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To create awareness and the benefits of yoga and meditation
- To study and analyze the influential factors, which affect the engineering students' healthy life

UNIT I: PHYSICAL STRUCTURE AND ITS FUNCTIONS **5**

Yoga – Purpose of life, philosophy of life, Physical structure, Importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, maharasana, body massage, acupressure, body relaxation

UNIT II: YOGASANAS **5**

Rules & Regulations – asana, pranayama, mudra, bandha

UNIT III: MIND **5**

Bio magnetism & mind – imprinting & magnifying – eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of meditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity, Simplified Kundalini yoga: Agna, Santhi, thuriam, thuriyatheetham.

Contact periods:

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

REFERENCES:

1. Yoga for Modern Age – Vethathiri Maharashi.
2. Mind – Vethathiri Maharashi.

COURSE OUTCOMES:

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

CO1: YOGA which gives healthy & better living, Physical, Mental mood, Intellectual & spiritual.

CO2: Work skillfully and perfectly towards the excellence.

CO3: Achieve meditation practices, which strengthen the mind and increase the will power.

CO4: Concentration, creativity and ultimately to transform the mind to achieve self-realization.

19MEVA907	PROJECT MANAGEMENT	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To prepare the students to identify, plan, develop, manage, successfully implement, execute and finish the projects within stipulated time in their chosen area.

UNIT I: BASICS OF PROJECT MANAGEMENT 5

Introduction, definition of project and project management, project objectives, classification of projects, need for project management, project management knowledge areas and processes, project life cycle, project management principles.

UNIT II: PROJECT IDENTIFICATION AND PLANNING 5

Project identification process – project initiation, pre-feasibility study, feasibility studies, project break-even point, Project planning – need of project planning, project life cycle, roles, responsibility and team work, project planning process.

UNIT III: PROJECT IMPLEMENTATION AND EXECUTION 5

Organizational structure influences on projects, project risk management – role of risk management in overall project management, steps in risk management, project execution – project control process and case studies in project management.

Contact periods:

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

REFERENCES:

1. Clifford F. Gray, Erik W. Larson., "Project Management: The Managerial Process", McGraw Hill, 6th Edition, 2014.
2. Gary R.Heerkens., "Project Management" McGraw Hill, 2002.
3. Nick Jenkins, "A Project Management Primer", 2006.
4. Robert K. Wysocki "Effective Project Management" Wiley Publishers, 2013.
5. Jack R. Meredith and Samuel J. Mantel., "Project Management, A Managerial Approach" John Wiley & Sons, 2015.

COURSE OUTCOMES:

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

CO1: Apply the concepts of project management in engineering.

CO2: Identify and plan new projects.

CO3: Implement and execute new projects.

19MEVA908	SIX SIGMA	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To impart knowledge on six sigma tools on projects and successful completion of projects that drive meaningful business results.

UNIT I: SIX SIGMA, QUALITY AND STANDARDS **5**

Meaning and use of the Six Sigma approach – the underlying concept of variation- the relationships to related Quality Management approaches – Basic six sigma tools – Nature of six sigma improvements projects.

UNIT II: DEFINING THE PROJECT MISSION **5**

Focus on creativity and creativity tools used in coming up with creative formulations and solutions in Six Sigma improvement projects. Review and management of Six Sigma projects

UNIT III: INTRODUCTION TO STATISTICS AND EXCEL **5**

Statistical techniques for summarizing data and extensive use of Microsoft Excel-Statistical Process control.

Contact periods:

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

REFERENCES:

1. Joseph A De Feo, William W Bearnard Juran Institute "Six Sigma Break Through and Beyond", Tata McGraw Hill, New Delhi, 2004.
2. Richard B Chase F Robert Jacobs and Nicholas J Aquilano, "Operations Management for Competitive Advantage", McGraw Hill Inc., New York, Tenth Edition, 2003.
3. Poka - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, Portland, Oregon, 1993.
4. George Eckes "Six Sigma for Everyone" John Wiley & Sons", 2003
5. J M Juran, F.M.Gyna & R.S.Bingham "Quality control Hand book" McGraw Hill book co, 2003
6. Rath, Strong Staff "Six Sigma Leadership Handbook" John Wiley & sons"2003.

COURSE OUTCOMES:

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

CO1: Describe the six sigma approach and basic six sigma tools.

CO2: Use the creativity tools.

CO3: Employ the statistical techniques for summarizing datas.

19MEVA909	PROFESSIONAL SKILLS	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To inculcate administrative skills in students minds to make them able to administrate effectively for project implementation.

UNIT I: SELF ANALYSIS AND CREATIVITY **5**

SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem. Out of box thinking, Lateral Thinking.

UNIT II: LEADERSHIP **5**

Skills for a good Leader, Assessment of Leadership Skills, Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

UNIT III: DECISION MAKING **5**

Importance and necessity of Decision Making, Process and practical way of Decision Making, Weighing Positives & Negatives.

Contact periods:

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

REFERENCES:

1. Covey Sean, "Seven Habits of Highly Effective Teens", New York, Fireside Publishers, 2003.
2. Carnegie Dale, "How to win Friends and Influence People", New York: Simon & Schuster, 2011.
3. Thomas A Harris, "I am ok, You are ok", New York-Harper and Row, 2004.
4. Daniel Coleman, "Emotional Intelligence", Bantam Book, 2006.
5. Soft Skills, 2015, "Career Development Centre", Green Pearl Publications.

COURSE OUTCOMES:

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

CO1: Do self analysis and pocess a positive approach.

CO2: Develop leadership qualities to solve conflicts and maintain good relationship with Personals.

CO3: Make decision for effective project implementation.

19MEVA910	INDUSTRY 4.0	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To know about latest technologies implemented in the industry.

UNIT I **5**

Definition, Environment for Industry 4, Characteristics, Technologies of Industry 4.0, Current Scenario.

UNIT II **5**

Industry 4.0 Solutions – Vertical networking, Horizontal integration, Exponential Technologies through Engineering.

UNIT III **5**

Future Potential of Industry 4.0, Case studies.

Contact periods:

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

REFERENCES:

1. Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation".
2. Bartodziej, Christoph Jan,"The Concept Industry 4.0".
3. Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises"
4. Klaus Schwab,"The Fourth Industrial Revolution".

COURSE OUTCOMES:

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

CO1: Able to identify the basics of industry.

CO2: Able to understand and identify the various solutions of industry.

CO3: Able to apply the techniques in industrial automation.