CURRICULUM AND SYLLABI

FOR B.E. / B.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2019-2020 onwards)

B.E. MECHANICAL ENGINEERING - FIRST SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19HST101	Communicative Techno English - I	HS	3	0	0	3	40	60	100
19MAT101	Engineering Mathematics - I	BS	3	1	0	4	40	60	100
19CYE101	Engineering Chemistry	BS	3	0	2	4	40	60	100
19PHE101	Engineering Physics	BS	3	0	2	4	40	60	100
19GET101	Engineering Graphics	ES	3	0	0	3	40	60	100
19GEE101	Computer Fundamentals and Python Programming	ES	3	0	2	4	40	60	100
19EEC101	Life Skills for Engineers	EEC	0	0	2	0	100	-	100
19MDC101	Induction Program (2 Weeks)	MC	-	-	-	-	-	-	-
TOTAL CREDITS IN SEMESTER - I			22						

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B.E. MECHANICAL ENGINEERING - SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19HST201	Communicative Techno English - II	HS	3	0	0	3	40	60	100
19CYT201	Environmental Science and Engineering	HS	3	0	0	3	40	60	100
19MAT201	Engineering Mathematics - II	BS	3	1	0	4	40	60	100
19PHT201	Physics of Materials	BS	3	0	0	3	40	60	100
19GEE202	Basic Electrical and Electronics Engineering	ES	3	0	2	4	40	60	100
19MET201	Engineering Mechanics	PC	3	1	0	4	40	60	100
19EEC201	Technical Skill (AutoCAD)	EEC	0	0	2	0	100	-	100
19MDC201	NSS / YRC /RRC	MC	-	-	-	-	100	-	100
TOTAL CREDITS IN SEMESTER - II			21						

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B.E. MECHANICAL ENGINEERING - THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MAT301	Transforms and Partial Differential Equations	BS	3	1	0	4	40	60	100
19MET301	Engineering Thermodynamics	PC	3	1	0	4	40	60	100
19MET302	Kinematics of Machinery	PC	3	1	0	4	40	60	100
19EET303	Electrical Drives and Control	PC	3	0	0	3	40	60	100
19MEE301	Manufacturing Technology - I	PC	3	0	2	4	40	60	100
19MEE302	Fluid Mechanics and Machinery	ES	3	0	2	4	40	60	100
19EEC302	Entrepreneurship Development Activity	EEC	0	0	2	0	100	-	100
19MDC301	Leadership Enhancement Programme	MC	1	-	-	-	100	-	100
TOTAL CREDITS IN SEMESTER - III			23						

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B.E. MECHANICAL ENGINEERING - FOURTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MAT404	Statistics and Numerical Methods	BS	3	1	0	4	40	60	100
19MET401	Engineering Metallurgy	PC	3	0	0	3	40	60	100
19MEE401	Thermal Engineering	PC	3	0	2	4	40	60	100
19MEE402	Strength of Materials	ES	3	0	2	4	40	60	100
19MEE403	Composite Materials and Mechanics	PC	3	0	2	4	40	60	100
19MEE404	Manufacturing Technology - II	PC	3	0	2	4	40	60	100
19EEC301	Communication Skills	EEC	0	0	2	0	100	-	100
19MDC401	Value Added Course - I	MC	-	-	-	-	100	-	100
TOTAL CREDITS IN SEMESTER - IV			23						

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BS : Basic Sciences
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B.E. MECHANICAL ENGINEERING - FIFTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MET501	Automobile Engineering	PC	3	0	0	3	40	60	100
19MET502	Design of Machine Elements	PC	3	1	0	4	40	60	100
19MET503	Power Plant Engineering	PC	3	0	0	3	40	60	100
19MEE501	Heat and Mass Transfer	PC	3	0	2	4	40	60	100
19MEE502	Metrology and Measurements	PC	3	0	2	4	40	60	100
	Professional Elective - I	PE	3	0	0	3	40	60	100
19EEC501	Quantitative Aptitude Learning	EEC	0	2	0	0	100	-	100
19MDC501	Value Added Course - II	MC	-	-	-	-	100	-	100
TOTAL CREDITS IN SEMESTER - V			21						

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TOT : Total

B.E. MECHANICAL ENGINEERING - SIXTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MET601	Finite Element Analysis	PC	3	1	0	4	40	60	100
19MET602	Design of Transmission Systems	PC	3	1	0	4	40	60	100
19MEE601	CAD/CAM	PC	3	0	2	4	40	60	100
19MEE602	Dynamics of Machinery	PC	3	0	2	4	40	60	100
	Professional Elective - II	PE	3	0	0	3	40	60	100
	Open Elective - I	OE	3	0	0	3	40	60	100
19MEJ601	Mini Project	EEC	0	0	2	1	100	-	100
19MDC601	Constitution of India	MC	3	-	-	-	100	-	100
TOTAL CREDITS IN SEMESTER - VI			23						

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BS : Basic Sciences
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PE : Professional Elective
OE : Open Elective
EEC : Employability Enhancement Courses
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TOT : Total

B.E. MECHANICAL ENGINEERING - SEVENTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MET701	Gas Dynamics and Jet Propulsions	PC	3	0	0	3	40	60	100
19MEE701	Mechatronics	PC	3	0	2	4	40	60	100
	Professional Elective - III	PE	3	0	0	3	40	60	100
	Open Elective - II	OE	3	0	0	3	40	60	100
19MEJ701	Project Work (Phase - I)	EEC	0	0	2	1	100	-	100
TOTAL CREDITS IN SEMESTER - VII			14						

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B.E. MECHANICAL ENGINEERING - EIGHTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
	Professional Elective - IV	PE	3	0	0	3	40	60	100
	Professional Elective - V	PE	3	0	0	3	40	60	100
19MEJ801	Project Work (Phase - II)	EEC	0	0	20	10	40	60	100
TOTAL CREDITS IN SEMESTER - VIII			16						

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BS : Basic Sciences
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PC : Professional Core
PE : Professional Elective
OE : Open Elective
EEC : Employability Enhancement Courses
MC : Mandatory Courses
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T : Tutorial
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TOT : Total

LIST OF PROFESSIONAL CORE (PC) COURSES

Course Code	Name of the Subject	Category	Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19MET201	Engineering Mechanics	PC	3	1	0	4	40	60	100
19MET301	Engineering Thermodynamics	PC	3	1	0	4	40	60	100
19MET302	Kinematics of Machinery	PC	3	1	0	4	40	60	100
19EET303	Electrical Drives and Control	PC	3	0	0	3	40	60	100
19MEE301	Manufacturing Technology - I	PC	3	0	2	4	40	60	100
19MET401	Engineering Metallurgy	PC	3	0	0	3	40	60	100
19MEE401	Thermal Engineering	PC	3	0	2	4	40	60	100
19MEE403	Composite Materials and Mechanics	PC	3	0	2	4	40	60	100
19MEE404	Manufacturing Technology - II	PC	3	0	2	4	40	60	100
19MET501	Automobile Engineering	PC	3	0	0	3	40	60	100
19MET502	Design of Machine Elements	PC	3	1	0	4	40	60	100
19MET503	Power Plant Engineering	PC	3	0	0	3	40	60	100
19MEE501	Heat and Mass Transfer	PC	3	0	2	4	40	60	100
19MEE502	Metrology and Measurements	PC	3	0	2	4	40	60	100
19MET601	Finite Element Analysis	PC	3	1	0	4	40	60	100
19MET602	Design of Transmission Systems	PC	3	1	0	4	40	60	100
19MEE601	CAD/CAM	PC	3	0	2	4	40	60	100
19MEE602	Dynamics of Machinery	PC	3	0	2	4	40	60	100
19MET701	Gas Dynamics and Jet Propulsions	PC	3	0	0	3	40	60	100
19MEE701	Mechatronics	PC	3	0	2	4	40	60	100

LIST OF PROFESSIONAL ELECTIVE (PE) COURSES

Course Code	Name of the Subject	Category	Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
Professional Elective – I									
19MEPX01	Mechanical Vibrations and Noise Control	PE	3	0	0	3	40	60	100
19MEPX02	Micro Electro Mechanical Systems	PE	3	0	0	3	40	60	100
19MEPX03	Design of Jigs, Fixtures and Press Tools	PE	3	0	0	3	40	60	100
19MEPX04	Solar Thermal Systems	PE	3	0	0	3	40	60	100
19MEPX05	Non-Destructive Test and Evaluation of Materials	PE	3	0	0	3	40	60	100
Course Code	**Name of the Subject**	**Category**	**Hours / Week**			**Credit**	**Maximum Marks**		
			L	**T**	**P**	**C**	**CIA**	**ESE**	**TOT**
Professional Elective – II									
19MEPX06	Concepts of Engineering Design	PE	3	0	0	3	40	60	100
19MEPX07	Computational Fluid Dynamics	PE	3	0	0	3	40	60	100
19MEPX08	Fuels and Combustion	PE	3	0	0	3	40	60	100
19MEPX09	Renewable Energy Sources	PE	3	0	0	3	40	60	100
19MEPX10	Professional Ethics in Engineering	PE	3	0	0	3	40	60	100
Course Code	**Name of the Subject**	**Category**	**Hours / Week**			**Credit**	**Maximum Marks**		
			L	**T**	**P**	**C**	**CIA**	**ESE**	**TOT**
Professional Elective – III									
19MEPX11	Product Design and Development	PE	3	0	0	3	40	60	100
19MEPX12	Refrigeration and Air Conditioning	PE	3	0	0	3	40	60	100
19MEPX13	Process Planning and Cost Estimation	PE	3	0	0	3	40	60	100
19MEPX14	New Venture Planning and Management	PE	3	0	0	3	40	60	100
19MEPX15	Total Quality Management	PE	3	0	0	3	40	60	100

Course Code	Name of the Subject	Category	Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
Professional Elective – IV									
19MEPX16	Thermal Turbo Machines	PE	3	0	0	3	40	60	100
19MEPX17	Robotics and Control	PE	3	0	0	3	40	60	100
19MEPX18	Engineering Economics and Analysis	PE	3	0	0	3	40	60	100
19MEPX19	Industrial Engineering and Management	PE	3	0	0	3	40	60	100
19MEPX20	Lean and Agile Manufacturing	PE	3	0	0	3	40	60	100
Course Code	**Name of the Subject**	**Category**	**Hours / Week**			**Credit**	**Maximum Marks**		
			L	**T**	**P**	**C**	**CIA**	**ESE**	**TOT**
Professional Elective – V									
19MEPX21	Design of Heat Exchangers	PE	3	0	0	3	40	60	100
19MEPX22	Industrial Tribology	PE	3	0	0	3	40	60	100
19MEPX23	Internal Combustion Engines	PE	3	0	0	3	40	60	100
19MEPX24	Metal Forming Technology	PE	3	0	0	3	40	60	100
19MEPX25	Computer Integrated Manufacturing Systems	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVE (OE) COURSES FOR OTHER BRANCHES

Course Code	Name of the Subject	Category	Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
OPEN ELECTIVE - I									
19MEOX01	Maintenance Engineering	OE	3	0	0	3	40	60	100
19MEOX02	Production Planning and Control	OE	3	0	0	3	40	60	100
19MEOX03	Automotive Systems	OE	3	0	0	3	40	60	100
19MEOX04	Principles of Management	OE	3	0	0	3	40	60	100
19MEOX05	Electrical Vehicle Technology	OE	3	0	0	3	40	60	100
Course Code	**Name of the Subject**	**Category**	**Hours / Week**			**Credit**	**Maximum Marks**		
			L	**T**	**P**	**C**	**CIA**	**ESE**	**TOT**
OPEN ELECTIVE - II									
19MEOX06	Sensors and Transducer	OE	3	0	0	3	40	60	100
19MEOX07	Computer Integrated Manufacturing Systems	OE	3	0	0	3	40	60	100
19MEOX08	Engineering Economics and Cost Analysis	OE	3	0	0	3	40	60	100
19MEOX09	Fiber Reinforced Plastics	OE	3	0	0	3	40	60	100
19MEOX10	Lean Manufacturing	OE	3	0	0	3	40	60	100

SCHEME FOR SYLLABI

B.E. -Mechanical

SENGUNTHAR
Shrine 2 Success

SEMESTER I

19HST101 **COMMUNICATIVE TECHNO ENGLISH - I** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **3 0 0 3**

OBJECTIVES

To enable students to:

- Understand the basics of the English Language in a graded manner.
- Enrich vocabulary for the development of all the four language skills (LSRW).
- Develop speaking skills through self introduction and delivering speeches.
- Write e-mails, informal letters.
- Improve writing skills to express thoughts freely.

UNIT I: VOCABULARY **8**

Synonyms and Antonyms- Single Word Substitutes - Use of Abbreviations and Acronyms- Homonyms and Homophones- Business Vocabulary - Commonly Confused Words- Collocation - British and American Vocabulary- Word formation.

Activity: Grammar worksheets on the given topics.

UNIT II: GRAMMAR **10**

Parts of speech - Comparative Adjectives - Numerical Adjectives - Be, Have and Do verbs- modal verbs- Types of Questions - Tenses - Impersonal Passive Voice - Direct and Indirect Speech- Gerunds and Infinitives - Same Word Used as Different Parts of Speech.

Activity: Grammar worksheets on the given topics.

UNIT III: INFORMAL WRITING **9**

Letter Writing - Informal Letters – e-mail Writing - Informal Dialogues – Essay Writing- Informal Essays- Movie Reviews -Writing Instructions.

Activity: Giving topic and ask the students to write informal letters, e-mail.

UNIT IV: LANGUAGE ENHANCEMENT THROUGH SPEAKING **9**

Self Introduction– (exchanging personal information) personal information, hobbies, strengths and weaknesses, likes and dislikes, special features of home town. Narrating Personal Experiences and Incidents- Two minute talk- Debate discussion.

Activity: Ask the students to speak about the above given topics.

UNIT V: READING SKILLS **9**

Reading Comprehension – reading techniques, pre-reading, post-reading, comprehension questions (multiple choice questions or short questions)- Short comprehension passages, practice skimming-scanning and predicting - Reading the passage and taking (Note making) Notes- Scan and understand main contents of the passage.

Activity: Giving topic and ask the students to find out answers for given passage

TOTAL: 45 PERIODS

OUTCOMES

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

- Learn to acquire usage of English.
- Use a wide range of vocabulary in oral and written communication.
- Give short informal presentations and participate in classroom discussions.
- Write informal letters and other communications.
- Frame grammatically correct sentences.

TEXT BOOKS

1. Board of Editors. Using English A Course book for Under graduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", 1st Edition, Orient Black Swan, Chennai. 2012.
2. Krishna Mohan, Meera Banerji ,"Developing Communication Skills", MacMillan Publishers, Paperback 2019.

E-RESOURCES

1. https://nptel.ac.in/courses/109/106/109106094/ - (Introduction to Vocabulory)
2. https://nptel.ac.in/courses/109/106/109106129/ - (Reading Comprehension)

19MAT101 **ENGINEERING MATHEMATICS - I** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **3 1 0 4**

OBJECTIVES

To enable students to:

- Develop the use of matrix algebra techniques that is needed by engineering for practical applications.
- Introduce the basic concepts of functions, limit of function, continuity, derivaties and extreme values.
- Provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions.
- Make the basic concepts of definite, indefinite, improper integrals and bernoulli's formula.
- Acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

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: DIFFERENTIAL CALCULUS **9+3**

Representation of function – Limit of a function – Continuity – Derivatives – Differentiation rule – Maximum and Minimum values – absolute Maximum and Minimum – local Maximum and Minimum.

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

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

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

Definite and Indefinite integral – Substitution rule – Integration by parts - Trigoniometric substitutions – Integration of rational function by partial fraction – Improper integrals – Bernoulli's formula.

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

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 45+15=60 PERIODS

OUTCOMES

After successfully completing the course, the student will have a good understanding of the following topics and their applications.

- Understanding of the ideas of matrix and its nature.
- Apply differentiation to solve maxima and minima problems.
- Understanding the concept of partial differentiation and total derivative.
- Evaluate integrals using techniques of integration such as substitution, partial fractions and integration by parts.
- Apply integration to compute multiple integrals, area, volume, integrals in polar co-ordinates, in addition to change of order and change of variables.

TEXT BOOKS

1. Grewal B.S., - "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of `Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., — Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.

E-RESOURCES

1. https://nptel.ac.in/courses/111/105/111105121/ - (Rolle`s Theorem)
2. https://nptel.ac.in/courses/111/105/111105035/ - (Linear Algebra)

19CYE101 **ENGINEERING CHEMISTRY** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**
(Common to Civil, CSE, ECE, EEE & Mechanical)

OBJECTIVES

To enable students to:

- Classify the impurities of water and know the treatment and the conditioning methods for domestic and industrial uses.
- Develop an understanding about fundamentals of polymers.
- Be familiar with the types of corrosion and control measures and working of batteries.
- Gain knowledge about the phase rule and its applications to engineering field.
- Explain the basics of Nanochemistry, synthesis, properties and applications of Nano materials.
- Acquire practical skills in the determination of water quality parameters, molecular weight of polymer, rate corrosion through volumetric and instrumental analysis.

UNIT I: WATER TECHNOLOGY **9**

Introduction - Characteristics – hardness – estimation of hardness by EDTA method – alkalinity and its estimation - Boiler feed water – requirements –Boilers troubles (Scale and Sludge) – Internal conditioning (colloidal – phosphate – calgon and carbonate conditioning methods) – External conditioning – zeolite process, demineralization process – Desalination of brackish water by reverse osmosis - Municipality water treatment - Break point chlorination.

UNIT II: POLYMER CHEMISTRY **9**

Introduction - Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types of polymerization: Addition condensation and copolymerization, Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Preparation, properties and uses of PVC, Nylon 6,6, Polyethylene - Rubbers – types – vulcanization of rubber – Plastics – Moulding constituents of plastics – Moulding of plastics - compression, injection and blow moulding-Biodegradable polymers-Conducting polymers.

UNIT III: CORROSION AND BATTERY TECHNOLOGY **9**

Corrosion – Types – Chemical Corrosion – Electrochemical Corrosion (galvanic and Differential aeration) - Factors influencing corrosion – Material selection and design aspects-control methods of corrosion –Sacrificial anodic and impressed current cathodic protection - Protective coatings – paints – constituents and their functions - electroplating of Copper - electroless plating of Nickel.

Batteries: Definition, Types - example, Lead acid battery, Lithium ion battery – H2 – O2 fuel cell-solar cell.

UNIT IV: PHASE RULE AND ALLOYS **9**

Phase rule - explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead – silver system only).

Alloys: Introduction- definition- properties of alloys- significance of alloying, functions and effect of alloying elements - ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

UNIT V: CHEMISTRY OF NANO MATERIALS **9**

Nano chemistry – Basics (Surface area to volume ratio - Quantum confinement – (0D, 1D, 2D & 3D) - Distinction between Molecules, Nanoparticles and Bulk Materials - Characterisation of nano materials using XRD and SEM. Synthesis of nano materials: Top down approach - Ball milling - Bottom up approach - Sol-gel method, Chemical vapour deposition - Properties of nanomaterials and Applications of Nanomaterials (Nano products of today).

LIST OF EXPERIMENTS

(Any Eight Experiments to be conducted)

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of sodium and potassium present in water using flame photometer.
7. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
8. Conductometric titration of strong acid vs strong base.
9. Corrosion experiment-weight loss method.
10. Estimation of copper content in the brass by Iodometry.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Identify the method of removal of impurities from water for domestic and industrial purpose.
- Identify the different types of polymers, polymerisation processes and some special properties and applications of polymers.

- Analyze the causes of corrosion and discuss the control measures and discuss the functions of batteries.

- Apply of phase rule to alloy making for various engineering applications.
- Discuss the fundamentals of the nano materials and nano products of today.
- Outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TEXT BOOKS

1. Jain P.C and Monika Jain, "Engineering Chemistry", Dhanpet Rai Publishing Company (P) Ltd.,New Delhi, 2013.
2. Viswanathan B, "Nanomaterials" Alpha Science International Ltd, 2009.

REFERENCES

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.

E-RESOURCES

1. https://nptel.ac.in/downloads/122101001/ - (Corrosion)
2. https://nptel.ac.in/courses/122/101/122101001/ - (Atomic Structure)

19PHE101 **ENGINEERING PHYSICS** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**
(Common to Civil, CSE, ECE, EEE & Mechanical)

OBJECTIVES

The main objective of this course is to:

- Recognize different lattices and crystal structures.
- Be aware of the basic concepts of stress and strain.
- Know the basics of photonics and its applications.
- Make known the principles of quantum theory.
- Understand the applications of acoustics and ultrasonics in industry.
- Demonstrate experiments to understand basic of Engineering Physics concepts to be applied in optics, thermal physics, properties of matter and liquids.

UNIT I: STRUCTURE OF SOLIDS **9**

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d -Spacing in Cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal Growth Techniques –Solution, melt (Bridgman and Czochralski) and Vapour growth techniques(qualitative).

UNIT II: ELASTICITY **9**

Elasticity – Stress-Strain diagram and its uses - Factors affecting elastic modulus and tensile strength – Torsional stress and deformations – Twisting couple - Torsion pendulum: theory and experiment - Bending of beams :Bending moment – Cantilever: Theory and Experiment – Uniform and Non-uniform bending: Theory and experiment - I- Shaped girders.

UNIT III: PHOTONICS **9**

Introduction to interaction of radiation with matter- Spontaneous and Stimulated emission- Population Inversion - Derivation of Einstein's A and B coefficients – Principle and working of Laser - Nd:YAG laser - Direct bandgap and indirect bandgap semiconductors - Semiconductor diode Laser- Principle and propagation light in optical fibres- Derivation of Numerical aperture and Acceptance angle - Fibre optic communication system.

UNIT IV: QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – Wave particle duality – Electron diffraction – Concept of wave function and its Physical significance –

Schrödinger's wave equation : Time independent and time dependent equations – Particle in a one-dimensional rigid box- Qunatum Tunnelling –Tunnelling Electron Microscope.

UNIT V: ACOUSTICS AND ULTRASONICS **9**

Classification of sound- decibel- Weber–Fechner law – Sabine's formula - Derivation using growth and decay method – Absorption Coefficient and its determination – Factors affecting acoustics of buildings and their remedies Introduction- Classification of Sound waves - Production of Ultrasonic's by magnetostriction and piezoelectric methods - Acoustic grating – Cavitation - Applications of Ultrasonics

LIST OF EXPERIMENTS

(Any Eight Experiments to be Conducted)

1. Laser : Determination of wavelength of laser and particle Size.
2. Fiber Optics : Determination of Numerical Aperture and Acceptance angle.
3. Determination of bandgap of semiconductor.
4. Determination of wavelength of mercury spectrum- Spectrometer.
5. Determination of Youngs modulus – Non- Uniform bending.
6. Determination of Youngs modulus - Uniform bending.
7. Torsional Pendulum : Determination of moment of inertia and rigidity modulus.
8. Determination of velocity of ultrasonic in liquid.
9. Determination of Thickness of a thin wire – Air Wedge.
10. Determination of Viscosity of a liquid –Poiseulle's Method.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Apply these basic principles of structures of Engineering materials.
- Make use of materials properties using the knowledge of elasticity.
- Acquire the concepts of light propagation and its applications in lasers and fibre optics.
- Realize advanced physics concepts of quantum theory and its applications.
- Incorporate the acoustics and ultrasound applications.
- Apply principles of elasticity, optics and acoustic properties in Engineering applications.

TEXT BOOKS

1. Avadhanulu M.N & Kshirsagar P.G "Text Book of Engineering Physics". S.Chand, 2006.
2. P.Mani, "Engineering Physics Practicals", Dhanam Publications, 2019.

REFERENCES

1. Raghavan V, "Materials Science and Engineering": A First Course, PHI Publications, 2015.
2. Rajendran V. "Engineering Physics". Tata McGraw Hill Publications, 2012.

E-RESOURCES

1. https://nptel.ac.in/courses/122107035/ (Polarization)
2. https://ocw.mit.edu/courses/physics/ (Introduction)

19GET101 **ENGINEERING GRAPHICS** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **3 0 0 3**

OBJECTIVES

The main objective of this course is to:

- Understand the principles in graphic skill to communicate the concepts, ideas and design of engineering components.
- Learn projections of points, lines, planes viewed in different positions.
- Learn the projection of solids viewed in different positions.
- Gain the knowledge about the section of solids and development of surfaces of the given solids.
- Expose the international standards of technical drawing.

UNIT I: GENERAL PRINCIPLES OF ORTHOGRAPHIC PROJECTION **9**

Graphics significance in engineering applications - study of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets – principle of Letter writing and dimensioning.

Projections of points, lines and planes. Principles of orthographic projection - First angle projection only - Layout of views - Projection of points located in all quadrant - Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II: PROJECTION OF SOLIDS **9**

Projections of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT III: SECTION OF SIMPLE SOLIDS **9**

Section of solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

UNIT IV: DEVELOPMENT OF SURFACES **9**

Development of lateral surfaces of simple and truncated solids - prisms, pyramids, cylinders and cones with cutout, perpendicular and inclined to the horizontal axis

UNIT V: ISOMETRIC AND PERSPECTIVE PROJECTIONS **9**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Conversion of isometric projection into orthographic projection. Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL: 45 PERIODS

OUTCOMES

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

- Construct multiple views of engineering components.
- Prepare the pictorial drawings as per the standards.
- Develop the projection of solids.
- Draw the section of solids drawings and development of surfaces of given objects.
- Apply free hand sketching and concept of isometric in engineering practice.

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V., - "Engineering Graphics", 15th Edition, New Age International (P) Limited, New Delhi, 2018.
2. Natarajan K.V., "Engineering Graphics", 32nd Edition, Dhanalakshmi Publishers, Chennai, 2019.

REFERENCES

1. K.R. Gopalakrishna, "Engineering Drawing Volume 1 & 2", 55th Edition, Subhas Publications, Bangalore, 2017.
2. T.Jeyapoovan., "Engineering Graphics using Auto CAD" 3rd Edition, vikas publishing house Pvt Ltd, New Delhi, 2017.

E- RESOURCES

1. https://nptel.ac.in/courses/112/103/112103019/ - (Geometric Constructions)
2. https://nptel.ac.in/courses/105/104/105104148/ - (Projections)

19GEE101 **COMPUTER FUNDAMENTALS AND PYTHON PROGRAMMING** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**
(Common to Civil, CSE, ECE, EEE & Mechanical)

OBJECTIVES

The course objectives are to:

- Enable the student to learn the major components of a computer system and software.
- Know the basics of algorithmic problem solving and fundamentals of python programming.
- Develop simple python programs.
- Define controls and functions in python.
- Use python data structures - lists, tuples and dictionaries.

UNIT I: INTRODUCTION **9**

Introduction, Characteristics of Computers, Generation and Classifications of Computers, Basic Computer Organization, Computer Software, Types of Software, Software Development Steps, Internet, Getting connected to Internet Applications

UNIT II: PROBLEM SOLVING AND PYTHON FUNDAMENTALS **9**

Algorithms, building blocks of algorithms (instructions/statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Introduction to Python: Basics of Python and history of Python - Unique features of Python, interpreter and interactive mode - values and types: int, float, boolean, string, and list; variables.

UNIT III: EXPRESSIONS AND STATEMENTS **9**

Expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT IV: CONTROL FLOW AND FUNCTIONS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions, Strings, Lists as arrays. Illustrative programs: square root, gcd, Tower of Hanoi, exponentiation, sum an array of numbers, linear search, binary search.

UNIT V: LISTS, TUPLES AND DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples:

tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension.

LIST OF EXPERIMENTS

(Any Eight to be conducted)

1. Document Creation, Table Creation and Flow chart
2. Spread sheet- Chart, Formula, Sorting
3. Compute the GCD of two numbers.
4. Find the square root of a number (Newton's method)
5. Exponentiation (power of a number)
6. Find the maximum of a list of numbers
7. Linear search and Binary search
8. First n prime numbers
9. Multiplication of two matrices
10. Simulate elliptical orbits in Pygame

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Know the Computer basics, Components and Sofwares.
- Develop algorithmic solutions to simple computational problems and Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, and dictionaries.

TEXT BOOKS

1. Ashok.N.Kamthane," Computer Programming", Pearson Education (India), (2015).
2. Allen B. Downey, ''Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

REFERENCES

1. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python ''– Revised and updated for Python 3.2, Network Theory Ltd., 2011.
2. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/106/106/106106145/ - (Introduction to Algorithms)
2. https://nptel.ac.in/courses/106/106/106106182/ - (Joy of Computing)

19EEC101 **LIFE SKILLS FOR ENGINEERS** **L T P C**
(Employability Enhancement Course) **0 0 2 0**
(Common to Civil, CSE, ECE, EEE & Mechanical)

OBJECTIVES

To enable students to:

- Develop communication competence for engineers and enable them to convey thoughts and ideas with clarity and focus.
- Inculcate critical thinking process on problem solving.
- Have an overview on career skills required in their profession.
- Learn professional Ethics and Moral values.
- Lead a team with more responsibilities to be succeed in their endeavour.

UNIT I: COMMUNICATION SKILL **6**

Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication- Technical Presentation

UNIT II: CRITICAL THINKING & PROBLEM SOLVING **6**

Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Mind Mapping & Analytical Thinking.

UNITIII: CAREER SKILLS **6**

Introduction to Employability and Career Skills - developing a long - term career plan - making career changes -Time Management - General awareness of Current Affairs - Stress management - Leadership straits - Team work - Career planning.

UNIT IV: ETHICS MORAL & PROFESSIONAL VALUES **6**

Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues.

UNIT V: LEADERSHIP SKILLS **6**

Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

TOTAL: 30 PERIODS

OUTCOMES

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

- Communicate effectively and make effective presentations.
- Write different types of reports.

- Face interview & group discussion.
- Critically think on a particular problem.
- Get success in all aspects and develop public skills.

TEXT BOOKS

1. Life Skills for Engineers, McGraw Hill Education (India) Private Ltd., 2016.
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.

REFERENCES

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", 1st Edition; Oxford Publishers.
2. Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.

SEMESTER II

19HST201	**COMMUNICATIVE TECHNO ENGLISH - II** (Common to Civil, CSE, ECE, EEE & Mechanical)	**L T P C** **3 0 0 3**

OBJECTIVES

To enable students to:

- Acquire usage of grammar in English language.
- Enhance the reading skill to comprehend technical writing.
- Improve business writing skills.
- Develop presentation skills in analytical view.
- Help learners to develop their speaking skills and speak fluently in real contexts.

UNIT I: GRAMMAR **9**

Compound words- prepositions- articles- conditionals - Direct and indirect speeches-subject verb agreement- active and passive voice.

Activity: **Grammar worksheets on the given topics.**

UNIT II: LANGUAGE ENHANCEMENT THROUGH LISTENING & READING **9**

Syllabification- sentence stress – Intonation – Listening to You Tube Documentaries- Reading Vocabulary- Reading News Papers- Reading short stories.

Activity: **Playing video & TED and identifying stress and intonation.**

UNIT III: BUSINESS WRITING **9**

Writing Recommendations - Checklist- Business Letters - Calling for Quotations, Placing Orders, Letter of Complaint, Letter of Clarification - Cover Letter with Résumé- Report Writing - Accident Report, Industrial Visit Report, Survey Report and Feasibility Report.

Activity: **Giving topic and ask the students to prepare checklist and complaint.**

UNIT IV: WRITING **9**

Transcoding Graphics - Bar Chart, Flow Chart, Pie Chart and Tables- - Tour Itinerary - Process Description- Agenda and Minutes of meeting.

Activity: **Giving charts to the students and ask them to transcode.**

UNIT V: SPEAKING **9**

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - suggesting - comparing and contrasting – expressing - Finding out facts, attitudes and opinions - Commonly

mispronounced words.

TOTAL: 45 PERIODS

OUTCOMES

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

- Acquire advanced level gramatical knowledge.
- Improve their language usage in LSRW skills.
- Speak fluently using a wide range of vocabulary.
- Acquire the ability to understand different written texts.
- Enhance the writing skills to express the ideas in the business contexts.

TEXT BOOKS

1. Title: Technical English II Author: S. Sumant Maven Learning.
2. Communicative English by KN Shoba ,Lourdes Joavani Rayen Publised by Cambridge university 2017.

REFERENCES

1. Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, "Resonance English for Engineers and Technologists".Cambridge University Press, 1st Edition, Foundation Books,New Delhi, 2013.
2. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.

E-RESOURCES

1. https://nptel.ac.in/courses/109/104/109104031/ - (Verbal and Non Verbal Communication)
2. https://nptel.ac.in/courses/109/106/109106094/ - (Technical English for Engineers)

19CYT201 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **3 0 0 3**

OBJECTIVES

To enable students to**:**

- Understand the importance of the environment and interrelationship between living organism and environment.
- Understand the various kinds of pollutions.
- Gain knowledge about natural resources and resource management.
- Be familiar with the social issues to improve the quality of environment.
- Gain knowledge about biodiversity, waste management and population explosion.

UNIT I: ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY **11**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – 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, rivers, oceans) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Activity: Biodiversity in and around the campus and report submission.

UNIT II: ENVIRONMENTAL POLLUTION **9**

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 - e-waste – role of an individual in prevention of pollution - pollution case studies – disaster management: floods, earthquake and cyclone.

Activity: Local Pollution Case Study and report submission.

UNIT III: NATURAL RESOURCES **10**

Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, 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, 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.

Activity: Waste to wealth.

UNIT IV: SOCIAL ISSUES AND THE ENVIRONMENT **9**

From unsustainable to sustainable development – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies - environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – Green Chemistry and principles - environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – Public awareness.

Activity: Creating Environmental 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.

Activity: Visit to local primary health center.

TOTAL: 45 PERIODS

OUTCOMES

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

- Find scientific, technological, economic and political solutions to environmental problems.
- Invent innovative solutions for pollutions to improve the quality of environment.
- Participate the conservation of natural resources to save earth.
- Promote sustainable development and understand the concept of green chemistry.
- Analyse the effects of human population and issues related to the environment and human health.

TEXT BOOKS

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.

REFERENCES

1. Erach Bharucha, 'Textbook of Environmental Studies', Universities Press (I) Pvt Ltd., Hydrabad, 2015.
2. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd., New Delhi, 2007

E-RESOURCES

1. https://nptel.ac.in/courses/122102006/ - (Nature of Environment)
2. https://nptel.ac.in/courses/127/105/127105018/ - (Sustainability Concepts)

19MAT201 **ENGINEERING MATHEMATICS – II** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **3 1 0 4**

OBJECTIVES

The Course objectives are to:

- Acquire sound knowledge of techniques in solving Ordinary Differential Equations that model engineering problem.
- Acquaint the concepts of vector calculus, needed for problems in all engineering disciplines.
- Understand the concept of bilinear transform and analytic functions.
- Understand the standard techniques of complex integration.
- Use Laplace transforms for solving the problems efficiently that occur in various branches of engineering disciplines.

UNIT I: DIFFERENTIAL EQUATIONS **9+3**

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

UNIT II: VECTOR CALCULUS **9+3**

Gradient and directional derivative - Divergence and curl – 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 function $W = \frac{1}{z}$ – Bilinear transformation.

UNIT IV: COMPLEX INTEGRATION **9+3**

Cauchy's integral theorem– Cauchy's integral formula –Laurent's series – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNITV: 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 –Inverse transforms –

Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 45+15=60 PERIODS

OUTCOMES

After successfully completing the course, the student will have a good understanding of the following topics and their applications

- Higher order linear differential equations with constant coefficients and variable coefficient.
- Green's,Gauss divergence and Stoke's theorems – Verification and application.
- Analytic functions, conformal mapping and Bilinear transformation.
- Application of residue theorem for evaluation of real integrals on contour integral.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, Delhi, 10th Edition, New 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.

E-RESOURCES

1. https://nptel.ac.in/courses/111/105/111105134/ - (Vector Functions)
2. https://nptel.ac.in/courses/122/107/122107036/ - (Complex Integration)

19PHT201 **PHYSICS OF MATERIALS** **L T P C**
(Common to Civil and Mechanical Engineering) **3 0 0 3**

OBJECTIVES

The main objectives of this course are to:

- Study the heat transfer modes and thermal conductivity of different materials.
- Observe the Iron-carbon phase diagram, steels & its applications.
- Get knowledge about various materials characterization techniques.
- Understand the low temperature applications of materials and Superconductivity.
- Update the knowledge of new kind of Engineering materials and Carbon Nanotubes.

UNIT I: THERMAL PHYSICS **9**

Transfer of heat energy – Thermal expansion of solids and liquids – Pxpansion joints - Bimetallic strips- Thermal conduction, convection and radiation – Heat conductions in solids – Thermal conductivity -Forbe's and Lee's disc method: theory and experiment - Conduction through compound media (series and parallel) – Thermal insulation.

UNIT II: FERROUS ALLOYS **9**

The iron-carbon equilibrium diagram - Phases, Invariant reactions - Microstructure of slowly cooled steels - Eutectoid steel, hypo and hypereutectoid steels - Phase transformations – TTT diagram for eutectoid steel – Pearlitic, baintic and martensitic transformations (qualitative)- Tempering of martensite – Steels – Stainless steels – Cast irons.

UNIT III: MATERIALS CHARACTERIZATION **9**

Introduction to materials and Techniques-X-ray diffraction (XRD)- Electron Microscope-Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM)- Non-destructive testing (NDT) : Liquid penetrant test, magnetic detection, Electromagnetic testing, Ultrasonic test, Thermal infrared testing and Spark test.

UNIT IV: CROYOGENICS **9**

Introduction to Cryogenics - Properties of Cryogenic Fluids- Gas-Liquefaction of gases and Refrigeration Systems – Cryocoolers -Cryogenic Insulations - Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity - High Tc superconductors – General applications of superconductors –Cryotron and Magnetic levitation. High Tc Superconductors- Sperfluity.

UNIT V: NEW ENGINEERING MATERIALS **9**

Ceramics – types and applications –Composites: classification, Role of matrix and reinforcement,

Characterisation of fiber reinforced plastics - Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application- Canbon Nano Tubes (CNT) structure, properties and applications.

TOTAL: 45 PERIODS

OUTCOMES

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

- Knowledge on the thermal conductivity and their applications.
- Aquire knowledge on phase diagram,various microstructures and alloys.
- Get knowledge on materials characterization techniques.
- Have the potential applications of superconductors.
- Understand the basics of ceramics, composites and nanomaterials.

TEXT BOOKS

1. P.Mani, " A text book of Engineering Physics " Dhanam Publications, 2018
2. Rajendran V. "Engineering Physics". Tata McGraw Hill Publications, 2012.

REFERENCES

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials" Narosa Publishing House, 2009.

E-RESOURCES

1. https://nptel.ac.in/courses/112108150/ - (Material Science)
2. https://swayam.gov.in/nd1_noc19_mm13/preview - (Advanced Materials and Processes)

19GEE202 **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**
(Common to Civil and Mechanical Engineering)

OBJECTIVES

The objective of this course will enable students to:

- Understand electric circuit laws, single and three phase circuits, wiring and measuring instruments.
- Know working principles of Electrical Machines.
- Realize the working principle of Various electronic devices and applications.
- Apply the principles of digital electronics in digital world.
- Aquire fundamental concepts of microprocessors and communication.
- Provide exposure with hands on training in electrical and electronics engineering.

UNIT I: ELECTRICAL CIRCUITS & MEASURMENTS **9**

Basic circuit components - Ohms Law - Kirchoff's Law - steady state solution of DC circuits - Nodal analysis, Mesh analysis- -Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits - housing wiring, industrial wiring, materials of wiring- Classification of instruments – Operating Principles of indicating Instruments.

UNIT II: ELECTRICAL MACHINES **9**

Construction – Principle of operation – Basic equations and characteristics of DC Generators – DC Motors – Transformers (single and three phase) – three phase and single phase induction motors.

UNIT III: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Introduction - Characteristics of PN Junction Diode – Forward and Reverse Bias – Zener Effect – Zener Diode and its Characteristics - Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics .

UNIT IV: DIGITAL ELECTRONICS **9**

Binary Number System – Boolean Algebra theorems – Digital circuits - Introduction to sequential Circuits – Flip -Flops – Registers and Counters – A/D and D/A Conversion .

UNIT V: FUNDAMENTALS OF MICROPROCESSORS AND COMMUNICATION ENGINEERING **9**

Block diagram – Pin diagram – Architecture – Addressing modes of 8085 microprocessor– Introduction –

Elements of Communication Systems – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

LIST OF PRACTICALS

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.
7. Identification of AC and DC instruments.
8. Calibration of ammeter and voltmeter.
9. Identification of electronic components and equipments.
10. Soldering practice-components devices and circuits-using general purpose PCB

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Understand electric circuits and choose appropriate instruments for electrical measurement for a specific application.
- Understand the concept of different types of DC and AC machines.
- Identify the diode's usage as a rectifier, and Zener diode's usage as an voltage regulator and discuss the basic characteristics of BJT.
- Employ Boolean algebra to implement the combinational logic circuits.
- Discuss about Microprocessors, Microcontrollers and recognize their needs.
- Carry out basic home electrical works and appliances and measure the electrical quantities and soldering practice.

TEXT BOOKS

1. D P Kothari and I.J Nagarath, "Electrical Machines ,Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, 3rd Reprint ,2017.
2. Sedha R.S., "Applied Electronics", S. Chand & Co., 2008.

REFERENCES

1. Ramesh Goankar, "Microprocessor Architecture", Programming and Applications with 8085, Wiley Eastern, 2000.

2. B.L.Thereja, "A Text of Electrical Technology", S.Channd publications, Vol.1 - Vol 4, 2012.

E-RESOURCES

1. https://nptel.ac.in/courses/108/105/108105132/ - (Digital Electronics Circuits)
2. http://onlinecourses.nptel.ac.in/108108076 -(Basic Electrical Technology)

19MET201 **ENGINEERING MECHANICS** **L T P C**
(Common to Civil and Mechanical Engineering) **3 1 0 4**

OBJECTIVES

The objective of this course will enable students to:

- Understand the definition of particle, body, force and their equilibrium conditions.
- Understand the concept of equilibrium of rigid bodies.
- Learn the basic concepts of friction.
- Learn about the center of gravity and moment of inertia of surfaces and solids.
- Understand the force motion relationship in components subjected to external forces and analysis of standard mechanism.

UNIT I: STATICS OF PARTICLES **9+3**

Introduction – Laws of Mechanics – Parallelogram and triangular Law of forces – Principle of transmissibility – Coplanar Forces – Resolution and composition of force – Free body diagram – Equilibrium of a particle in plane – Forces in space – Equilibrium of a particle in space.

UNIT II: STATICS OF RIGID BODIES **9+3**

Moments: Moment of a force about a point and about an axis – Scalar components of a moment – Varignon's theorem – Single equivalent force – Types of supports and reactions – stable equilibrium – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III: FRICTION **9+3**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – Angle of Repose – Belt friction – Ladder friction – wedge friction – Rolling resistance.

UNIT IV: PROPERTIES OF SURFACES AND SOLIDS **9+3**

Determination of areas and Volumes – First moment of area and Centroids of sections – T - section, I-section, - Angle section, Hollow section by using standard formula – 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 – Relation to area moments of inertia.

UNIT V: 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.

TOTAL: 45+15=60 PERIODS

OUTCOMES

On successful completion of this course, The Students can able to:

- Understand the forces and its related laws of mechanics in static and dynamic conditions.
- Solve problems in engineering systems using the concept of static equilibrium.
- Solve problems involving frictional phenomena in machines.
- Solve the moment of inertia of any sections and masses for the structural members.
- Apply the different principles to study the motion of a body and analyze their constitutive equations.

TEXT BOOKS

1. Dr.N.Kottiswaran, "Engineering Mechanics", 11th Edition, Sri Balaji Publications, Coimbatore, (2017).
2. Vela Murali, "Engineering Mechanics", Oxford University Press, (2017).

REFERENCES

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education, 2010.
2. 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).

E-RESOURCES

1. https://nptel.ac.in/courses/122/104/122104015/ - ((Engineering Mechanics)
2. https://www.courses.com/indian-institute-of-technology-guwahati/engineering-mechanics - (Engineering Mechanics)

19EEC201 **TECHNICAL SKILL (AutoCAD)** **L T P C**
(Employability Enhancement Course) **0 0 2 0**
(Common to Civil and Mechanical Engineering)

OBJECTIVES

The objective of this course will enable students to:

- Develop skill to use software to create 2D and 3D models.

LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING AND MODELING

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

TOTAL: 20 PERIODS

OUTCOMES

On successful completion of this course, The Students can able to:

- Understand develop skill to use software to create 2D and 3D models.

SEMESTER III

19MAT301 **TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **3 1 0 4**

OBJECTIVES:

The objective of this course will enable students to:

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

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations - 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 types.

UNIT II: FOURIER SERIES **9+3**

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range Sine and Cosine series - Parseval's identity - Harmonic analysis.

UNIT III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Classification of partial differential equations - 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+3**

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

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

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

TOTAL= 45+15=60 PERIODS

OUTCOMES

After successfully completing the course, the student will be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- 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.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z- transform techniques for discrete time systems.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., ManicavachagomPillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES

1. N.P. Bali and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
2. Erwin Kreyszig, "Advanced Engineering Mathematics",10th Edition, John Wiley,India,2016.

E-RESOURCES

1. https://nptel.ac.in/courses/111/105/111105035/ - (Review Groups, Fields and Matrices)
2. https://nptel.ac.in/courses/111105035/27 - (Complex Variables)

19MET301 **ENGINEERING THERMODYNAMICS** **L T P C**

(Use of Standard Refrigerant Tables and Chart Data Book and Steam Table is Permitted) **3 1 0 4**

OBJECTIVES

The objective of this course will enable students to:

- Understand the fundamentals of thermodynamics and basic conversion principles of mass and energy to closed and open systems.
- Provide better understanding of laws of thermodynamics.
- Achieve the understanding of the thermodynamic properties and properties of pure substance.
- Develop an ability to identify the concept of thermodynamic relations.
- Enlighten the basic concept of psychrometry.

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

Basic concepts - Concept of continuum, comparison of microscopic and macroscopic approach - Thermodynamic systems - Closed, open and isolated - Thermodynamic equilibrium state, path and process - Quasi-static, reversible and irreversible processes - Heat and work transfer, Zeroth law of thermodynamics and First law of thermodynamics - Application to closed and open systems - Steady and unsteady flow processes.

UNIT II: SECOND LAW **9+3**

Heat Reservoir, source and sink - Heat Engine, Refrigerator, Heat pump - Second law of themodynamics - Kelvin - Planck and Clausius statements - Carnot cycle Reversed Carnot cycle, Performance - Clausius inequality - Concept of entropy, entropy change for - Pure substance, ideal gases, principle of increase in entropy.Basic concept of availability.

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

Thermodynamic properties, p-v, p-T, T- v, T-s, h- s diagrams, p- v-T surface - Application of I and II law for pure substances - Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, and regenerator.

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.Compressibility factor and Compressibility chart and its use. Maxwell relations, Tds Equations,

Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation.

UNIT V: PSYCHROMETRY **9+3**

Psychrometric - Properties, 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 - Air-conditioning.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Understand the fundamental concepts and definitions, thermodynamic principles to Engineering problems.
- Understand the second law of thermodynamics and availability analysis.
- Identify the properties of pure substance and explain the working of steam power cycle.
- Discuss the thermodynamic relation, ideal and real gas behavior.
- Understand the fundamental properties and types of psychrometric process.

TEXT BOOKS

1. Nag.P.K., "Engineering Thermodynamics", 4th Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw Hill, 2010.

REFERENCES

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam publications, 2012.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105266/ - (Concepts of Thermodynamics)
2. https://nptel.ac.in/courses/112/104/112104113/ - (Basics of Thermodynamics)

19MET302 **KINEMATICS OF MACHINERY** **L T P C**
3 1 0 4

OBJECTIVES

The objective of this course will enable students to:

- Comprehend the fundamentals of kinematics and to understand the concept of machines, mechanisms and related terminologies.
- Study the motion and forces concerning different parts of mechanism and to understand the concepts of theory of machines involved in design of parts.
- Draw the displacement, velocity and acceleration diagrams for a given cam profile and analyse the special contour cams.
- Inferring about the basic concepts, terminologies of gears and gear trains.
- Illustrate the occurrence and its effects of friction in various machine elements.

UNIT I: BASICS OF MECHANISMS **9+3**

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.

UNIT II: LINKAGE MECHANISMS **9+3**

Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method - Velocity and acceleration polygons - Velocity analysis using instantaneous centres.

UNIT III: CAM MECHANISMS **9+3**

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.

UNIT IV: GEARS AND GEAR TRAINS **9+3**

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 - Epicyclic Gear Trains.

UNIT V: FRICTION IN MACHINE ELEMENTS **9+3**

Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads - Friction clutches - Belt and rope drives.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Build up critical thinking and problem solving capacity of various mechanical engineering problems related to kinematics of machines.
- Perform the velocity and acceleration analysis on various links which constitute a mechanism.
- Understand the working principles of gears, gear trains and cams.
- Develop the ability to use mathematics as a tool whereby the solution to problem may be carried out in the most direct and effective manner. .
- Recognize the effect of friction in different friction drives.

TEXT BOOKS

1. Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.
2. R.S.Khurmi and J.K.Gupta, "Theory of Machines" S.Chand and Co Ltd., 2019.

REFERENCES

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 3rd Edition, 2019.
2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 3rd Edition, 2015 .

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104121/ - (Kinematics of Machines)
2. https://nptel.ac.in/courses/112/105/112105268/ - (Kinematics of Mechanism and Machines)

19EET303 **ELECTRICAL DRIVES AND CONTROL** **L T P C**
3 0 0 3

OBJECTIVES

The objective of this course will enable students to:

- Understand the basic knowledge of Electrical Drives.
- Familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications.
- Learn the different methods of starting D.C motors and induction motors.
- Learn the operation of controlled rectifier and chopper fed DC Drives.
- Understand the Conventional and solid-state drives.

UNIT I: ELECRICAL DRIVES **9**

Basic Elements - Types of Electric Drives - Factors influencing the choice of electrical drives - Heating and cooling curves - Loading conditions and classes of duty - Selection of power rating for drive motors with regard to thermal overloading and Load variation factors**.**

UNIT II: DRIVE MOTOR CHARACTERISTICS **9**

Speed - Torque characteristics of various types of load and drive motors - DC shunt motor, series motor and Induction motors - Characteristics and application - Braking of Electrical motors - DC motors: Shunt, series and compound - Single phase and three phase induction motors.

UNIT III: STARTING METHODS **9**

Need for starters - Types of D.C Motor starters -Two Point Starter, Three Point Starter and Four Point Starter - Types of A.C Motor starters - Direct on-line Starter, Primary Resistance Starter, Auto-transformer Starter, Star-Delta Starter and Rotor Resistance Starter.

UNIT IV: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES **9**

Speed control of DC series and shunt motors - Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers - Applications**.**

UNIT V: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES **9**

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

TOTAL: 45 PERIODS

OUTCOMES

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

- Identify and explain the types and selection of rating of electrical drives.
- Analyze the speed-torque characteristics and braking characteristics of electrical drives for DC shunt, series and induction motors.
- Illustrate the types and characteristics of DC and AC motor starters.
- Compare and contrast the conventional and solid-state speed control of DC and AC drives.
- Test the speed control of DC and AC motors and the performance analysis of DC and AC motor drives.

TEXT BOOKS

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2016.
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2017.

REFERENCES

1. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2016.
2. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2017.

E-RESOURCES

1. http://www.nptelvideos.in/2012/ll/advanced-electric-drives.html - Advanced Electric Drives, NPTEL Videos, IIT Delhi.
2. http://nptel.iitm.ac.in - Advanced Electric Drives by Dr. S.P. Das, Department of Electrical Engineering, IIT Kanpur.

19MEE301 **MANUFACTURING TECHNOLOGY - I** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

The main objective of this course is to:

- Study the sand casting for a two part mould is to remove the pattern without breaking the mould cavity and ready to be filled with the molten metal.
- Join two separate pieces of metal or plastic together to form one singular piece and not be able to break apart under (potential) applied load.
- Understand modern forging machine driven impact hammers or presses which deform the workpiece by controlled pressure.
- Obtain the sheet metal forming involves a wide range of processes that manufacture parts for a vast amount of purposes, both seen and unseen.
- Provide the students with overall knowledge on the manufacturing of plastic materials, their properties, applications, processing & quality control, and recycling through theory as well as practical training.
- Study and practice the moulding processes techniques, various operations that can be performed in lathe machines, welding and sheet metal.

UNIT I: CASTING PROCESSES **9**

Sand casting - Sand moulds - Type of patterns - Pattern materials - Pattern allowances - Types of moulding sand - Properties - Core making - Methods of Sand testing - CO_2 process - Moulding machines - Melting furnaces.Working principle of special casting processes - Shell, investment casting - Pressure die casting - Centrifugal casting - Sand Casting defects

UNIT II: METAL JOINING PROCESSES **9**

Fusion welding processes - Types of Gas welding - Equipments used - Flame characteristics - Filler and Flux materials - Arc welding equipments - Electrodes - Coating and specifications - Principles of Resistance welding - Spot/butt, Seam welding - Percussion welding - Gas metal arc welding - Flux cored - Submerged arc welding - Electro slag welding - TIG welding.

Principle and application of special welding processes - Plasma arc welding - Thermit welding - Electron beam welding, Laser Beam Welding, Friction stir welding, Ultrasonic Welding - Weld defects

UNIT III: BULK DEFORMATION PROCESSES **9**

Hot working and cold working of metals - Forging processes - Open and closed die forging - Characteristics of the process - Types of forging machines - Typical forging operations.

Rolling of metals - Types of Rolling mills - Flat strip rolling - Shape rolling operations - Defects in rolled parts - Principle of rod and wire drawing - Tube drawing - Principles of Extrusion - Types of Extrusion - Hot and Cold extrusion - Equipments**.**

UNIT IV: SHEET METAL FORMING PROCESSES **9**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations - Stretch forming operations - Formability of sheet metal and Bending force calculations - Test methods. Working principle and application of special forming processes - Hydro forming - Rubber pad forming - Metal spinning - Explosive forming - Magnetic pulse forming - Peen forming - Super plastic forming.

UNIT V: PROCESSING OF PLASTIC COMPONENT **9**

Types of plastics - Characteristics of the forming and shaping processes - Moulding of Thermoplastics - Working principles and applications of Injection moulding - Plunger and screw machines - Compression moulding - Transfer moulding - Typical industrial applications - Blow moulding - Rotational moulding - Film blowing - Extrusion - Thermoforming - Bonding of Thermoplastics.

LIST OF EXPERIMENTS

1. Mould with solid and split patterns.
2. Mould with loose-piece pattern.
3. Perform facing, plain turning and step turning operations in centre lathe.
4. Perform taper turning, thread cutting and knurling operations in centre lathe.
5. Fabrication of simple structural shapes using welding.
6. Manufacturing of simple sheet metal components using shearing and bending operations.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Understand the usage of pattern and casting production by using different methods.
- Understand the basic concepts of metal joining and their application.
- Summarize various hot working and cold working methods of metals.
- Analysis the various sheet metal making processes.
- Distinguish various methods of manufacturing plastic components.

- Ability to make moulding, use different machine tools to machining, welding and sheet metal operations.

TEXT BOOKS

1. Hajra Chouldhary S.K and Hajra Choudhury. A.K., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013.

REFERENCES

1. Rao,P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH-2013.
2. Roy.A.Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006.

E-RESOURCES

1. http://nptel.ac.in/courses/1121 05126/ - Rao P.N, "Manufacturing Technology - Metal Cutting and Machine Tools"
2. https://freevideolectures/A0dTvf_Q8BA / - Prof.A.B.Chattopadhyay, "Manufacturing Process"

19MEE302 **FLUID MECHANICS AND MACHINERY** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

The main objective of this course is to:

- Impart knowledge on the properties of fluid flow characteristics and its dynamics.
- Understand the difference between laminar and turbulent flow through circular conduits and losses in pipe flow.
- Gain the knowledge of dimensional and model analysis.
- Improve the knowledge of types of pumps, working principle, application and performance analysis of fluid pumps.
- Recognize the basic knowledge of types of turbines, working principle, velocity triangle and performance curves of hydraulic turbines.
- Verify the principles studied in fluid mechanics theory by performing experiments in lab.

UNIT I: FLOW CHARACTERISTICS AND DYNAMICS OF FLUID FLOW **9**

Introduction - Properties of fluids - Density, specific weight, specific volume, Specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity. Flow characteristics - Rate of flow, concept of control volume and continuity equation for one dimensional flow.

Dynamics of fluid flow - Euler's equation of motion, Bernoulli's equation and practical application of Bernoulli's Equation - Venturimeter and Orifice meter - Horizontal type.

UNIT II: FLUID FLOW TYPES AND FLOW THROUGH PIPES **9**

Flow of viscous fluid through circular pipe- Hagen Poiseuille equation - Types of fluid flow - Steady and unsteady, Uniform and non-uniform, Laminar and Turbulent, Compressible and incompressible, Rotational and irrotational (Qualitative treatment).

Flow through pies (Loss of energy in pipes) - Major losses - Darcy-Weisbach equation and chezy's formula - Minor losses - Moody diagram (Qualitative treatment) - Flow though pipes in series and in parallel.

UNIT III: DIMENSIONAL AND MODEL ANALYSIS **9**

Introduction - Derived quantities - Dimensional Homogeneity - Method of dimensional analysis - Buckingham's π- theorem.

Similitude - Types of similitude - Dimensionless numbers - Model laws - Application of dimensionless

parameters - Model analysis.

UNIT IV: HYDRAULIC PUMPS **9**

Centrifugal pumps - Construction details - Working principle - Velocity triangle - Work done by the impeller - Performance curves - Multi stage centrifugal pump for high head and high discharge - Specific speed.

Reciprocating pump - Construction details - Working principle - Slip - Discharge - Work done - Power required to drive single acting and double acting pumps - Rotary pumps - Classification -Working principles.

UNIT V: HYDRAULIC TURBINE **9**

Classification of turbines - Construction details - 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

LIST OF EXPERIMENTS

1. Coefficient of discharge of Venturi meter/ Orifice meter.
2. Determination of friction factor for a given set of pipes.
3. Performance test on centrifugal pump.
4. Performance test on reciprocating pump/submersible pump/gear pump.
5. Performance analyse of Pelton wheel.
6. Performance analyse of Francis turbine/ Kaplan turbine.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Analyze the dynamics of fluid flow and summarize the flow characteristics.
- Identify the flow characteristics and calculate major and minor losses associated with pipe flow in piping networks.
- Invent the principles of dimensional analysis and model analysis to fluid flow problems.
- Evaluate the performance of pumps.
- Conduct the performance study on different turbines.
- Apply the Bernoulli's principle to find the coefficient of discharge, determine the friction factor for set of pipes, and analyze the performance characteristics of turbine and pumps.

TEXT BOOKS

1. Moodi P.N and Seth.S.M, "Hydraulics and Fluid Machines", Standard Book house, New Delhi, 22nd Edition, 2019.

2. Dr R.K. Bansal, "A text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 10th Edition, 2018.

REFERENCES

1. R.K Rajput, "A Textbook of Fluid Mechanics and Hydraulic Machines", S.Chand & company Ltd., 6th Edition, 2015.
2. K.L Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 7th Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105171/ - (Fluid Mechanics)
2. https://nptel.ac.in/courses/112/105/112105182/ - (Introduction to Fluid Mechanics and Compressible flow)

19EEC302	ENTREPRENEURSHIP DEVELOPMENT ACTIVITY (Common to Civil, CSE, ECE, EEE & Mechanical)	L T P C 0 0 2 0

OBJECTIVES

The objectives will make the students to :

- Evaluate social and civil responsibilities of business ownership.
- Describe typical behavioral characteristics of an effective entrepreneur.
- Develop a business plan, including identifying an executive summary; conducting a marketing and competitive analysis report; and developing a marketing, management, and financial plan.
- Determine career opportunities, responsibilities, and educational and credentialing requirements related to various entrepreneurship ventures.
- Interpret research data to determine market-driven problems faced by entrepreneurs.

TOIPICS TO BE COVERED

1. Should You Become an Entrepreneur?
    - Entrepreneurship: Present & Past
    - Is Entrepreneurship Right for You
    - Identify Business Opportunities & Set Goals
2. What Skills Do Entrepreneurs Need
    - Communication Skills
    - Math Skills
    - Problem Solving Skills
3. Entrepreneurs in a Market Economy
    - What is an Economy?
    - The Concept of Cost
    - Government in a Market Economy
4. Select a Type of Ownership
    - Run an Existing Business
    - Own a Franchise or Start a Business
    - Choose the Legal Form of Your Business

5. Develop a Business Plan
    - Why Do You Need a Business Plan
    - What Goes into a Business Plan
    - Create an Effective Business Plan

6. Identify and Meet a Market Need
    - The Value of Market Research
    - How to Perform Market Research Entrepreneurship Syllabus
    - Identify Your Competition
7. Finance, Protect, and Insure Your Business
    - Put Together a Financial Plan
    - Obtain Financing for Your Business
    - Protect Your Business
8. Choose Your Location & Set Up for Business
    - Choose a Retail Business Location
    - Choose a Location for a Nonretail Business
    - Obtain Space and Design the Physical Layout
    - Purchase Equipment, Supplies, and Inventory
9. Market Your Business
    - The Marketing Mix
    - Product, Price, Distribution, Price, and Promotion
    - Set Marketing Goals
10. Hire and Manage a Staff
    - Hire Employees
    - Create a Compensation Package
    - Manage your Staff
11. Record-Keeping and Accounting
    - Set up a Record Keeping System
    - Understand Basic Accounting
    - Track Your Inventory
12. Financial Management
    - Manage your Cash Flow

- Analyze Your Financial Performance
- Hire Experts

13. Use Technology
    - Technology and Your Business
    - Learn about the Interest
    - Purchase Technology
14. Intellectual property Rights
    - Patents
    - Copyright
    - Industrial design rights
    - Trademarks
    - Trade secrets
15. Innovation Contest
    - Innovative Idea
    - Proof of Concept (PoC)
    - Prototype Creation
    - The students may be grouped into 2 to 3 and work under a project supervisor. The Prototypes to be fabricated may be decided in consultation with the supervisor. A innovative report to be submitted by the group and the model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.

OUTCOMES

At the end of this course, students can:

- Identify personal strengths and value systems.
- Recall important tenets of digital literacy.
- Discuss the essentials of matters pertaining to money.
- Prepare for employment and self-employment.
- Illustrate the basics of entrepreneurship and identify new business opportunities.

TOTAL: 15 PERIODS

19MDC301 **LEADERSHIP ENHANCEMENT PROGRAMME** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **1 0 0 0**

OBJECTIVES

The objective of the course is enabling the students to:

- Find new, innovative ways of developing and managing people.
- Develop new business opportunities.
- Tackle the broader societal issues the face.
- key benefits of leadership skills in different situations.
- formulate and implement effective leadership strategies.

TOIPICS TO BE COVERED

1. Leadership for an Engineering students: Skills & Strategies
2. Qualities of good leaders and 21 irrefutable laws of Leadership
3. Empowering Others and Managing People
4. Leading Meetings
5. Leadership competencies and Leadership Styles
6. Difference between a boss and a leader.
7. Leadership and Assertiveness Skills : A Good Leader, Leadership Theories, Leadership Behaviour , Assertiveness skills.
8. Leadership development opportunities and suggestions
9. Teamwork and Leadership : Concept of teams , Building Effective teams, Concept of leadership and sharpening leadership skills.
10. Teamwork and Leadership Activities : Group discussion, Solving Puzzle as a team, describing a leadership style.

OUTCOMES

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

- Develop the capabilities needed to increase team's work productivity.
- Help to decrease employee turnover and increase engagement, creating a strong and united team.
- Develop communication skills, mastering the art of negotiation, influence and conflict management.

- More confident as a leader and find new ways of influencing the teams they lead.
- Effectively connect to people, developing the ability to give constructive feedback, and critically seek the feedback of the team.

TOTAL: 12 PERIODS

TEXT BOOKS

1. John maxwell, "21 irrefutable laws of leadership" 2008
2. Sara N. King, David G. Altman, Robert J. Lee, "Discovering the leader in you"
3. Louis carter, David ulrich , Marshall Goldsmith "Best practices in leadership development and Organization change".

REFERENCES

1. Barry Benator, Albert Thumann,"Project Management and Leadership Skills for Engineering and Construction Projects" 2003.
2. Sydänmaanlakka Pentti. "Intelligent leadership and leadership competencies". Dissertation Series.

E-RESOURCES

1. https://nptel.ac.in/courses/122/105/122105021/ - (Introduction to Leadership)
2. www.ccl.org/leadership/research/index.aspx - (Centre for Creative Leadership)

SEMESTER IV

19MAT404 **STATISTICS AND NUMERICAL METHODS** **L T P C**
3 1 0 4

OBJECTIVES

The main objective of this course is to:

- Provide the necessary basic concepts of a few statistical and numerical methods for solving the problems Engineering and technology field.
- Acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- Introduce the basic concepts of solving algebraic, transcendental, exponential and logarithmic equations.
- Introduce the numerical techniques of interpolation and numerical techniques of differentiation in Engineering and technology disciplines.
- Acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I: TESTING OF HYPOTHESIS **9+3**

Sampling and Large sample tests - Standard error - Test of significance for small samples - 't' test - Snedecor's F- test of significance for small samples - Chi-square test for goodness of fit - Independence of attributes.

UNIT II: DESIGN OF EXPERIMENTS **9+3**

Basic principles of experimental design - Completely randomised design - Analysis of vaiance for one way classification - Randomised block design - Analysis of variation for two factor experiments variations - Latin square design.

UNIT III: SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+3**

Solution of algebraic and transcendental equations by Newton Raphson method - Solution of linear system of equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method.

UNIT IV: INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION **9+3**

Newton's forward and backward interpolation formulae - Lagrange's interpolation and Newton's divided difference interpolation formulae - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson's 1/3 rule - Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Taylor's series method - Euler's and Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Milne's Predictor corrector methods for solving first order equations - Finite difference methods for solving second order ordinary differential equations.

TOTAL: 45+15=60 PERIODS

OUTCOMES

After successfully completing the course, the students can:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS

1. Grewal,B.S., and Grewal.J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Dr.Kandasamy.P, Dr.Thilagavathy. K and Dr.Gunavathy.K., "Statistics and Numerical Methods", S.Chand and Company Ltd., New Delhi, 2010.

REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore.J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.

E-RESOURCES

1. https://nptel.ac.in/courses/111/107/111107105/ - (Numerical Methods)
2. https://nptel.ac.in/courses/111/105/111105041/ - (Probability and statics)

19MET401 **ENGINEERING METALLURGY** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Provide in depth knowledge on the constitution of alloys and phase diagrams.
- Correlate the materials behaviour and heat treatment process.
- Correlate the materials behavior and evaluate material properties.
- Impart knowledge on non-metallic materials.
- Identify and select suitable materials properties and testing.

UNIT I: CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS **9**

Constitution of alloys - Solid solutions, substitutional and interstitial - Phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron-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.

UNIT III: FERROUS AND NON-FERROUS METALS **9**

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W 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 MATERIAL **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.

UNIT V: MECHANICAL PROPERTIES AND TESTING **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 Izod and charpy, fatigue and creep failure mechanisms.

TOTAL: 45 PERIODS

OUTCOMES

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

- Describe the phase diagram, microstructure and composition of the Iron-Iron carbon diagram.
- Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
- Identify the effect of alloying elements on ferrous and non-ferrous metals
- Summarize the properties and applications of non metallic materials.
- Explain the testing procedure to evaluate mechanical properties.

TEXT BOOKS

1. Raghavan V, Materials Science and Engineering. John Wiley and Sons, 2007
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition, 2014.

REFERENCES

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company,1997.
2. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.

E-RESOURCES

1. https://nptel.ac.in/courses/113/102/113102080/ - (Introduction to Material science and Engineering)
2. https://nptel.ac.in/courses/113/104/113104068/ - (Phase diagram in Material science and Engineering)

19MEE401 **THERMAL ENGINEERING** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**
(Use of Standard Refrigerant Tables and Chart Data Book and Steam Table is Permitted)

OBJECTIVES

The main objective of this course is to:

- Understand the working of various auxiliary systems of internal combustion engines..
- Integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes.
- Apply the thermodynamic concepts into various thermal application like steam nozzles and turbines.
- Acquire knowledge on the principles and working of air compressors.
- Analyse various refrigeration and air conditioning systems.
- Understand the value timing, port timing diagram of IC engine, perfomance test on petrol engine, diesel engine, compressor and characteristics of fuels/lubricates.

UNIT I: INTERNAL COMBUSTION ENGINES **9**

IC engines - 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 and their comparison - Fuel injection system and Ignition system - Battery and Magneto Ignition System - Knocking in SI and CI Engines - Supercharger and Turbocharger - Lubrication and Cooling systems - Performance calculation.

UNIT II: GAS POWER CYCLES **9**

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

UNIT III: STEAM NOZZLES AND TURBINES **9**

Steam nozzle - 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 turbines, speed regulations - Governors.

UNIT IV: AIR COMPRESSOR **9**

Classification of air compressors and working principle of various types of compressors - Construction and

working of single stage air compressor 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 - Performance calculations - Super heat, sub cooling - Working principle of vapour absorption system, Ammonia - Water, Lithium bromide - Water systems (Description only) - Air conditioning system - Processes - Types and Working Principles - Simple Cooling Load calculations.

LIST OF EXPERIMENTS

1. Valve Timing and Port Timing diagrams.
2. Performance and Heat BalanceTest on 4 - stroke Diesel Engine.
3. Morse Test on Multi-cylinder Petrol Engine.
4. Retardation Test on a Diesel Engine.
5. Determination of Flash Point and Fire Point of various fuels / lubricants.
6. Performance Test on Reciprocating air compressor.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Identify the various components of IC engine and their process.
- Analyze the different properties of gas power cycles and apply in different Thermal engineering applications.
- Explain the formation of steam, steam nozzles and turbines.
- Find out the various flow parameters of air compressors.
- Describe the concepts of Refrigeration cycles and Air Conditioning systems.
- Conclude the value timing, port timing diagram of IC engine, Perfomance test on Petrol Engine, Diesel Engine and compressor and characteristics of fuels/Lubricates.

TEXT BOOKS

1. Kothandaraman.C.P.,Domkundwar. S,Domkundwar.A.V., "A course in thermal Engineering", 5th Edition, "DhanpatRai & sons , 2016.
2. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2017.

REFERENCES

1. Arora.C.P, "Refrigeration and Air Conditioning ", Tata McGraw-Hill Publishers, 2008.
2. Ganesan V.." Internal Combustion Engines", 3rd Edition, Tata Mcgraw-Hill, 2012.

E-RESOURCES

1. https://nptel.ac.in/courses/112/103/112103262/ - (Engine and Gas Turbines)
2. https://nptel.ac.in/courses/112/103/112103275/ - (Applied Thermodynamics for Engineers)

19MEE402 **STRENGTH OF MATERIALS** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

The main objective of this course is to:

- Make the students to understand the concepts of stress and strains.
- Study the concept of two dimensional stress systems and stresses in thin and thick cylinders.
- Familiarize about shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- Impart knowledge on finding slope and deflection of beams by various methods and buckling of columns for different boundary conditions.
- Provide awareness on stresses on shafts and helical springs based on theory of torsion.
- Learning the mechanical properties of materials when subjected to different types of loading.

UNIT I: STRESS, STRAIN, DEFORMATION OF SOLIDS **9**

Stresses types -Tension, compression and shear stresses - Hooke's law - Stresses and strains due to axial force in stepped and composite bars - Stresses due to thermal effect in composite bars - Factor of safety - Poisson ratio - Elastic constants and their relationship.

UNIT II: STRESSES IN TWO DIMENSIONS **9**

Stresses on inclined planes - Principal planes and Principal stresses - Mohr's circle for bi-axial stress with shear stress - Analytical and Graphical methods.Hoop and longitudinal stresses in thin and thick cylindrical vessels, Maximum Shear stress, Changes in dimensions and volume.

UNIT III: TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAMS **9**

Types of supports, Loads and beams - Shear force and bending Moment in cantilever, simply supported and overhanging beams.Theory of simple bending - Bending stress distribution – Load carrying capacity - Proportioning of sections - Shear stress distribution.

UNIT IV: DEFLECTION OF BEAMS AND COLUMN **9**

Evaluation of slope and deflection of cantilever and simply supported beams - Double integration method - Macaulay's method.Types of Columns, Equivalent length, Euler and Rankine's formulae, Slenderness ratio.

UNIT V: TORSION IN SHAFT AND HELICAL SPRING **9**

Torsion of circular solid and hollow shafts - Shear strength - Angle of twist and torsional stiffness - Stresses in helical springs - Deflection of helical springs, carriage springs.

LIST OF EXPERIMENTS

1. Tension test on steel rod in U.T.M.
2. Torsion test on steel rod.
3. Impact test on metal specimen.
4. Hardness test on metals - Brinell and Rockwell Hardness.
5. Deflection test on beams.
6. Spring Test - Open coil and Closed coil.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Calculate the stress and strains in regular and composite structures subjected to axial loads.
- Analyze the importance of two dimensional stress systems and stresses in thin and thick cylinders.
- Draw the shear force diagram, bending moment diagram for beams subjected to different loading conditions. Evaluate the bending stress and shear stress distribution.
- Estimate the slope and deflection of beams and buckling loads of columns under different boundary conditions.
- Apply torsion equation in design of circular shafts and helical springs.
- Perform tension test, torsion test, impact test, hardness test, deflection test and spring test on given specimen.

TEXT BOOKS

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., New Delhi, 6th Edition, 2017.
2. F.P. Beer and R.Johnston, "Mechanics of Materials", McGraw Hill Education India (P) Ltd., 7th Edition, 2017.

REFERENCES

1. Rajput R K., "A Textbook of Strength of Materials (Mechanics of Solids)", S Chand and Company Ltd., New Delhi, 7th Edition, 2018.

2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 3rd Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107146 - (Strength of Materials)
2. https://nptel.ac.in/courses/105/105/105105108/ - (Introduction to Strength of Materials)

19MEE403 COMPOSITE MATERIALS AND MECHANICS L T P C
3 0 2 4

OBJECTIVES

The main objective of this course is to:

- Know the different manufacturing methods available for composite material.
- Enlighten the students in different types of reinforcement.
- Aware of different processing methods of composite materials.
- Understand properties of composite materials.
- Extend a knowledge of applications and selection of different composites in consideration of the properties and characteristics.
- Learning the mechanical properties of materials when subjected to different types of loading.

UNIT I: INTRODUCTION TO COMPOSITES 9+3

Fundamentals of composites - Need for composites - Enhancement of properties - Classification of composites - Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) - Reinforcement - Particle reinforced composites, Fibre reinforced composites. - Applications of various types of composites.

UNIT II: POLYMER MATRIX COMPOSITES 9+3

Polymer matrix resins - Thermosetting resins, thermoplastic resins - Reinforcement fibres - Rovings - Woven fabrics - Non woven random mats - various types of fibres - PMC processes -Hand lay up processes - Spray up processes - Compression moulding - Reinforced reaction injection moulding - Resin transfer moulding - Pultrusion - Filament winding - Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP).

UNIT III: METAL MATRIX COMPOSITES 9+3

Characteristics of MMC - Various types of Metal matrix composites - Alloy vs. MMC - Advantages of MMC - Limitations of MMC - Metal Matrix, Reinforcements - Particles - Fibres - Effect of reinforcement - Volume fraction - Rule of mixtures - Processing of MMC - Powder metallurgy process - Diffusion bonding - Stir casting - Squeeze casting.

UNIT IV: CERAMIC MATRIX COMPOSITES 9+3

Engineering ceramic materials - Properties - Advantages - Limitations - Monolithic ceramics - Need for CMC - Ceramic matrix - Various types of Ceramic Matrix composites- Oxide ceramics - Non oxide ceramics - Aluminium oxide - Silicon nitride - Reinforcements - Particles- Fibres- Whiskers - Sintering - Hot pressing - Cold isostatic pressing (CIPing) - Hot Isostatic Pressing (HIPing).

UNIT V : ADVANCES IN COMPOSITE MATERIALS **9+3**

Carbon /carbon composites - Advantages of carbon matrix - limitations of carbon matrix Carbon fibre - chemical vapour deposition of carbon on carbon fibre perform. Solgel technique. Composites in aerospace applications.

LIST OF EXPERIMENTS

1. Preparation of composites.
2. Tensile strength of composites.
3. Compression strength of composites.
4. Hardness measurement of composites.
5. Drop weight impact testing of composite.
6. Study of microstructure of composite.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Apply knowledge of composite mechanical performance and manufacturing methods to a composites design project.
- Describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
- Acquire the knowledge in metal matrix composites and its processing methods.
- Acquire the knowledge in ceramics matrix composites and its processing methods.
- Adequate Knowldege about the composite materials in industry.
- Perform tension test, compression test, impact test , hardness test and micro structure analysis on given specimen.

TEXT BOOKS

1. Chawla, K.K, "Composite Material s", Fourth Edition, Springer Science in progress, 2019.
2. Balasubramaniam, Composite Materials, John Wiley & Sons, Indian Ed., 2014.

REFERENCES

1. Sharma S.C., "Composite materials", Narosa Publications, 2000.

2. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, 1st Indian Edition – 2007.

E-RESOURCES

1. http://nptel.ac.in/courses/101104010/ - (Composite Materials and Structures)
2. https://www.digimat.in/nptel/courses/video/112104229/L01.html - (Introduction to composites)

19MEE404 **MANUFACTURING TECHNOLOGY - II** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

The main objective of this course is to:

- Acquire knowledge on the mechanism of chip formation in machining, cutting tool materials, tool life and cutting fluids.
- Understand the working of lathe and milling machine.
- Provide working skill and knowledge on shaping, planing, slotting and different drilling operations.
- Learning the process parameters in grinding operations, finishing operations and gear generations.
- Understand the basic concepts of computer numerical control (cnc) of machine tools and cnc programming.
- Recognize the various concepts of modern machine process like shapping, milling, planing, grinding, cnc part programming and their techniques.

UNIT I: THEORY OF METAL CUTTING **9**

Mechanism of chip formation - Orthogonal and Oblique cutting - Machining forces - Merchant's Circle Diagram - Thermal aspects of metal machining - Cutting fluids - Machinability - Cutting tool materials - Tool wear - Tool life calculations.

UNIT II: LATHE AND MILLING MACHINE **9**

Lathe machine - Centre lathe, tool nomenclature, operations, machining time and power estimation - Milling - Specifications - Types - Cutter nomenclature - Operations - Milling processes - Indexing - Gear forming.

UNIT III: MACHINE TOOLS AND HOLE MAKING **9**

Types, Specification and Quick return Mechanisms: Shaper, Planer and Slotter - Hole making operations - drilling, reaming, boring, counter boring, counter sinking and tapping.

UNIT IV: GRINDING AND GEAR GENERATION **9**

Grinding - Types of grinding - Grinding wheel designation and selection - Honing, lapping, super finishing, polishing and buffing - Gear generation - Gear shaping and gear hobbing - Specifications - Cutting spur and

helical gears.

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 - Wafer machining**.**

LIST OF EXPERIMENTS

1. Spur gear/contour cutting in milling machine.
2. Keyway cutting in shaper.
3. Prepare good surface finish on flat metal.
4. Round to square in shaper.
5. Gear generation in hobbing machine.
6. CNC part Programming using CNC lathe and CNC milling machine.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Describe the fundamentals of metal cutting in machining operations.
- Identify the components of lathe and milling machine.
- Execute various machining processes such as shaping, milling and gear cutting.
- Select the process parameters in grinding operations, finishing operations and gear generations for the given material.
- Summarize numerical control of machine tools iperations and write a part program.
- Perform gear cutting operations using milling machine, keyway cutting operation using shaping, Surface finsinhing operations using grinding machine, Gear hopping operations using hopping machine and CNC part programming.

TEXT BOOKS

1. Rajput R. K, "Manufacturing Technology", Laxmi Publications (P) Ltd., New Delhi, 2013.
2. Richard R Kibbe, John E Neely, Roland O Merges and Warren T White, "Machine Tool Practices", Prentice Hall of India, New Delhi, 10th Revised edition, 2014.

REFERENCES

1. Hajra Choudhury S. K, "Elements of Workshop Technology", Vol. II, Media Promoters & Publishers Pvt Ltd., Mumbai, 2010.

2. Rao P.N, "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105233/ - (Metal cutting and Machine Tools)
2. https://nptel.ac.in/courses/112/105/112105126/ - (Manufacturing Process - II)

19EEC301 COMMUNICATION SKILLS L T P C
0 0 2 0

OBJECTIVES:

The purpose of learning this course is to:

- Improve fluency in English through well developed vocabulary.
- Improve the oral communication skills.
- Focus the effective reading of general and technical text.
- Improve writing skill
- Communicate ideas in group discussion and interviews.

UNIT I: VOCABULARY **6**

Vocabulary building – articulate ideas and thoughts; usage of palindromes,greetings, wishes, festival related words - homophones and homonyms - connotation - vocabulary words with sentences. - Idiomatic Expressions - One- word Substitutes.

Activities: Learn a word a week, Use newspaper to write unfamiliar words, Word association games.

UNIT II: LISTENING **6**

Listening Skill- Its importance – Purpose - Process - Types- Barriers- Effective Listening strategies- Listening and note-taking – Listening to telephonic conversations – Ted talks – Watching Inspiring Speech videos on You tube- Listening native speaker's videos for pronunciation.

Activities: Listen and draw the different scenes in a story, Secret Message games,watching videos and listing difficult words.

UNIT III: SPEAKING **6**

JAM Talk - Role play – Debate - Conversational skills (formal and informal) - Conversation practice – group discussion and interview skills – Introducing oneself and others –– Presentation skills -Making presentations (individual and group) through seminars / PPTs.

Activities: Picture Description, Giving Directions and Guidelines, Making a short speech-Extempore.

UNIT IV: READING **6**

Strategies for effective reading (Guessing meanings from contexts -Scanning, skimming, inferring meaning

and critical reading)- Read and recognize different text types ranging from newspaper articles, magazines, books, Technical articles and Reading autobiographies -.

Activities: Reading online sources like e-books, e-journals and e-newspapers,cloze exercises,Reading and answering questions.

UNIT V: WRITING **6**

Develop a paragraph: topic sentence, supporting sentences, concluding sentence - Writing simple Essays – argument, descriptive and comparative essays- Creative writing.

Activities: Write Essays with sub titles,Write a story that uses as many clichés and idioms, Write Paragraph.

TOTAL: 30 PERIODS

The following Practice Session will be conducted for the Communication Skills (CS) Lab sessions:

- Activities on Presentations Skills- Students make presentations on given topics
- Activities on Group Discussion- Students participate in group discussions
- Interview Skills- Students participate in Mock Interviews
- Essay Writing - Students prepare their own paragraph and essay

Guidelines for conducting assessments as per 2019 regulations

- 30 hours – Two consecutive hoursallotted for each class.
- Three Continuous assessmentsonly conducted and no end semester exam.
- For the award of Continuous assessment the best three activities from Essay Writing, Oral Presentation, Extempore, Group Discussion and Mock Interview (one-on-one basis) can be taken.

OUTCOMES

At the end of this course, learners will be able to:

- Improve vocabulary and express the same contextually.
- Communicate to his peer group properly and make presentations.
- Comprehend the general and technical text.
- Write simple paragraph and essay in any topic.
- Participate in group discussions expressing ideas relevantly, coherently and cogently.

TEXT BOOKS

1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011.

2. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.

REFERENCES

1. Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.

2. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan:
3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press 1992.
4. Technical communication by Asraf rezvi.

E- RESOURCES

1. www.youglish.com
2. www.Newwellington University.com
3. www.newsinlevels.com
4. www.Britishcouncil.org
5. www.writeandimprove.com
6. www.purdueonline.com

19MDC401	VALUE ADDED COURSES- I (SOLIDWORKS)	L T P C - - - -

OBJECTIVES

The main objective of this course is to:

- Learn the individual features and functions of SOLIDWORKS, thereby emphasizing processes and procedures for completion of any task.
- Understand the principles of technical drawings to create different 3D models.
- Extend a knowledge of parametric 3D models to design and build mechanical parts and assemblies.
- Know the setup sheets for plotting with text, dimensions, and details.
- Familiar with Parametric Modeling to manufacturing and engineering concepts.

COURSE CONTENTS

a. 2D DRAFTING

b. 3D-MODELLING

c. SURFACE CREATIONS AND ASSEMBLY

d. DRAFTING & DRAWING

e. SHEET METAL FEATURES

f. PHOTO WORKS

g. PROJECT

OUTCOMES

At the end of this course, learners will be able to:

- Demonstrate competency with multiple drawing and modification commands.
- Create three-dimensional solid models.
- Build three-dimensional assemblies incorporating multiple solid models.
- Apply industry standards in the preparation of technical mechanical drawings.
- Make simulation of the assemblies incorporating multiple solid models.

TEXT BOOKS

1. John E Matsson, "An Introduction to Solidworks Flow Simulation 2020", SDC Publication, USA, 2020.
2. Prof. Sham Tickoo , "Solidworks 2020 for designers", Purdue University Northwest, USA, 2020.

REFERENCES

1. Alejandro Reyes, "Beginner's Guide to Solidworks 2020", SDC Publication, USA, 2019.
2. Matt Lombard, "Mastering SolidWorks", Wiley Publisher, 2018.

E-RESOURCES

1. https://mlc-cad.com/solidworks-online-resources/
2. https://www.cadimensions.com/video/solidworks-online-resources-webinar/

SEMESTER V

19MET501	AUTOMOBILE ENGINEERING	L T P C 3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Impart the knowledge about the engine chasis, transmission, steering, suspension system, rear axles and final drive of automobiles.
- Acquire knowledge on engine auxiliary system and ignition systems.
- Know about the engine transmission systems.
- Learn the working principle of steering, brakes and suspension systems.
- Practice for assembling and dismantling of engine parts and transmission system.

UNIT I: VEHICLE STRUCTURE AND ENGINES **9**

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC Engines - Components - Functions and materials, Variable Valve Timing (VVT).

UNIT II: ENGINE AUXILIARY SYSTEMS **9**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system, Ignition system - Types - 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 - Types - Over drive, transfer box, fluid flywheel, torque converter, 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), Electronic Brake force

Distribution (EBD) and traction control.

UNIT V: ALTERNATIVE ENERGY SOURCES **9**

Use of natural gas - Liquefied petroleum gas, bio-diesel, bio-ethanol, gasohol and hydrogen in automobiles - Engine modifications required - Performance, combustion and emission characteristics of SI and CI Engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell.

TOTAL: 45 PERIODS

OUTCOMES

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

- Recognize the various parts of the automobile and their functions and materials.
- Discuss the engine auxiliary systems and engine emission control.
- Distinguish the working of different types of transmission systems.
- Identify the types of steering, brakes and suspension systems.
- Predict possible alternate sources of energy for IC Engines.

TEXT BOOKS

1. Jain K.K. and Asthana .R.B, "Automobile Engineering", Tata McGraw Hill Publishers, New Delhi, 2002.
2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Standard Publishers, 7th Edition, New Delhi.

REFERENCES

1. Ganesan V. "Internal Combustion Engines", Tata McGraw-Hill, 3rd Edition, 2012.
2. Heinz Heisler, "Advanced Engine Technology", SAE International Publications USA, 1998.

E-RESOURCES

1. https://nptel.ac.in/courses/107/106/107106088/ - (Fundamentals of Automotive Systems)
2. https://www.youtube.com/watch?v=GinzMttVE1M&ab_channel=NPTEL-NOCIITM- (Introduction to Suspension System Part-I)

19MET502 **DESIGN OF MACHINE ELEMENTS** **L T P C**
(Use of Approved Design Data Book is Permitted) **3 1 0 4**

OBJECTIVES

The main objective of this course is to:

- Understand the design methodology for machine elements.
- Acquire knowledge on analysis of forces acting on the machine elements and appropriate design methodology and design of couplings.
- Analyze the stresses acting on the temporary and permanent joints.
- Design the various types of springs under constant loads and varying loads.
- Design various types of bearing like rolling contact and sliding contact bearing.

UNIT I: STEADY AND VARIABLE STRESSES IN MACHINE ELEMENTS **9+3**

Introduction to the design Process - Direct, Bending and Torsional Stress Equations - Eccentric Loading - Calculation of principle stresses for various Load Combinations - Theories of failure - Design of curved Beams - Crane hook and C frame - Stress Concentration - Design for variable loading - Soderberg, Goodman and Gerber Relations.

UNIT II: DESIGN OF SHAFTS AND COUPLINGS **9+3**

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

UNIT III: DESIGN OF TEMPORARY AND PERMANENT JOINTS **9+3**

Threaded fasteners - Design of bolted joints under eccentric loading - Design of welded joints - Design of riveted joints for structures.

UNIT IV: DESIGN OF SPRINGS **9+3**

Springs -Types- Helical springs, materials, end connections, terms used in compression springs - Stresses and deflection in helical springs of circular wire - Surge in springs - Design of leaf springs - Stress and deflection equation.

UNIT V: DESIGN OF BEARINGS **9+3**

Sliding Contact bearing - Design of journal Bearings - Rolling contact bearings - Selection of rolling contact bearings.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Relate the concepts of principal stresses, stress concentration in machine members and fatigue loading.

- Identify the various stresses induced in shafts and couplings for design process.
- Solve the various stresses induced in design of bolted, welded and riveted joints.
- Choose the different types of springs and their design procedure.
- Apply the design procedure and calculate the life and thermal properties for bearings.

TEXT BOOKS

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", McGraw-Hill, New Delhi, 10th Edition, 2017.
2. R.S.Khurmi and J.K.Gupta, "A Text Book of Machine Design", S.Chand Publications, New Delhi, 2014.

REFERENCES

1. Bhandari V.B., "Design of Machine Elements", , McGraw-Hill, New Delhi, 4th Edition, 2016.
2. Robert C. Juvinall, Kurt M. Marshek, "Machine Component Design", Wiley India Pvt Ltd., 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105124/ - (Design of Machine Elements - I)
2. http://www.nptelvideos.in/2012/12/design-of-machine-elements.html - (Design of Machine Elements)

19MET503 **POWER PLANT ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Acquire knowledge on working principle of steam power plant.
- Understand the working principle of diesel power plant.
- Introduce the principles and operation of nuclear power plant.
- Know the principles and operation of power plant working on renewable energy.
- Impart knowledge on energy, economic and environmental issues of power plants.

UNIT I: STEAM POWER PLANTS **9**

Layout of modern coal power plant - Super Critical Boilers - FBC Boilers - Turbines, Condensers, Subsystems of thermal power plants - Fuel and ash handling - Draught system - Feed water treatment - Binary cycles and cogeneration systems.

UNIT II: DIESEL AND COMBINED CYCLE POWER PLANTS **9**

Components of Diesel - Fuel system - Common Rail Injection - Individual pump injection - Distributor system - Combined cycle power plants - Integrated Gasifier based combined cycle systems.

UNIT III: NUCLEAR POWER PLANTS **9**

Basics of Nuclear Engineering - Layout and parts - Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium - Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors - Safety measures.

UNIT IV: RENEWABLE ENERGY **9**

Hydro Electric Power Plants - Classification, Layout and component - Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel cell power systems.

UNIT V: ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS **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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Describe the layout, construction and working of the components inside a thermal power plant.
- Demonstrate the layout, construction and working of the components inside a Diesel, Combined cycle power plants.

- Summarize the working of the components inside nuclear power plants.
- Classify the type of energy sources and explain the layout, construction and working of the components inside Renewable energy power plants.
- Identify the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

TEXT BOOKS

1. Nag. P.K., "Power Plant Engineering", Tata McGraw – Hill Publishing Company Ltd., 3rd Edition, 2008.
2. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Standard Handbook of McGraw – Hill, 2nd Edition, 1998.

REFERENCES

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107291/ - (Power Plant Engineering)
2. https://www.youtube.com/watch?v=iWWyI8CZhUw - (Introduction to Power Plant Engineering)

19MEE501	HEAT AND MASS TRANSFER (Lab Embedded Theory Course) (Use of Standard HMT Data Book is Permitted)	L T P C 3 0 2 4

OBJECTIVES

The main objective of this course is to:

- Understand the mode of heat transfer through various configuration..
- Achieve knowledge on convection in various systems.
- Learn the thermal analysis and sizing of heat exchangers.
- Attain knowledge on radiation heat transfer.
- Understand the basic concepts of mass transfer.
- Study the heat transfer phenomena predict the relevant coefficient using implementation.

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.

UNIT II: CONVECTION **9**

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

UNIT III: HEAT EXCHANGERS **9**

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.

LIST OF EXPERIMENTS

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
3. Determination of heat transfer coefficient by forced convection inside tube.

4. Efficiency calculation of a pin-fin apparatus (natural and forced convection modes).
5. Determination of emissivity of a given grey surface.
6. Determination of Stefan - Boltzmann constant.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Solve heat conduction equations to different surface configurations under steady state heat conduction
- Analyze free and forced convective heat transfer correlations to internal and external flow
- Classify the various types of condensation processes in the heat exchangers.
- Illustrate about thermal radiation exchange between black and gray surfaces.
- Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications
- Conduct tests on heat conduction, convective heat transfer and radiative heat transfer apparatus and evaluate thermal conductivity, heat transfer coefficient and emissivity of materials.

TEXT BOOKS

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition, 2015.

REFERENCES

1. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.
2. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002.

E-RESOURCES

1. http://nptel.ac.in/courses/112101097/ - (Introduction to Heat and Mass Transfer)
2. https://nptel.ac.in/courses/112/108/112108149/ - (Basics of Heat Transfer)

19MEE502 **METROLOGY AND MEASUREMENTS** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

The main objective of this course is to:

- Study the concepts of measurement and characteristics of instruments.
- Learn the method of linear and angular measurements techniques.
- Identify the use of laser and advances in metrology for linear geometric dimensions.
- Provide knowledge on measurement of thread and gear terminologies using suitable instruments.
- Categorize the methods of measurement of force, torque, power, flow and temperature.
- Attain knowledge on measurement of mechanical parameters using suitable instruments.

UNIT I: BASICS OF METROLOGY **9**

Introduction - Need for measurements - Methods of measurement - Generalized measuring systems - Units and Standards - Types of measuring instruments - Errors in Measurement - Types of errors - Calibration and Interchangeability - Precision and Accuracy - Characteristics of measuring instruments.

UNIT II: LINEAR AND ANGULAR MEASUREMENTS **9**

Linear Measuring Instruments: Vernier Caliper, Vernier Height and Vernier Depth Gauge - Inside, Outside and Depth Micrometer - Slip Gauge - Limit Gauge - Comparator: Mechanical, Pneumatic and Electrical - Angular Measurements: Bevel protractor, Sine bar, Angle Decker, Autocollimator.

UNIT III: ADVANCES IN METROLOGY **9**

Interferometer: NPL Flatness, Laser and Michelson - Coordinate Measuring Machine - Basic concept, Types, Constructional features, Probes, Accessories - 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 MECHANICAL PARAMETERS **9**

Measurement of forces: Direct methods - Equal arm balance and unequal arm balance - Indirect methods - Accelerometers, Load cells, Bourdon tubes. Torque measurement: Strain gauges - Torsion bars. Measurement of Power: Mechanical and DC dynamometers, Eddy current dynamometers. Measurement of flow: Hot wire anemometer, Ultrasonic flow meter. Temperature Measurement: Bimetallic strip, pyrometers, Pressure thermometers, Thermocouples, Thermopoile, Thermistors.

LIST OF EXPERIMENTS

1. Calibration of precision measuring instruments: Vernier caliper, Micrometer, Vernier height gauge and calibration of bore gauge and telescopic gauge.
2. Measurement of taper angle using sine bar/sine center and angular dimension measurement using Bevel protractor.
3. Measurement of thickness of gear tooth using gear tooth Vernier.
4. Comparison of gear/screw parameter using Profile projector/Tool Maker‟s microscope.
5. Measurement of force/torque/ temperature.
6. Inspection of specimen using Mechanical/Electrical comparator.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Describe the concepts of measurements to apply in various metrological instruments.
- Illustrate the methods for linear, angle and flatness measurements and select a suitable method and its relevant instrument for a given application.
- Understand the procedure for conducting computer aided inspection.
- Measure the threads, gear tooth profiles, surface roughness and flatness using appropriate instruments and analyze the data.
- Identify the construction, working principles and select appropriate measuring instruments for force, torque, power, flow and temperature for a given application.
- Examine various measuring techniques of mechanical properties in industrial applications.

TEXT BOOKS

1. Jain R.K. “Engineering Metrology”, Khanna Publishers, 21st Edition, 2010.
2. R.K .Rajput, “ A textbook of Measurements and Metrology”, Katson Publishers, 2013.

REFERENCES

1. Raghavendra , Krishnamurthy “Engineering Metrology & Measurements”, Oxford Univ. Press, 1st Edition, 2013.
2. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104250/ - (Introduction to Measurements and Metrology)
2. http://www.downloadmela.com/video-lectures/engineering5/mechanicalengineering6/mechanicalmeasurements-and-metrology/ - (Metrology and Measurements)

19EEC501 **QUANTITATIVE APTITUDE LEARNING** **L T P C**
(Common to Civil, CSE, ECE, EEE and Mechanical) **0 2 0 0**

OBJECTIVES

The main objective of this course is to:

- Understand the basics of the numbers, Highest common factor and Least common multiple.
- Develop the use of decimal fraction and problems on ages.
- Introduced basic concepts of time, work, distance, calendar and clock.
- Acquaint the student with the concept of simple and compound interest.
- Understand the knowledge of polynomial and quadratic equations.

UNIT I: NUMBERS, HIGHEST COMMON FACTOR AND LEAST COMMON MULTIPLE **9**

Numbers and their basic classification – Types of number – Basic operations of numbers – Progression – Tests of divisibility – Highest common factor – Least common multiple.

UNIT II: DECIMAL FRACTION AND PROBLEMS BASED ON AGES **9**

Decimal fraction – Types of fraction – Comparison of fractions – Inserting fractions in between two given fractions – Relation between decimal fraction and normal fraction – Conversion of a decimal fraction into a vulgar fraction – Types of decimals – Conversion of mixed recurring decimal into a vulgar fraction – Standard form of decimal – Problems based on ages.

UNIT III: TIME, WORK, DISTANCE, CALENDER AND CLOCK **9**

General rule for time and work – General rule for work and wages – Speed – Unit of speed – Average speed – Some useful relations – Problems on Trains – Calendars and clocks – Odd days – Ordinary year – Leap year.

UNIT IV: SIMPLE INTEREST, COMPOUND INTEREST AND ELEMENTARY ALGEBRA **9**

Simple interest – Compound interest – Some useful relations – Difference between compound interest and simple interest – Short cut methods to solve special types of problems – Elementary Algebra and averages.

UNIT V: POLYNOMIAL AND QUADRATIC EQUATIONS **9**

Polynomial introduction – Degree of a polynomial – Types of polynomial – Operations on polynomial – Remainder and factor theorem – Quadratic equation – Pure Quadratic equation – Discriminant – Roots of the Quadratic equations – Solution of Quadratic equation – Framing of a Quadratic equation – Special types of roots.

TOTAL: 45 PERIODS

OUTCOMES

After successfully completing the course, the student will have a good understanding of the following topics and their applications.

- Understand the basic concepts and techniques of the numbers, Highest common factor and Least common multiple.

- Apply the concept of decimal fraction and problems on ages.
- Understand and apply the concept of time, work, distance, calendar and clock.
- Acquire skills in simple interest, compound interest and elementary algebra.
- Be exposed to concepts and properties of polynomial and quadratic equations.

TEXT BOOKS

1. Aggarwal R.S., "Quantitative Aptitude", S.Chand & Company Ltd, New Delhi, 2012.
2. Dinesh Khattar, "Quantitative Aptitude for competitive examinations ", Pearson India Education Services Pvt. Ltd, New Delhi, 2019.

REFERENCES

1. Praveen R.V., "Quantitative Aptitude and Reasoning", PHI Learning Private Limited, Delhi, 2013.
2. Gupta P, "A unique Approach to Quantitative Aptitude ", Unique Publishers (I) Pvt. Ltd, New Delhi, 2017.

E-RESOURCES

1. https://youtube.com/playlist?list=RDQM5Xl256aOq24
2. https://youtu.be/KE7tQf9spPg

19MDC501	VALUE ADDED COURSE - II (ANSYS)	L T P C - - - -

OBJECTIVES

The main objective of this course is to:

- Acquire skill in finite element simulations using commercially available software.
- Know the steps involved in discretization of the cad model using various elements.
- Learn the steps involved in solving structural problems with given specifications.
- Gain knowledge on modal and harmonic analysis.
- Understand the thermal analysis with given specifications.

COURSE CONTENTS

a. Analysis of a plate with a circular hole.

b. Analysis of beams (Cantilever, Simply supported and Fixed ends).

c. Analysis of truss component.

d. Analysis of an Axi-symmetric component.

e. Modal analysis of a component.

f. Harmonic analysis of a component.

g. Thermal mixed boundary conditions (Conduction and Convection).

OUTCOMES

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

- Solve structural analysis problems using one dimensional and two dimensional elements.
- Determine numerical solution of problem using axi-symmetric condition.
- Evaluate various model of failure of a machine component using Modal analysis.
- Apply harmonic analysis to find the response of a structural system using simulation.
- Analyze engineering heat transfer problem under given boundary conditions.

TEXT BOOKS

1. John E Matsson, "An Introduction to ANSYS Fluent 2020", SDC Publications, 1st Edition, 2020.
2. Huei-Huang Lee, "Finite Element Simulations with ANSYS Workbench 2020", SDC Publications.

REFERENCES

1. Choudary R.B., "Introduction to ANSYS 16.0", 2nd Edition, IK International Publishing 2016.
2. Muralidhar K, Sundarajan T., "Computational Fluid Flow and Heat Transfer", 2nd Edition, Narosa Publishing House, 2014.

E-RESOURCES

1. https://nptel.ac.in/courses/105/103/105103140/ - (Structural Reliability)
2. https://nptel.ac.in/courses/112/105/112105045/ - (Computational Fluid Dynamics)

SEMESTER VI

19MET601	FINITE ELEMENT ANALYSIS	L T P C 3 1 0 4

OBJECTIVES

The main objective of this course is to:

- Introduce the concepts of mathematical modeling and numerical solution of engineering problems.
- Use of Finite Element Method to a range of engineering problems.
- Gain knowledge related to two dimensional scalar variable problems with heat transfer.
- Analyze the vector variable of the axisymmetric problems and fluid mechanics.
- Learn Isoparametric formulation and advanced topics in FEM.

UNIT I: INTRODUCTION **9+3**

Historical background - Mathematical modeling of field problems in Engineering - Governing equations Discrete and continuous models - Boundary, Initial and Eigen value problems - Weighted Residual methods - Variational formulation of boundary value problems - Ritz technique - Basic concepts of the Finite Element Method.

UNIT II: ONE DIMENSIONAL PROBLEMS **9+3**

One Dimensional second order equations - Discretization - Element types - Linear and Higher order elements - Derivation of shape functions and stiffness matrices and force vectors - Assembly of Matrices - Solution of problems from solid mechanics and heat transfer - Fourth order beam equation - Transverse deflections and natural frequencies of beams.

UNIT III: TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS **9+3**

Second order 2D Equations involving scalar variable functions - Variational formulation - Finite Element formulation - Triangular elements - Shape functions and element matrices and vectors - Application to field problems - Thermal problems - Higher order elements.

UNIT IV: AXISYMMETRIC PROBLEMS **9+3**

Equations of elasticity - Plane stress, plane strain and axisymmetric problems - Body forces and temperature effects.

UNIT V: ISOPARAMETRIC FORMULATION **9+3**

Natural co-ordinate systems - Isoparametric elements - Shape functions for isoparametric elements - One and two dimensions - Serendipity elements - Numerical integration and application to plane stress problems.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Understand the use of the FEM to solve problems in Engineering.
- Solve one dimensional structural problems.
- Inspect two dimensional scalar variable structural and heat transfer problems.
- Discover the two dimensional axisymmetric problems.
- Analyze the problems involving isoparametric, numerical integration approach.

TEXT BOOKS

1. Reddy. J.N., "An Introduction to the Finite Element Method, Tata McGraw-Hill", 3rd Edition, 2017.
2. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2017.

REFERENCES

1. Chandrupatla and Belagundu, "Introduction to Finite Elements in Engineering", Pearson Education India, New Delhi, 4th Edition, 2015
2. Rao, S.S., "The Finite Element Method in Engineering", Butter worth Heinemann, Elsevier India, 3rd Edition, 2004.

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104193/ - (Basic Finite Element Analysis - I)
2. https://nptel.ac.in/courses/112/103/112103295/ - (Finite Element Method: Variational Methods to Computer Programming)

19MET602 **DESIGN OF TRANSMISSION SYSTEMS** **L T P C**
(Use of Approved Design Data Book is Permitted) **3 1 0 4**

OBJECTIVES

The main objective of this course is to:

- Study the design procedure of belt and rope drive.
- Find out the design procedure of spur and helical gear drives.
- Discover the design procedure of bevel and worm gear drives.
- Learn the design procedure of multistage gear box.
- Develop the students for design of cams, clutches and brakes.

UNIT I: DESIGN OF FLEXIBLE ELEMENTS **9+3**

Selection of flat belts and pulleys - Selection of V belts and pulleys - Selection of hoisting wire ropes and pulleys - Selection of transmission chains and sprocket.

UNIT II: DESIGN OF SPUR AND HELICAL GEARS **9+3**

Spur and Helical gears - Introduction - Gear design - Force analysis - Tooth stresses - Failure in gears.

UNIT III: DESIGN OF BEVEL AND WORM GEARS **9+3**

Bevel gear - Introduction - Types - Geometry - Angle relations - Basic dimensions - Force analysis. Worm Gear - Introduction - Types, Geometry - Basic dimensions - Forces on worm and worm wheel - Modes of failures.

UNIT IV: DESIGN OF GEAR BOXES **9+3**

Gear Box - Geometric progression - Standard step ratio - Ray diagram - Kinematics layout - Design of multi stage gear boxes - Calculation of number of teeth and overlapping speed.

UNIT V: CAMS, CLUTCHES AND BRAKES **9+3**

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 - Band and Block brakes - External shoe brakes - Internal expanding shoe brake.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Design of belt and rope drives.
- Recognize the design of spur and helical gear drives.
- Elaborate the design of bevel and worm gear drives.
- Draw the kinematic and ray diagrams for multi stage gear boxes.
- Apply the concepts of design to cams, brakes and clutches.

TEXT BOOKS

1. Bhandari V, "Design of Machine Elements", Tata McGraw-Hill Book Co, New Delhi, 4th Edition, 2017.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", Tata McGraw-Hill, 10th Edition, 2014.

REFERENCES

1. T. J. Prabhu, "Design of Transmission Elements", Mani Offset, Chennai, 2015.
2. B. J. Hamrock, B. Jacobson and S. R. Schmid, "Fundamentals of Machine Elements", Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 3rd Edition, 2014.

E-RESOURCES

1. http://www.nptelvideos.com/lecture.php?id=15548 - (Belt Drives)
2. https://www.digimat.in/nptel/courses/video/112105234/L01.html - (Gear and Gear unit Design)

19MEE601	CAD/CAM (Lab Embedded Theory Course)	L T P C 3 0 2 4

OBJECTIVES

The main objective of this course is to:

- Provide an overview of how computers are being used in mechanical component design.
- Introduce the concept of geometric modeling.
- Analyze the concept of computer graphics.
- Understand the basics of cnc machine tools.
- Acquire knowledge on the concept of computer aided manufacturing.
- Gain practical experience in handling 3d modeling software systems and application of cnc machines.

UNIT I: INTRODUCTION TO CAD/CAM **9**

Product cycle - Design process - Sequential and Concurrent Engineering - Computer Aided Design - CAD system architecture - Computer graphics - Co-ordinate systems - 2D and 3D transformations - Homogeneous coordinates - Line drawing - Clipping - Viewing transformation - Brief introduction to CAD and CAM - Manufacturing Planning, Manufacturing control - Introduction to CAD/CAM - CAD/CAM concepts.

UNIT II: GEOMETRIC MODELING **9**

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

UNIT III: CAD STANDARDS **9**

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

UNIT IV: CNC MACHINE TOOLS **9**

Principle of Numerical Control - Component of NC system - NC procedure - Types of CNC machine tools - Programming of CNC machine tools - Preparatory functions - Miscellaneous functions - Part programming - Types- Turning and machining center.

UNIT V: COMPUTER AIDED MANUFACTURING **9**

Group Technology (GT) - Part Families - Parts classification and coding - Cellular manufacturing - Composite part concept - Types of flexibility - FMS Components - Application and Benefits - FMS planning and control - Quantitative analysis in FMS.

LIST OF EXPERIMENTS

a) CAD (3D)

1. Flange Coupling
2. Screw Jack
3. Universal Joint
4. Non return valve

b) CAM LAB

1. Part Programming - CNC Machining Centre

a) Linear Cutting, b) Circular cutting.

2. Part Programming - CNC Turning Centre

a) Straight, Taper and Radius Turning, b) Rough and Finish Turning Cycle.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Inspect the 2D and 3D transformations, clipping algorithm, Manufacturing models and metrics.
- Examine various CAD models, stages in geometric modeling.
- Summarize the different types of standard systems used in CAD.
- Distinguish the NC, CNC and DNC systems and explain their working principles.
- Illustrate the different types of techniques used in cellular manufacturing and FMS.
- Demonstrate manual part programming with G and M codes using CAM.

TEXT BOOKS

1. Ibrahim Zeid and Sivasubramanian.R, "CAD/CAM Theory and Practice", Tata McGraw Hill Publications, New Delhi, 2009.
2. Radhakrishan.P,Subramanyan.S,Raju.V,"CAD/CAM/CIM", New Age International Publishers Ltd., 4th Edition, 2018.

REFERENCES

1. David F. Rogers, J. A. Adams, "Mathematical Elements for Computer Graphics", Tata McGraw Hill Publications, 2017.
2. Groover, M. P. and Zimmers, E. W., "CAD/ CAM", Dorling Kingsley, 2014.

E-RESOURCES

1. http://www.nptelvideos.in/2012/12/computer-aided-design.html - (Computer Aided Design)
2. https://nptel.ac.in/courses/112/102/112102101/ - (Computer Aided Design and Manufacturing)

19MEE602	DYNAMICS OF MACHINERY (Lab Embedded Theory Course)	L T P C 3 0 2 4

OBJECTIVES

The main objective of this course is to:

- Understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- Comprehend the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- Predicting effect of dynamics of free vibrations.
- Analysis the effect of dynamics of forced vibrations.
- Understand the principles in mechanisms used for speed control and stability control.
- Interpreting how certain measuring devices are used for dynamic testing.

UNIT I: FORCE ANALYSIS **9**

Dynamic force analysis - Inertia force and Inertia torque - D Alembert‟s principle - Dynamic analysis in reciprocating engines - Inertia effect of connecting rod - Crank shaft torque - Turning moment diagrams.

UNIT II: BALANCING **9**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder engine - Balancing of multi-cylinder inline - Partial balancing in engines - Balancing machines.

UNIT III: FREE VIBRATION **9**

Basic features of vibratory systems - Free vibration - Equations of motion - Natural frequency - Types of damping - Damped vibration - Critical speeds of shafts - Torsional vibration - Two and three rotor torsional systems.

UNIT IV: FORCED VIBRATION **9**

Response of one degree freedom systems to periodic forcing - Harmonic disturbances - Disturbance caused by unbalance - Support motion - Transmissibility - Vibration isolation

UNIT V: MECHANISM FOR CONTROL **9**

Governors and its types - Gyroscopes - Gyroscopic forces and torques - Gyroscopic effects in ships and airplanes.

LIST OF EXPERIMENTS

1. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
2. a) Balancing of rotating masses. b) Balancing of reciprocating masses.
3. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
4. Determination of transmissibility ratio using vibrating table.
5. Motorized gyroscope – Study of gyroscopic effect and couple.
6. Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Compute static and dynamic forces of mechanisms.
- Analyze the balancing masses and their locations of reciprocating and rotating masses.
- Conclude the frequency of free vibration.
- Evaluate the frequency of forced vibration and damping coefficient.
- Calculate the speed and lift of the governor and estimate the gyroscopic effect on ships and airplanes.
- Determine mass moment of inertia of mechanical element, governor effort and range sensitivity, natural frequency and damping coefficient, critical speeds of shafts, balancing mass of rotating and reciprocating masses.

TEXT BOOKS

1. Rattan, S.S, "Theory of Machines", Tata McGraw-Hill, 5th Edition, 2019.
2. Khurmi, R.S., "Theory of Machines", S Chand Publications, 14th Edition, 2014.

REFERENCES

1. Uicker,J.J., Pennock.G.R and Shigley,J.E., "Theory of Machines and Mechanisms", Oxford University Press, 4th Edition, 2014.
2. R L Norton, "Kinematics and Dynamics of Machinery", McGraw-Hill Education, 2017.

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104114/ - (Dynamics of Machines)
2. www.downloadmela.com/video-lectures/engineering5/mechanical-engineering6/ dynamics-of-machines/- Dynamics of Machines)

19MEJ601 **MINI PROJECT** **L T P C**
0 0 2 1

OBJECTIVES

The main objective of this course is to:

- Design and fabrication of one or more components of a complete working model, which is designed by them.
- Ability to fabricate any components using different manufacturing tools.

GUIDELINES 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.

TOTAL: 60 PERIODS

OUTCOMES

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

- Design and fabricate the machine element or the mechanical product.
- Demonstrate the working model of the machine element or the mechanical product.

19MDC601 **CONSTITUTION OF INDIA** **L T P C**
(Common to Civil, CSE, ECE, EEE & Mechanical) **3 0 0 0**

OBJECTIVES

The main objective of this course is to:

- Understand the meaning of the Constitution law and Constitutionalism.
- Realize the fundamental rights.
- Understand the execution powers of union and states bout.
- Be aware of the Constitutional powers.
- Acquaint with other Constitutional functionaries.

UNIT I: INTRODUCTION **3**

Meaning of the Constitution law and constitutionalism – Historical perspective of the Constitution of India – Preamble – Salient features and characteristics of the Constitution of India – Citizenship.

UNIT II: FUNDAMENTAL RIGHTS **3**

Scheme of the fundamental rights - The scheme of the fundamental duties and its legal status - The directive principles of state policy - Its importance and implementation.

UNIT III: UNION AND STATE EXECUTIVE **3**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary form of Government in India - The Constitution powers and status of the President of India - Governor - Appointment, powers and functions.

UNIT IV: CONSTITUTIONAL POWERS **3**

Amendment of the Constitutional powers and procedure - The historical perspectives of the Constitutional amendments in India - Emergency provisions : National emergency, President rule, financial emergency.

UNIT V: OTHER CONSTITUIONAL FUNCTIONARIES **3**

Election Commission of India: Organization, powers and functions, Union Public Service Commission, State Public Service Commission - Local Self Government.

TOTAL: 15 PERIODS

OUTCOMES

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

- Understand the salient features and characteristics of the Constitution of India.
- Analyze the scheme of the fundamental rights and duties.
- Evaluate in detail the powers between the Union and the States.
- Know the concept of Constitutional powers.
- Recognize other Constitutional functionaries.

TEXT BOOKS

1. Introduction to the Constitution of India - Durga Das Basu.
2. Our Constitution by Subhash by C. Kashyap.

REFERENCES

1. Indian Polity by Spectrum.
2. The Indian Constitution: Cornerstone of a Nation, by Granville Austin.

E-RESOURCES

1. https://www.youtube.com/watch?v=vq2Q1_v6TNU
2. https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text

SEMESTER VII

19MET701	GAS DYNAMICS AND JET PROPULSIONS (Use of Standard Gas Table is Permitted)	L T P C 3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the basic difference between incompressible and compressible flow.
- Exposure on isentropic flow through variable area ducts.
- Acquire knowledge on the phenomenon of shock waves and its effect on flow.
- Gain basic knowledge about jet propulsion.
- Analyze the performance of space population system.

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) - 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 - Use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V: SPACE 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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the concept of compressible flows in variable area ducts.
- Apply the concept of compressible flows in constant area ducts.
- Examine the effect of compression and expansion waves in compressible flow.

- Apply the concept of gas dynamics in Jet Propulsion in turbojet, turbofan and turbo prop engines.
- Analysis the concept of gas dynamics in space propulsion.

TEXT BOOKS

1. Anderson, J.D., "Modern Compressible flow", McGraw Hill, 3rd Edition, 2012.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2002.

REFERENCES

1. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd., 1980.
2. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York, 2010.

E-RESOURCES

1. https://nptel.ac.in/courses/112/106/112106166/ -(Gas Dynamics and Propulsion-Introduction)
2. https://nptel.ac.in/courses/101/106/101106044 - (Gas Dynamics)

19MEE701 **MECHATRONICS** **L T P C**
(Lab Embedded Theory Course) **3 0 2 4**

OBJECTIVES

The main objective of this course is to:

- Impart knowledge about various elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
- Understand the working and programming of 8085 microprocessor and 8051 microcontroller.
- Study the programmable peripheral interface of microprocessor and micro controller with Mechatronics systems.
- Learn the Programmable Logic Controller (PLC) used in Mechatronics systems.
- Understand various actuators and design Mechatronics system with the help of microprocessor, PLC and other electrical and electronics circuits.
- Know the method of programming the microprocessor and also the design, modeling and analysis of basic Electrical, Hydraulic and Pneumatic 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, and Temperature Control - Stepper motor control - Traffic 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 MECHATRONICS 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.

LIST OF EXPERIMENTS

1. Manual control of single and double acting cylinders with direction control valves using pneumatic trainer kit.
2. Pneumatic cylinder sequencing using electrical control with internal relay.
3. Control of double acting cylinder using Timer, DPDT relay with solenoid operated valves.
4. Stepper motor interfacing using 8051 microcontroller.
5. Servo control open loop and closed loop system.
6. Assembly language programming of 8085 - Addition - Subtraction - Multiplication - Division.

TOTAL: 45+15=60 PERIODS

OUTCOMES

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

- Confer the interdisciplinary applications of Electronics, Electrical, Mechanical and computer systems.
- Illustrate the architecture of microprocessor and microcontroller, pin diagram, addressing modes of microprocessor and microcontroller.
- Discuss programmable peripheral interface, architecture of 8255 PPI, and various device interfacing.
- Understand the architecture, programming and application of programmable logic controller problems and challenges in the areas of Mechatronics Engineering.
- Identify the various actuators and design Mechatronics systems with the help of microprocessor, PLC and other Electrical and Electronics circuits.
- Demonstrate the functioning of Mechatronics system with various Pneumatic, Hydraulic, Electrical systems and control systems with the help of PLC and microcontrollers.

TEXT BOOKS

1. Bolton, "Mechatronics", Prentice Hall, 2008.
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085",Prentice Hall, 5th Edition, 2008.

REFERENCES

1. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/112/103/112103293/ - (Automation in Manufacturing)
2. https://nptel.ac.in/courses/112/103/112103174/- (Mechatronics and Manufacturing Automation)

19MEJ701 **PROJECT WORK (PHASE - I)** **L T P C**
0 0 2 1

OBJECTIVES

The main objective of this course is to:

- Identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- Build up skills to formulate a technical project.
- Develop the methodology to solve the identified problem.
- Teach use of new tools, algorithms and techniques required to carry out the projects.
- Train the students in preparing project reports and to face reviews and viva-voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 works on a topic approved by the head of the department under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 15 PERIODS

OUTCOMES

At the end of the project, the students will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Prepare technical report and oral presentations.
- At the end of the course the students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

SEMESTER VIII

PROJECT WORK (PHASE - II) **L T P C**
0 0 20 10

OBJECTIVES

The main objective of this course is to:

- Develop skills to formulate a technical project.
- Develop the ability to solve specific problem.
- Teach use of new tools, algorithms and techniques required to carry out the projects.
- Give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
- Provide guidelines to prepare technical report of the project.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. 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.

TOTAL: 300 PERIODS

OUTCOMES

At the end of the project, the students will be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare technical report and oral presentations.
- On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering and find better solutions to it.

PROFESSIONAL ELECTIVE – I

19MEPX01 **MECHANICAL VIBRATIONS AND NOISE CONTROL** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Make the students to understand different types of vibration.
- Identify with concepts of noise and its level in a system.
- Make them to understand the source of noise.
- Recognize various techniques to control vibration.
- Sort out various types of noise induced and methods to control noise.

UNIT I: BASICS OF VIBRATION **9**

Introduction - Classification of vibration - Response of damped and undamped systems under harmonic force - Analysis of single degree and two degree of freedom systems.

UNIT II: BASICS OF NOISE **9**

Introduction - Amplitude, frequency, wavelength and sound pressure level - Addition, subtraction and averaging decibel levels - Noise dose level - Measurement and analysis of noise, environment and equipment,.

UNIT III: AUTOMOTIVE NOISE SOURCES **9**

Noise characteristics of engines - Engine overall noise levels - Assessment of combustion noise and mechanical noise - Engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise and 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 and mechanical noise - Predictive analysis - Automotive noise control principles - Sound in enclosures - Sound energy absorption - Sound transmission through barriers.

.TOTAL: 45 PERIODS

OUTCOMES

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

- Précis the basics of vibration.
- Summarize the basics of noise.
- Enlighten the sources of automotive noise.
- Converse the control techniques for vibration.
- Illustrate the sources and control of noise.

TEXT BOOKS

1. Singiresu S.Rao, "Mechanical Vibrations", Pearson Education, 6th Edition, 2017.
2. Rao V. Dukkipati J. Srinivas. Text book of Mechanical Vibrations, PHI Learning Pvt Ltd., New Delhi, 2nd Edition, 2017.

REFERENCES

1. Dr. Sadhu Singh, "Mechanical Vibration and Noise Control", Khanna Publishers, 2nd Edition, 2018.
2. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 8th Edition, 2019.

E-RESOURCES

1. http://nptel.ac.in/courses/112103111/ - (Basic Terminology in Vibrations)
2. https://www.youtube.com/watch?v=hWNpID0TWYU- (Basics of Vibrations for Simple Mechanical Systems)

19MEPX02 **MICRO ELECTRO MECHANICAL SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- Educate on the rudiments of micro fabrication techniques.
- Introduce various sensors and actuators.
- Illustrate the different materials used for MEMS.
- Educate on the applications of MEMS to disciplines beyond Electrical and Mechanical actuators.

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 ofElectrical and Mechanical concepts in MEMS - Semiconductor devices - Stress and strain analysis - Flexural beam bending - Torsional deflection.

UNIT II: SENSORS AND ACTUATORS-I **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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Demonstrate the concept of MEMS with applications and working principles.
- Identify the suitable sensors and type of actuators to achieve the desired output motion.
- Recommend the suitable sensors and type of actuators with applications and working principles.
- Summarize the steps involved in various micro system fabrication processes.
- Discuss with polymer and optical MEMS technology used in sensors.

TEXT BOOKS

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES

1. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010.
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD, 2002.

E-RESOURCES

1. https://nptel.ac.in/courses/117/105/117105082/ - (Introduction to MEM and Microsystem)
2. https://nptel.ac.in/courses/108/106/108106165/ - (MEMS)

19MEPX03 **DESIGN OF JIGS, FIXTURES AND PRESS TOOLS** **L T P C**
(Use of Approved Design Data Book is Permitted) **3 0 0 3**

OBJECTIVES

The main objective of this course is to:

- Understand the concept of design tools, dies, jigs and fixtures.
- Attributing and optimize an existing jigs.
- Validating the knowledge about the design of various fixtures.
- Assessing students to design of dies for press work.
- Adapting students to design of dies for forging.

UNIT I: LOCATING AND CLAMPING PRINCIPLES **9**

Objectives of tool design - Function and advantages of Jigs and fixtures - Locating methods and devices - Redundant location - Principles of clamping - Mechanical actuation - Pneumatic and Hydraulic actuation standard parts - Drill bushes and jig buttons -Tolerances and materials used.

UNIT II: JIGS **9**

Drill bushes - Different types of Jigs - Plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs - Automatic drill jigs - Rack and Pinion operated - Air operated Jigs components

UNIT III: FIXTURES **9**

General principles of boring, lathe, milling and broaching fixtures - Grinding, planning and shaping fixtures - Assembly, Inspection and Welding fixtures - Modular fixtures - Design and development of Jigs and fixtures for given components.

UNIT IV: PRESS TOOLS **9**

Press working terminology - Presses and accessories - Computation of capacities and tonnage requirements - Strip layout - Design and development of various types of cutting, forming and drawing dies - Blank development for cylindrical and non cylindrical shells

UNIT V: 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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Identify the different methods of locating Jigs, fixtures and clamping principles.
- Design and develop jigs for given component.

- Design and develop fixtures for given component.
- Elaborate the press working terminologies and elements of cutting dies.
- Analyze the different types of forming techniques.

TEXT BOOKS

1. Joshi, P.H. "Jigs and Fixtures", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 3rd Edition, 2017.
2. Joshi P.H "Press tools - Design and Construction", S Chand & Company, 23rd edition, 2017.

REFERENCES

1. Donaldson, Lecain and Goold "Tool DesignTata McGraw Hill ", 5th Edition, 2017.
2. Venkataraman. K., "Design of Jigs Fixtures & Press Tools", John Wiley & Sons, Ltd", 5th Edition, 2015.

E- RESOURCES

1. https://www.youtube.com/watch?v=jYuNMMe0vKY - (Lecture on Jigs and Fixtures)
2. http://www.nptelvideos.in/search?q=Jigs+and+Fixtures - (Jigs and Fixtures For Machine Shops)

19MEPX04 **SOLAR THERMAL SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the concept of solar radiation and solar intensity measuring devices.
- Understand the solar applications like cookers, pumps, ponds etc.,
- Learn the solar utilities under varying operating conditions.
- Provide the knowledge on solar thermal utility working on active and passive modes.
- Study the concept of solar power generation.

UNIT I: S\OLAR RADIATION **9**

Solar radiation on the earth surface - Extraterrestrial radiation characteristics - Terrestrial radiation - Solar insulation - Solar radiation measuring devices - Pyrheliometer and Pyranometer - Spectral energy distribution of solar radiation - Depletion of solar radiation - Absorption, scattering.

UNIT II: SOLAR THERMAL COLLECTORS **9**

Theory of flat plate collectors, evacuated tube collectors and heat pipe based collectors - Performance evaluation - Collector testing - Natural and forced circulation - System configurations - Applications.

UNIT III: SOLAR THERMAL UTILITIES - I **9**

Solar air heaters - Theory and applications - Solar drying - Theory, design, performance analysis and types - Solar desalination - Solar still - Types - Theory and performance analysis.

UNIT IV: SOLAR THERMAL UTILITIES - II **9**

Solar cooking devices - Solar cooling - Absorption, adsorption and passive systems - Solar thermal pumps - Energy storage - Solar ponds - Solar chimney.

UNIT V: SOLAR CONCENTRATORS AND POWER GENERATION **9**

Solar concentrator types - Optics - Performance analysis - Design considerations - Tracking - Solar electric power generation systems - Economics of solar thermal utilities.

TOTAL: 45 PERIODS

OUTCOMES

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

- Estimate solar radiation received on a surface using solar radiation measuring devices.
- Identify the solar thermal utilities for heating and drying applications.
- Predict and analyze the performance of solar utilities under varying operating conditions.

- Design a solar thermal utility working on active and passive modes.
- Demonstrate the solar power generation principles, design and performance.

TEXT BOOKS

1. Goswami Y, Kreith F and Kreider J. F, "Principles of Solar Engineering", CRC Press, 5th Edition , 2017.
2. Sukhatme. S. P, "Solar Energy : Principles of Thermal Collection and Storage", Tata Mc Grawill, 7th Edition, 2018.

REFERENCES

1. Prakash J and Garg H, "Solar Energy: Fundamentals and Applications", McGraw Hill Education, 5th Edition, 2017.
2. Solanki C.S, "Solar Photovoltaics - Fundamentals, Technologies and Applications", Prentice Hall India, 3rd Revised Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105050/- (Principles and Performance of Solar energy thermal systems)
2. https://nptel.ac.in/courses/112/105/112105051/ - (Solar Energy Technology)

19MEPX05 NON DESTRUCTIVE TEST AND EVALUATION OF MATERIALS **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Study and understand the various Non-Destructive Testing and Evaluation methods.
- Know the various applications of penetrate testing methods.
- Learn the concept of thermography and eddy current testing process.
- Gain knowledge on ultrasonic testing.
- Provide a basic understanding of radiographic inspection.

UNIT I: INTRODUCTION TO NDT AND VISUAL INSPECTION **9**

NDT versus Mechanical testing- Non Destructive Testing Methods - Detection of manufacturing defects - Material characterization - Relative merits and limitations - Various physical characteristics of materials - applications in NDT- Visual inspection - Unaided and aided.

UNIT II: PENETRANT TESTING **9**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrates - Developers - Advantages and limitations of various methods - Testing Procedure - Interpretation of results - Magnetic Particle Testing - Theory of magnetism, inspection materials, Magnetization methods.

UNIT III: EDDY CURRENT TESTING **9**

Eddy Current Testing - Generation of eddy currents - Properties of Eddy currents - Eddy current sensing elements, Probes, Instrumentation - Types of arrangement - Applications, advantages, limitations.

UNIT IV: ULTRASONIC TESTING **9**

Ultrasonic Testing - Principle - Transducers - Transmission and pulse-echo method - Straight beam and angle beam - Instrumentation, data representation - A-Scan, B-scan, C-scan - Phased Array Ultrasound - Time of flight diffraction.

UNIT V: RADIOGRAPHY (RT) **9**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques - Types and use of filters and screens - Geometric factors - Inverse square law - Characteristics of films - Graininess, density, speed, contrast - Characteristic curves - Penetrameters - Exposure charts, Radiographic equivalence - Fluoroscopy - Xero-Radiography - Computed Radiography - Computed Tomography.

TOTAL: 45 PERIODS

OUTCOMES

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

- Differentiate various defect types and select the appropriate NDT methods for better evaluation.
- Complete theoretical understanding of the penetrants, penetrant testing and safety precautions.
- Implement various eddy current inspection methods to find material imperfections.
- Evaluate the concept of ultrasonic testing and acoustic emission.
- Apply radiation property for inspecting materials.

TEXT BOOKS

1. Osama Lari, Rajeev Kumar, "Basics of Non-Destructive testing", S.K.Kataria and Sons, 1st Edition, 2015.
2. Don E Bray and Roderick K Stanley, "Non-Destructive Evaluation: A Tool in Design, Manufacturing and Service", CRC Press, 3rd Edition, 2014.

REFERENCES

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Prasad.J and Nair.C.G.K, "Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Publishing company Limited, 4th Edition, 2015.

E-RESOURCES

1. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-mm04/ - (Theory and Practice of Non Destructive Testing)
2. https://nptel.ac.in/courses/113/106/113106070/ - (Introduction to Non Destructive Testing)

PROFESSIONAL ELECTIVE – II

19MEPX06 **CONCEPTS OF ENGINEERING DESIGN** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Gain the knowledge on the principle and procedures of design process.
- Enable Students to attain knowledge on tools used in design Methods.
- Understand the process of material selection and design.
- Develop in depth knowledge on Engineering statistics and reliability.
- Create awareness on legal and ethical issues in Design and Quality Engineering.

UNIT I: DESIGN PROCESS 9

The design process - Morphology of design - Design drawings - Computer Aided Engineering - Designing of Standards - Concurrent Engineering - Product Life Cycle - Technological forecasting - Market identification - Competition Bench Marking - Systems Engineering - Life Cycle Engineering - Human factors in design - Industrial design.

UNIT II: DESIGN METHODS 9

Creativity and problem solving - Product design specifications - Conceptual design - Decision theory - Decision tree - Embodiment design - Detail design - Mathematical modeling - Simulation - Geometric modeling - Finite Element Modeling - Optimization - Search Methods - Geometric programming - Structural and shape optimization.

UNIT III: MATERIAL SELECTION PROCESSING AND DESIGN 9

Material Selection Process - Economics - Cost Vs Performance - Weighted property index - Value analysis - Role of processing in design – Classification of manufacturing process - Design for manufacture - Design for assembly - Designing for castings, forging, metal forming, machining and welding - Residual stresses - Fatigue, fracture and failure.

UNIT IV: ENGINEERING STATISTICS AND RELIABILITY 9

Probability - Distributions - Test of Hypothesis - Design of experiments - Reliability theory - Design for reliability - Reliability centered maintenance.

UNIT V: LEGAL AND ETHICAL ISSUES IN DESIGN AND QUALITY ENGINEERING 9

Introduction - The origin of laws - Contracts - Liability - Tort law - Product liability - Protecting intellectual property - Legal and ethical domains - Codes of ethics - Solving ethical conflicts - Case studies - Quality Assurance - Statistics Process Control - Taguchi methods - Robust design - Failure Model Effect Analysis.

TOTAL: 45 PERIODS

OUTCOMES

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

- Get clear understanding on CAE / Concurrent Engineering and Systems Engineering.
- Attain problem solving skills through modeling/simulation and optimize design.
- Ability to do material selection based on economy and value analysis. Develop understanding on DFM/DFA.
- Have good understanding on DOE, reliability theory and reliability centered maintenance.
- Exposed to laws, codes of ethics, quality concepts and FMEA.

TEXT BOOKS

1. Aziz, Atif – "Concepts in Engineering Design", New age international (p) limited, publishers, Edition: 1, New Delhi, 2017.
2. Linda C. Schmidt, George Dieter - "Engineering Design", McGraw Hill Education; Fourth edition, 2017.

REFERENCES

1. Pahl, G, and Beitz, W.," Engineering Design", Springer - Verlag, NY. 1984.
2. Ray, M.S., "Elements of Engg. Design", Prentice Hall Inc. 1985. Suh, N.P., "The principles of Design", Oxford University Press, NY.1990.

E-RESOURCES

1. https://nptel.ac.in/courses/107/101/107101087/ - (An Introduction to Design)
2. https://nptel.ac.in/courses/112/107/112107217/ - (Product Design and Development)

19MEPX07 **COMPUTATIONAL FLUID DYNAMICS** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Instigate governing equations of viscous fluid flows.
- Introduce numerical modeling and its role in the field of fluid flow and heat transfer.
- Identify with the various discretization methods, solution procedures and turbulence modeling.
- Impart one dimensional and two dimensional elements in finite element techniques for fluid flow problems.
- Solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I: GOVERNING EQUATIONS AND BOUNDARY CONDITIONS **9**

Basics of computational fluid dynamics - Governing equations of fluid dynamics - Continuity, momentum and energy equations - Chemical species transport - Physical boundary conditions - Time-averaged equations for Turbulent flow - Kinetic energy equations - Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II: FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION **9**

Derivation of finite difference equations - Simple methods - General methods for first and second order accuracy - Finite volume formulation for steady state one, two and three dimensional diffusion problems - Parabolic equations - Explicit and implicit schemes.

UNIT III: FINITE VOLUME METHOD FOR CONVECTION DIFFUSION **9**

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes properties of discretization schemes - Conservativeness, boundedness, transportiveness, hybrid power-law, QUICK schemes.

UNIT IV: FLOW FIELD ANALYSIS **9**

Finite volume methods - Representation of the pressure gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure correction equation, SIMPLE algorithm and its variants - PISO algorithms.

UNIT V: TURBULENCE MODELS AND MESH GENERATION **9**

Turbulence models, mixing length model, Two equation (k-Є) models - High and low Reynolds number models - Structured grid generation - Unstructured grid generation - Mesh refinement - Adaptive mesh - Software tools.

TOTAL: 45 PERIODS

OUTCOMES

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

- Derive the governing equations and boundary conditions for fluid dynamics.
- Analyze finite difference and finite volume methods for diffusion.
- Evaluate finite volume method for convective diffusion.
- Examine flow field problems.
- Solve the turbulence models and mesh generation techniques.

TEXT BOOKS

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.
2. Jiyuan Tu,Guan Heng and Yeoh Chaoqun Liu, "Computational Fluid Dynamics - A Practical Approach", Butterworth–Heinemann publishers, UK, 3rd Edition, 2018.

REFERENCES

1. Anil W. Date "Introduction to Computational Fluid Dynamics", 2nd Edition, Cambridge University Press, 2009.
2. Chung, T.J. "Computational Fluid Dynamics", 2nd Edition, Cambridge University Press, 2014.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105045/ -(Introduction to Computational Fluid Dynamics)
2. https://freevideolectures.com/course/3512/computational-fluid-dynamics-I - (Introduction to CFD)

19MEPX08 **FUELS AND COMBUSTION** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Impart the knowledge about the different types of fuel.
- Gain knowledge on types and properties of solid and liquid fuels.
- Study the types and properties of gaseous fuels.
- Learn about the stoichiometry and kinetics of combustion.
- Develop the knowledge on combustion kinetics of fuels.

UNIT I: FUEL CHARACTERISTICS **9**

Fuels - Types and characteristics of fuels - Determination of properties of fuels - Fuels analysis - Proximate and ultimate analysis - Moisture determination - Calorific value - Gross and Net calorific values - Bomb calorimetry - DuLong's formula for CV estimation - Flue gas analysis - Orsat apparatus.

UNIT II: COMBUSTION PRINCIPLES **9**

Determination of the quantity of normal and oxygenated air necessary for complete combustion - Calculation of the volume and the composition of the flue gas -Auto ignition - Induced ignition - Explosives - Flammability limits - Minimum ignition energy - Ignition delay time.

UNIT III: ENVIRONMENTAL IMPACTS **9**

Pollutants - Formation and impact - Relevant pollutants - Concepts for pollutant reduction - Combustion and climate change - Primary energy production - Combustion and global warming by sectors - Mitigation of global warming in the context of combustion - Carbon sequestration.

UNIT IV: COMBUSTION, STOICHIOMETRY **9**

Stoichiometry - Mass Basis and Volume Basis - Fuel and Flue Gas Compositions – Calculations - Excess air calculation from flue gas analysis - Rapid methods for solid, liquid and gaseous fuels - Thermodynamics - Heat of combustion - Equilibrium constants of combustion reactions - Enthalpy - Temperature diagrams - Flame Temperature - Theoretical - Adiabatic and actual.

UNIT V: COMBUSTION, KINETICS **9**

Combustion Processes - Stationary flame - Surface or flameless combustion - Submerged Combustion - Pulsating and slow combustion - Explosive combustion - Mechanism of Combustion - Chain reactions - Thermal mechanism - Ignition and Ignition Energy - Spontaneous Combustion - Flame Propagation - Ignition Limits - Limits of Inflammability.

TOTAL: 45 PERIODS

OUTCOMES

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

- Determine the characteristics and calorific value of fuels.
- Summarize the combustion principles of various fuels and estimation methods.
- Identify the various types of emissions during combustion process and ways to minimizing emissions.
- Formulate the stoichiometry and thermodynamics of combustion.
- Analyze the kinetics of combustion processes of fuels.

TEXT BOOKS

1. Maximilan Lackner, Arpad B. Palotas and Franz winter, "Combustion", Wiley-VCH Verlag GmbH and Co, 4th Edition, 2012.
2. Samir Sarkar, "Fuels and Combustion", Universities Press, 3rd Edition, 2009.

REFERENCES

1. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1986.
2. Sharma SP, Mohan Chander, Fuels & Combustion, Tata McGraw Hill, 1984.

E-RESOURCES

1. https://nptel.ac.in/courses/101/104/101104014/ - (Fundamentals of Combustion Part 1)
2. https://nptel.ac.in/courses/101/104/101104072/ - (Fundamentals of Combustion Part 2)

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19MEPX09 **RENEWABLE ENERGY SOURCES** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Provide students an overview of global energy resources.
- Educate the students the importance of bio-fuels, hydrogen energy and solar energy.
- Enable the students understand the importance of energy efficiency.
- Understand the need of conservation in the context of future energy supply.
- Expose students to future energy systems and energy use scenarios.

UNIT I: BIOFUELS **9**

Biofuels classification - Biomass production for energy forming - Energy through fermentation - Pyrolysis - Gasification and combustion - Biogas - Aerobic and anaerobic bio conversion process - Feed stock - Properties of bio-gas composition - Biogas plant design and operation - Alcoholic fermentation.

UNIT II: HYDROGEN ENERGY **9**

Electrolytic and thermo chemical hydrogen production - Metal hydrides and storage of hydrogen - Hydrogen energy conversion systems hybrid systems - Economics and technical feasibility.

UNIT III: SOLAR ENERGY **9**

Solar radiation - Availability- measurement and estimation- Isotropic and an Isotropic models - Introduction to solar collectors (liquid flat-plate collector - Air heater and concentrating collector) and thermal storage - Steady state transient analysis - Photovoltaic solar cell - Hybrid systems - Thermal storage- Solar array and their characteristics evaluation - Solar distillation - Solar drying.

UNIT IV: WIND ENERGY **9**

Wind energy - General considerations - Wind power plant design - Horizontal axis wind turbine - Vertical axis wind turbine- Rotor selection - Design considerations - Number of blades - Blade profile - Power regulation - Yaw system - Choice of power plant - Wind mapping and selection of location - Cost analysis and economics of systems utilizing renewable sources of energy.

UNIT V: TIDAL AND GEOTHERMAL ENERGY **9**

Geothermal - Wave and tidal energy - Availability - Geographical distribution - Power generation using OTEC - Wave and tidal energy - Scope and economics - Geothermal energy - Availability - Limitations.

TOTAL: 45 PERIODS

OUTCOMES

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

- Possess the knowledge of global energy.
- Identify the renewable technologies like solar, biomass, wind, hydrogen etc. to produce energy.
- Evaluate and select proper solar utilities.
- Select the appropriate energy conversion system.
- Involve in optimizing and selecting an alternate source of energy.

TEXT BOOKS

1. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.

REFERENCES

1. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2015.
2. David M. Mousdale - "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA, 2017.

E-RESOURCES

1. https://nptel.ac.in/courses/121/106/121106014/ - (Non Conventional Energy Resources)
2. https://freevideolectures.com/course/4480/ - (Principles of Energy Resources)

19MEPX10 **PROFESSIONAL ETHICS IN ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the human values and ethical theory.
- Provide basic knowledge about engineering ethics, variety of moral issues and moral dilemmas, professional ideals and virtues.
- Provide basic familiarity about engineers as responsible experimenters, research ethics, codes of ethics, industrial standards, exposure to safety and risk, risk benefit analysis.
- Understand the relationship between the engineer and the society.
- Have an adequate knowledge about MNC‟s, business, environmental, computer ethics, moral leadership, sample code of conduct.

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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand human values.
- Realize professional, ethical values and the knowledge of contemporary issues.
- Excel in competitive and challenging environment and contribute to industry through professional careers.
- Update and maintain the technical skills and continuing their education throughout their professional careers.
- Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2014.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2014.

REFERENCES

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics - Concepts and Cases", Cengage Learning, 2014.
2. Subramaniam R, "Professional Ethics", Oxford University Press, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/110/105/110105097/ - (Ethics in Engineering Practice)
2. https://spocathon.page/video/lecture-11-professional-ethics-values-teaching - (Professional Ethics and Values in teaching)

PROFESSIONAL ELECTIVE – III

19MEPX11	PRODUCT DESIGN AND DEVELOPMENT	L T P C 3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the concept of product development and product planning.
- Understand the concept generation, selection and testing.
- Know product development management and product architecture.
- Study the stages of product development followed in industries.
- Acquire knowledge on concepts of design for manufacturing and prototyping.

UNIT I: INTRODUCTION **9**

Strategic importance of product development - Integration of customer, designer, material supplier and process planner - Competitor and customer - Behavior analysis - Understanding and promoting customer - Involve customer in development and managing requirements - Organization process management and improvement.

UNIT II: CONCEPT GENERATION, SELECTION AND TESTING **9**

Plan and establish product specifications and task - Structured approaches - Clarification - Search externally and internally - Explore systematically - Reflect on the solutions and processes - Concept selection - Methodology - Benefits - Implications - Product change - Variety - Component standardization - Product performance - Manufacturability.

UNIT III: PRODUCT ARCHITECTURE **9**

Product development management - Establishing the architecture - Creation - Clustering - Geometric layout development - Fundamental and incidental interactions - Related system level design issues - Secondary systems - Architecture of the chunks - Creating detailed interface specifications - Portfolio Architecture.

UNIT IV: INDUSTRIAL DESIGN **9**

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools - Simulating product performance and manufacturing processes electronically - Need for industrial design - Impact - Design process.

UNIT V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT **9**

Definition - Estimation of manufacturing cost - Reducing the component costs and assembly costs - Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes.

TOTAL: 45 PERIODS

OUTCOMES

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

- Describe the steps involved in product development process and product planning.
- Examine the ideas of concept generation for a new product and the development stages.
- Choose the architecture of the product considering various functional requirements.
- Apply the design process for product development.
- Identify the design and manufacturing constraints during product design and development process.

TEXT BOOKS

1. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", Tata McGraw-Hill Publishing Company Limited, 5th Edition, 2016.
2. G. E. Dieter, Linda C. Schmidt, "Engineering Design", McGraw - Hill, 4th Edition, 2013.

REFERENCES

1. Dr. Ali Jamnia "Introduction to Product Design and Development for Engineers" CRC Press, 2018.
2. Ulrich, Karl T., Eppinger, Steve D., and Yang, Maria C., "Product Design and Development", McGraw-Hill Education, 7th Edition, 2020.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107217/ - (Product Design and Development)
2. https://nptel.ac.in/courses/112/104/112104230/ - (Product Design and Manufacturing)

19MEPX12 **REFRIGERATION AND AIR CONDITIONING** **L T P C**
(Use of Standard Gas Table Book is Permitted) **3 0 0 3**

OBJECTIVES

The main objective of this course is to:

- Acquire knowledge on basics of refrigeration and air conditioning.
- Study the various refrigeration system and air conditioning.
- Study the basics of psycrometric properties and process.
- Understand the cooling load calculation of air conditioning system.

UNIT I: INTRODUCTION **9**

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

UNIT II: VAPOUR COMPRESSION REFRIGERATION SYSTEM **9**

Vapor compression cycle : p-h and T-s diagrams - Deviations from theoretical cycle - Subcooling and super heating - Effects of condenser and evaporator pressure on COP - Multipressure system - Low temperature refrigeration - Cascade systems.

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 - Psychrometric chart.

UNIT V: AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION **9**

Air conditioning loads - Outside and inside design conditions - Infiltration and ventilation - internal heat load - Apparatus selection - fresh air load, human comfort and IAQ principles - Calculation of summer and winter air conditioning load.

TOTAL: 45 PERIODS

OUTCOMES

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

- Demonstrate the basic concepts of refrigeration.
- Elucidate the vapor compression refrigeration systems and to solve problems.
- Identify the various types of refrigeration systems.
- Calculate the Psychrometric properties and its use in Psychrometric processes.
- Enlighten the concepts of air conditioning and to solve problems.

TEXT BOOKS

1. Arora, C.P., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 3rd Edition, 2010.
2. ASHRAE Hand book, Fundamentals, 2010.

REFERENCES

1. Jones W.P., "Air conditioning engineering Elsevier Butterworth-Heinemann", 5th Edition, 2007.
2. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105128/ - (Refrigeration and Air Conditioning)
2. https://nptel.ac.in/courses/112/105/112105129/ - (History of Refrigeration)

19MEPX13 PROCESS PLANNING AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the steps involved in process planning and computer aided process planning.
- Study the process parameter calculation for various production process.
- Acquire knowledge on elements and estimation of cost, material cost and weight estimation.
- Estimate the production cost.
- Introduce the techniques in estimation of time and cost of machining, forging and welding.

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 - Selection of quality assurance methods - Set of documents for process planning - Economics of process planning - Case studies.

UNIT III: INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation - Methods of costing - Elements of cost estimation -Types of estimates - Estimating procedure - Estimation labor cost, material cost - Allocation of overhead charges - Calculation of depreciation cost.

UNIT IV: PRODUCTION COST ESTIMATION 9

Estimation of different types of jobs - Estimation of forging shop - Estimation of welding shop - Estimation of foundry shop.

UNIT V: MACHINING TIME CALCULATION 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Summarize the steps involved in process planning and/or computer aided process planning.
- Identify the elements of cost during manufacture of a product and/or apply the methods to estimate the cost.

- Estimate the material cost weight for a particular part.
- Determine the machining time of material removal processes in lathe, milling, shaping, planning and grinding.
- Adopt the methods of estimation in forging and welding processes to find cost of the process.

TEXT BOOKS

1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems, John Wiley", 9th Edition, 1998.
2. Dr.V.Jayakumar, "Process Planning and Cost Estimation", Lakshmi publications, Chennai, 2013.

REFERENCES

1. Davim, J. Paulo, Jain, Ajai, Phanden, Rakesh Kumar "Integration of process planning and scheduling: approaches and algorithms" CRC Press/Taylor & Francis Group, 2020.
2. R. Kesavan, C. Elanchezhian, B. Yijaya ramnath "Process Planning and Cost Estimation", New Age International (P) Limited, New Delhi, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/110/101/110101132/ - (Cost Accounting)
2. https://youtu.be/y24meNZbUoU - (Process Planning)

19MEPX14 **NEW VENTURE PLANNING AND MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the concept, theories of entrepreneurship and functions of entrepreneur.
- Know the steps involved in new venture promotion and fund management.
- Acquire knowledge on entrepreneurial behavior, development programme roles of entrepreneur.
- Get exposure on entrepreneurial behavior and development programme.
- Establish the role and responsibilities of entrepreneur.

UNIT I: FUNCTIONS OF ENTREPRENEUR **9**

Entrepreneur - Definition and concept - Characteristics of entrepreneur - Entrepreneurship - Definition and characteristics - Emergence of entrepreneurial class - Comparison of entrepreneur with entrepreneurship - Enterprise and manager - Danhofis classifications, other classifications - Intrapreneurs - Ultrapreneurs - Functions of entrepreneurs.

UNIT II: THEORIES OF ENTREPRENEURSHIP **9**

Sociological theories - Economic theories - Cultural theories - Psychological theories - Specialists views on entrepreneurship - Walker on entrepreneurship - Harbison entrepreneurship - Drucker on entrepreneurship - Peter kilby on entrepreneurship - Models on entrepreneurship.

UNIT III: PROMOTION OF A VENTURE **9**

Opportunity analysis - Environment and entrepreneurship - Technological environment - Competitive factors - Small scale industrial undertakings - Steps in setting up a small scale industrial enterprise - Legal requirements - Important acts , policies of government - Raising of funds - Internal and external sources of finance - Capital structure - Capitalization - Export finance - Venture capital - Concept, aims, features of venture capital and financing steps - sources of venture capital and criteria to provide venture capital finance.

UNIT IV: ENTREPRENEURIAL BEHAVIOUR AND DEVELOPMENT PROGRAMME **9**

Innovation and entrepreneur - Schumpeteris and Drucker theories - Entrepreneurial behaviour and psychological theories - Social responsibility - Entrepreneurship development programmes - Meaning and objectives - Indian EDP model - Phase of EDPs - EDP Curriculum - Common denominators of success of EDPs - Role, relevance and achievements of EDPs - Role of government in organizing EDPs.

UNIT V: ENTREPRENEURSHIP AND ROLE OF ENTREPRENEUR **9**

Role of entrepreneur - As an innovator in economic growth - Generation of employment opportunities - Complementing and supplementing economic growth - Bringing about social stability and balanced regional development of industries - Export promotion and import substitution - Foreign exchange earnings and augmenting and meeting local demand - Rural entrepreneur - Women entrepreneurship.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the concept of entrepreneurship and functions of an entrepreneur.
- Describe various theories of entrepreneurship.
- Identify the steps involved during new venture establishment and fund requirements.
- Summarize the entrepreneurial behavioural aspects and types entrepreneurship development programmes.
- Demonstrate the idea of Women and Rural entrepreneurship roles of entrepreneur.

TEXTBOOKS

1. Shangram Keshari Mohanty, "Fundamentals of Entrepreneurship", Prentice Hall India Private Ltd., 11th Special Indian Edition, 2020.
2. Robert D Hisrich, Mathew J Manimala, Michael P Peters and Dean A Shepherd, "Entrepreneurship", Tata Mcgraw Hill Education Private Limited, 6th Edition, 2013.

REFERENCES

1. Bruce R. Barringer and Duane Ireland.R, "Entrepreneurship: Successfully Launching New Ventures", Pearson Education, 3rd Edition, 2011.
2. Jain.P.C, "Handbook of New Entrepreneur", Oxford University Press, 2003.

E-RESOURCES

1. https://nptel.ac.in/courses/110/106/110106141/ - (Entrepreneurial Journey)
2. https://nptel.ac.in/courses/110/107/110107094/ - (Innovation, Business Models and Entrepreneurship)

19MEPX15 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Acquire various concepts of quality management.
- Apply the various principles of quality management.
- Impart quality using statistical process.
- Make use of the various tools to maintain quality.
- Implement the quality system for ISO certification.

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, Customer retention.

UNIT II: TQM PRINCIPLES **9**

Leadership - Quality statements - Strategic quality planning - Quality councils - Employee involvement - Motivation, empowerment, team and teamwork, recognition, reward and 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**

Quality circles - Cost of quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V: QUALITY MANAGEMENT SYSTEM **9**

Introduction - Benefits of ISO registration - ISO 9000 series of standards - Specific standards - AS 9100, TS16949 and TL 9000 - ISO 9001 requirements - Implementation - Documentation - Internal audits - Registration - Environmental Management System: Introduction - ISO 14000 series standards - Concepts of ISO 14001 - Requirements of ISO 14001 - Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOMES

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

- Demonstrate various concepts of quality management.
- Elaborate the various principles of quality management.
- Inspect quality using statistical process.
- Select the various tools to maintain quality.
- Evaluate the quality system for ISO certification.

TEXT BOOKS

1. Dale H.Besterfiled, "Total Quality Management", Pearson Education Asia, Revised, Indian Reprint, Sixth Impression, 3rd Edition, 2013.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2011.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", First Indian Edition, Cengage Learning, 8th Edition, 2012.
2. Subburaj ramasamy, " Total Quality Management", McGraw Hill Education, Noiad, 2011.

E- RESOURCES

1. https://www.youtube.com/watch?v=UOuTBCrW2kY - (Total Productive Maintenance)
2. https://www.youtube.com/watch?v=ksR4Xy6tFcM - (Total Quality Management)

PROFESSIONAL ELECTIVE – IV

19MEPX16 **THERMAL TURBO MACHINES** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the various systems and principles of turbo machinery components.
- Acquire knowledge on types of centrifugal fans and blowers.
- Know the construction and working of centrifugal compressor.
- Impart knowledge on axial flow compressor.
- Provide knowledge on axial and radial flow turbines.

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 - Performance curves.

UNIT IV: AXIAL FLOW COMPRESSOR 9

Stage velocity diagrams - Enthalpy-Entropy diagrams - Stage losses - Efficiency - Work done - Simple stage design problems - 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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the basic concepts of turbo machinery components.
- Elucidate the types of centrifugal fans and blowers.
- Discuss the various types of centrifugal compressor.
- Enlighten the concepts of axial flow compressor.
- Illustrate about the concepts of axial and radial flow turbines.

TEXT BOOKS

1. Yahya, S.H., Turbines, Compressor and Fans, Tata McGraw Hill Publishing Company, 1996.
2. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.

REFERENCES

1. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
2. Dixon, S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 1990.

E-RESOURCES

1. https://nptel.ac.in/courses/101/101/101101058/ - (Introduction to Turbo Machines)
2. http://nptel.vtu.ac.in/econtent/courses/ME/06ME55/index.php - (Introduction to Turbo Machines)

19MEPX17 **ROBOTICS AND CONTROL** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Learn the construction and fundamentals of robots.
- Provide knowledge on types of drives and end effectors in robots.
- Impart knowledge on sensors and machine vision system.
- Study the kinematics of robots and its programming method.
- Accurate positioning of the robot and error compensation by servo control.

UNIT I: FUNDAMENTAL OF ROBOTICS PROCESS **9**

Robot – Definition - Robotics and automation - Law of robotics - Robot anatomy - Co-ordinate systems, work envelope - Classification - Specifications - Pitch, yaw, roll, joint notations - Pay load - Need for robots.

UNIT II: ROBOT DRIVE SYSTEM AND END EFFECTORS **9**

Pneumatic, Hydraulic, Mechanical and Electrical Drives - End effectors - Grippers - Pneumatic Hydraulic, Magnetic, Vacuum and Mechanical Grippers - Two and three fingered grippers - Internal and External grippers.

UNIT III: SENSORS AND MACHINE VISION SYSTEMS **9**

Sensors - Types - Tactile , proximity and range sensors - Contact and non-contact sensors - Velocity sensors - Touch and slip sensors - Force and torque sensors - Robotic vision systems - Imaging components - Image representation, picture coding, object recognition and categorization - Visual inspection.

UNIT IV: ROBOT KINEMATICS AND PROGRAMMING **9**

Forward and Inverse kinematics – Forward and reverse kinematics of manipulators with two and three degrees of freedom (In 2 Dimensional) - Four degrees of freedom (In 3 Dimensional) - Teach pendant programming - Lead through programming - Robot programming languages - VAL Programming - Motion commands.

UNIT V: SERVO SYSTEMS FOR ROBOT CONTROL **9**

Robot control - Basic control techniques - Mathematical modeling of robot servos - Error responses and steady state errors in robot servos - Feedback and feed forward compensations - Hydraulic position servo - Computer controlled servo system - Robot applications.

TOTAL: 45 PERIODS

OUTCOMES

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

- Identify the components and construction of robots.
- Select a suitable drive and an end effector for industrial robots.
- Choose sensors and machine vision system for industrial robots.
- Formulate forward and inverse kinematics and construct program for robots.
- Summarize the methodology of servo system and control of robots.

TEXT BOOKS

1. M. P. Groover, Industrial Robotics Technology, Programming and Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2nd Edition, 2012.
2. S K Saha, "Introduction to Robotics", 2nd Edition, McGraw Hill, 2015.

REFERENCES

1. Mittal R K and Nagrath I J, "Robotics and Control", McGraw Hill Education (India) Private Limited, 1st Edition, 2012.
2. D. Richard, Klafter, A. Thomas, Chmielewski and Michael Negin, "Robotics Engineering, An Integrated Approach", Prentice Hall of India, New Delhi, 2013.

E-RESOURCES

1. https://nptel.ac.in/courses/112/101/112101099/ - (Robotics)
2. https://nptel.ac.in/courses/112/107/112107289/ - (Robotics and Control: Theory and Practice)

19MEPX18 **ENGINEERING ECONOMICS AND ANALYSIS** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is:

- Understand the basics of economics.
- Enable students to understand the fundamental economic concepts and value engineering.
- Know the methods by which cost analysis and pricing done in the industry.
- Recognize about the maintenance analysis performed in industries.
- Learn the techniques of incorporating inflation factor in economic decision making.

UNIT I: INTRODUCTION TO ECONOMICS **9**

Introduction to Economics - Flow in an economy - Law of supply and demand - Concept of engineering economics - Engineering efficiency, Economic efficiency - Scope of engineering economics - Element of costs, marginal cost, marginal revenue, sunk cost, opportunity cost - Break- Even Analysis - P/ V ratio - Elementary economic analysis - Material selection for product - Design selection for a product, process planning.

UNIT II: VALUE ENGINEERING **9**

Make or buy decision - Value engineering - Function, aims, value engineering procedure - Interest Formulae and their applications - Time value of money - Single payment compound amount factor - Single payment present worth factor - Equal payment series sinking fund factor - Equal payment series payment present worth factor- Equal payment series capital recovery factor - Uniform gradient series annual equivalent factor , examples in all the methods.

UNIT III: CASH FLOW **9**

Methods of comparison of alternatives - Present worth method (Revenue dominated cash flow diagram , cost dominated cash flow diagram) - Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram - Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), examples in all the methods.

UNIT IV: REPLACEMENT AND MAINTENANCE ANALYSIS **9**

Replacement and maintenance analysis - Types of maintenance - Types of replacement problem, determination of economic life of an asset, replacement of an asset with a new asset - Capital recovery with return and concept of challenger and defender, simple probabilistic model for items which fail completely.

UNIT V: DEPRECIATION **9**

Depreciation – Introduction - Straight line method of depreciation - Declining balance method of depreciation - Sum of the years digits method of depreciation - Sinking fund method of depreciation - Service output method of depreciation - Evaluation of public alternatives - Introduction, examples.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the basics of economics and cost analysis to engineering applications.
- Summarize the steps involved in decision making with economic feasibility.
- Evaluate an alternative by considering the economic factors.
- Conclude the replacement and maintenance policies of industrial equipment.
- Determine the depreciation of industrial equipment over the operating periods using appropriate method.

TEXT BOOKS

1. Panneer Selvam.R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2013.
2. Donald G. Newnan, Ted Eschenbach, Jerome P. Lavelle, "Engineering Economic Analysis", Oxford University Press, 9th Edition, 2010.

REFERENCES

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107209/ - (Engineering Economic Analysis)
2. https://www.youtube.com/watch?v=TJr_29zC9hc - (Cash Flow Analysis)

19MEPX19 INDUSTRIAL ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession.
- Gain the knowledge on production system and layout design.
- Provide the knowledge of work study, process charts and ergonomic condition.
- Learn about statistical quality control and total quality management concepts.
- Familiarize the resource management, value analysis and project management techniques.

UNIT I: INDUSTRIAL ENGINEERING 9

Industrial engineering - Concept, History and Development, Applications - Roles of Industrial Engineer - Differences between production management and industrial engineering - Quantitative tools of Industrial Engineering and productivity measurement - Concepts of management, importance, functions of management, scientific management - Taylor‟s principles, theory X and theory Y- Fayol‟s principles of management.

UNIT II: PLANT LAYOUT 9

Factors governing plant location - Types of production layouts - Advantages and disadvantages of process layout and product layout - Applications - Quantitative techniques for optimal design of layouts - Plant maintenance, preventive and breakdown maintenance.

UNIT III: OPERATION MANAGEMENT 9

Importance - Types of production - Applications - Workstudy, method study and time study - Work sampling - PMTS - Micro-motion study - Rating techniques - MTM - Work factor system - Principles of Ergonomics - Flow process charts - String diagrams - Therbligs,

UNIT IV: STATISTICAL QUALITY CONTROL AND TOTAL QUALITY MANAGEMENT 9

Quality control - Queing assurance and its importance - SQC - Attribute - Sampling inspection with single and double sampling - Control charts - Applications - Numerical examples. TQM: Zero defect concept - Quality circles - Implementation - Applications - ISO quality system - Six sigma.

UNIT V: RESOURCE MANAGEMENT, VALUE ANALYSIS AND PROJECT MAMANGEMENT 9

Concepts - Personnel management and industrial relations - Functions of personnel management - Job-evaluation - Importance and types - Merit rating - Quantitative methods - Wage incentive plans - Types. Value Analysis**:** Value engineering - Implementation procedure - Enterprise Resource Planning - Supply chain management. Project Mamangement: PERT, CPM - Differences and applications - Critical path - Determination of floats - Importance - Project crashing - Smoothing and numerical examples.

TOTAL: 45 PERIODS

OUTCOMES

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

- Explain the fundamental concepts of Industrial Engineering.
- Select proper plant layout for the required production system.
- Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
- Analyze the statistical quality control methods and total quality management concepts.
- Understand the resource management, value analysis and project management techniques.

TEXT BOOKS

1. Khanna O.P, "Industrial Engineering and management", Dhanpat Rai Publications, 2010.
2. Martand T.Telsang, "Industrial Engineering and Production Management", S Chand Publishers, New Delhi, 2006.

REFERENCES

1. Ravi Shankar, "Industrial Engineering and Management", Golgotia Publications Pvt. Ltd., New Delhi, 2009.
2. Panneerselvam R., "Production and operations management", Heritage Publishers, 2006.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107292/ - (Principles of Industrial Engineering)
2. https://nptel.ac.in/courses/112/107/112107143/ - (Operation Management)

19MEPX20 **LEAN AND AGILE MANUFACTURING** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the principles of Lean manufacturing.
- Acquire knowledge on tools of Lean manufacturing.
- Explore various visual management techniques, TPM and Lean practices.
- Find knowledge on management and technology drivers of agile manufacturing.
- Know the fundamentals of manufacturing strategy and competitive drivers of agile manufacturing.

UNIT I: LEAN MANUFACTURING PRINCIPLES **9**

Lean and Agile manufacturing paradigms - Lean manufacturing - Origin - Toyota Production system - Types of wastes - Tools and techniques to eliminate wastes - Value stream mapping (VSM) - Primary icons - Secondary icons - Developing the VSM.

UNIT II: LEAN MANUFACTURING TOOLS **9**

5S concepts - Stages of 5S and waste elimination - Kaizen - Steps of Kaizen - Lean manufacturing through Kaizen – Single minute exchange of Die - Theory of SMED - Design for SMED - Strategic SMED and waste elimination - Pull production through Kanban - One piece flow production.

UNIT III: VISUAL MANAGEMENT, TPM AND LEAN IMPLEMENTATION **9**

Visual management - Tools for eliminating wastes - Overproduction, inventory, delay, transportation - Processing, unnecessary motion - Defective parts - Underutilization of people - Implementation - Total Productive Maintenance - Implementation of Lean practices

UNIT IV: MANAGEMENT AND TECHNOLOGY DRIVERS OF AGILE MANUFACTURING **9**

Agile manufacturing - Twenty criteria model - Management driver - Organizational structure - Devolution of authority - Employee status and involvement - Nature of management - Business and technical processes - Time management - Agility through technology driver

UNIT V: MANUFACTURING STRATEGY AND COMPETITIVE DRIVERS OF AGILEMANUFACTURING **9**

Quick manufacturing setups - Quick response - Product life cycle management - Product service elimination - Automation - Competitive driver - Status of quality and productivity - Compatible cost accounting system - Outsourcing - Implementation of agile manufacturing.

TOTAL: 45 PERIODS

OUTCOMES

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

- Demonstrate the lean manufacturing principles to find and eliminate wastes.
- Identify the lean manufacturing tools and their potential applications.
- Summarize the usage of visual management, TPM and lean practices.
- Compare the technology drivers of agile manufacturing.
- Explain the technology drivers of agile manufacturing.

TEXT BOOKS

1. Devadasan.S.R, Mohan Sivakumar.V, Murugesh.R and Shalij.P.R, "Lean and Agile Manufacturing:, Theoretical, Practical and Research Futurities", PHI Learning Private Limited, 2012.
2. Pascal Dennis, "Lean Production Simplified", Productivity Press, 2nd Edition, 2007.

REFERENCES

1. Bill Carreira, "Lean Manufacturing That Works", PHI Learning Private Limited, 3rd Edition, 2016.
2. Dennis P. Hobbs, "Lean Manufacturing Implementation", Cengage Learning, 5th Edition, 2015.

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104188/ - (Lean Manufacturing System Technology)
2. https://freevideolectures.com/course/4162/nptel - (Toyota Production system)

PROFESSIONAL ELECTIVE – V

19MEPX21 **DESIGN OF HEAT EXCHANGERS** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Learn the thermal analysis on various parts of the heat exchangers.
- Get exposure on stress analysis on various parts of the heat exchangers.
- Analyze the sizing and rating of the heat exchangers for various applications.
- Understand the types of heat exchanger.
- Acquire knowledge on condensers and cooling tower.

UNIT I: FUNDAMENTALS OF HEAT EXCHANGER 9

Temperature distribution and its implications types - Shell and tube heat exchangers - Regenerators and recuperators - Analysis of heat exchangers - LMTD and effectiveness method.

UNIT II: FLOW AND STRESS ANALYSIS 9

Effect of turbulence - Friction factor - Pressure loss - Stress in tubes - Header sheets and pressure vessels - Thermal stresses, shear stresses - Types of failures.

UNIT III: DESIGN ASPECTS 9

Heat transfer and pressure loss - Flow configuration - Effect of baffles - Effect of deviations from ideality - Design of double pipe - Finned tube - Shell and tube heat exchangers - Simulation of heat exchangers.

UNIT IV: COMPACT AND PLATE HEAT EXCHANGERS 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 characteristics.

TOTAL: 45 PERIODS

OUTCOMES

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

- Interpret the concept of thermal analysis in heat exchangers.
- Identify and explain the concept of stress analysis in heat exchangers.
- Design the heat exchanger based on the information provided for a particular application.
- Describe the working of the different types of heat exchanger.
- Explain the applications of condensers and cooling tower.

TEXT BOOKS

1. Sadik Kakac and Hongtan Liu, Heat Exchangers Selection, Rating and Thermal Design, CRC Press, 2002
2. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1988.

REFERENCES

1. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co. 1980.
2. Hewitt.G.F, Shires.G.L and Bott.T.R, Process Heat Transfer, CRC Press, 1994.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105248/ - (Heat Exchangers: Fundamentals and Design)
2. https://nptel.ac.in/courses/103/105/103105140/ - (Introduction to Heat Transfer)

19MEPX22 **INDUSTRIAL TRIBOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is:

- Impart basic knowledge on surfaces and friction.
- Learn the wear mechanisms and its consequences under different contact conditions.
- Identify the appropriate lubrication method based on contact conditions.
- Study about film lubrication theory.
- Acquire knowledge on surface engineering and materials for bearings.

UNIT I: SURFACES AND FRICTION **9**

Engineering surfaces - Contact between surfaces - Sources of sliding friction - Adhesion - Plouging - Energy dissipation mechanisms - Friction characteristics of metals - Friction of non metals. Friction of lamellar solids - Friction of ceramic materials and polymers - Rolling friction - Source of rolling friction - Stick slip motion - Measurement of friction.

UNIT II: WEAR **9**

Types of wear - Simple theory of sliding wear mechanism of sliding wear of metals - Abrasive wear - Materials for adhesive and abrasive wear situations - Corrosive wear - Surface fatigue wear situations - Brittle fracture - Wear - Wear of ceramics and polymers - Wear measurements.

UNIT III: LUBRICANTS AND LUBRICATION TYPES **9**

Types and properties of Lubricants - Testing methods - Hydrodynamic lubrication - Elasto Hydrodynamic lubrication - Boundary lubrication - Solid lubrication - Hydrostatic lubrication.

UNIT IV: FILM LUBRICATION THEORY **9**

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation - Reynolds equation for film lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual co-efficient of friction - The Somerfield diagram.

UNIT V: SURFACE ENGINEERING AND MATERIALS FOR BEARINGS **9**

Surface modifications - Transformation hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion processes - Vapour phase processes - Materials for rolling element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

TOTAL: 45 PERIODS

OUTCOMES

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

- Demonstrate the fundamental concepts of surfaces and friction.
- Analyze the wear mechanism and measure wear rate.
- Identify the types o lubricants used in various lubrication methods.
- Discover the effect of fluid film in bearing.
- Select appropriate materials for various bearings.

TEXT BOOKS

1. Homer Rahnejat, Ramsey Gohar, "Fundamentals of Tribology", World Scientific Publishing Europe Ltd.,3 rd Edition, 2018.
2. Gwidon W. Stachowiak and Andrew W. Batchelor, "Engineering Tribology", Butterworth-Heinemann, 4th Edition, 2016.

REFERENCES

1. M.J.Neale (Editor), " Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 2016.
2. Michael M. Khonsari, E. Richard Booser, " Applied Tribology: Bearing Design and Lubrication", Wiley, 3rd Edition, 2017.

E-RESOURCES

1. https://nptel.ac.in/courses/112/102/112102014/ - (Introduction to Tribology)
2. https://nptel.ac.in/courses/113/108/113108083/ - (Friction and Wear of Materials: Principals and Case Study)

19MEPX23 **INTERNAL COMBUSTION ENGINES** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the working principle of spark ignition engines.
- Initiate students to the working of compression ignition engines.
- Understand the effect of engine emissions, pollution and their control.
- Know the usage of alternate fuels in ic engines.
- Introduce students to the recent trends in IC engines like stratification, multi point injection, plasma ignition etc.,

UNIT I: SPARK IGNITION ENGINES **9**

Mixture requirements - Fuel injection systems - Monopoint, multipoint and direct injection - Stages of combustion - Normal and abnormal combustion, spark knock, factors affecting knock, combustion chambers.

UNIT II: COMPRESSION IGNITION ENGINES **9**

Diesel fuel injection systems - 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.

UNIT IV: STUDY OF FUELS **9**

Alcohol, hydrogen, compressed natural gas, liquefied petroleum gas and bio diesel - Properties, suitability, merits and demerits.

UNIT V: RECENT TRENDS IN IC ENGINES **9**

Air assisted combustion, homogeneous charge compression ignition engines - Variable geometry turbochargers - Common Rail Direct Injection Systems - Hybrid electric vehicles - Onboard diagnostics.

OUTCOMES

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

- Determine performance and combustion characteristics of SI engines.
- Summarize the combustion characteristics of CI engines.
- Estimate emissions from SI and CI engines using quantitative methods.
- Analyze the performance of IC engines using alternative fuels.
- Demonstrate the recent trends in IC engines with applications.

TEXT BOOKS

1. Ganesan V, "Internal Combustion Engines", 4th Edition, Tata McGraw Hill, New Delhi, 2013.
2. B.P.Pundir, "Internal combustion Engines Combustion and Emissions", Narosa Publishing House Private limited, New Delhi, 2017

REFERENCES

1. Colin R.Feriguson and Allan.T.Kirkpatrik, "IC Engines: Applied Thermo sciences Wiley-Blackwell", 3rd Revised Edition, 2015.
2. John B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Publishing Company Private limited, New Delhi, 2015.

E-RESOURCES

1. https://nptel.ac.in/courses/112/103/112103262/ - (IC Engines and Gas Turbines)
2. https://nptel.ac.in/courses/112/104/112104033/ - (Engine Combustion)

19MEPX24 **METAL FORMING TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the fundamentals of metal forming.
- Introduce the theory of metal forming, techniques of forging and extrusion.
- Acquire knowledge on operation sequence of rolling and drawing processes.
- Know the techniques of sheet metal forming.
- Identify various forming process.

UNIT I: FUNDAMENTALS OF METAL FORMING **9**

Classification and methods in forming - Tensile test and metallurgy - Theory of plasticity - Effect of temperature, strain rate, metallurgical microstructure, chemical elements and mechanical properties - Friction and lubrication - Deformation zone geometry - Workability - Mechanics of metal forming - Flow stress determination.

UNIT II: FORGING AND EXTRUSION **9**

Classification of forging - Forging equipment - Plane strain forging with coulomb friction - Residual stresses in forgings - Forging defects - Open and closed die forging - Forging die design - Extrusion - Principal variables - Calculation of extrusion load - Defects in extrusion - Deformation and flow pattern - Extrusion of tubing.

UNIT III: ROLLING AND DRAWING **9**

Classification - Rolling mills - Rolling of bars and shapes - Forces and geometrical relationship - cold rolling - Frictional forces in the arc of contact - Rolling - Process variables - Defects - Cold rolling theory - Roll flattening - Roll camber - Theory of strip - Drawing - Rod and wire drawing - Lubrication - Patenting heat treatment - Defects - Variables in wire drawing.

UNIT IV: SHEET METAL FORMING **9**

Metal spinning - Manual spinning - Power spinning - Spinnability of metals - Blanking - Rubber pad forming - Marform process - Deep drawing process - Stress pattern - Drawability - Defects - Stretch forming operation - Plastic stress strain relation - Deep drawing tools design.

UNIT V: FORMING PROCESSES **9**

Explosive Forming - Electro hydraulic forming - Magnetic pulse forming - Petro forge hammer - Drop hammer and dynapak - Forming by laser beam - Die-less forming.

TOTAL: 45 PERIODS

OUTCOMES

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

- Discuss the principles of metal forming, mechanical behaviour of materials and grain structure of materials during forming processes.
- Identify the components and explain the working principles of forging and extrusion equipments.
- Recommend the process parameters of rolling or drawing for a particular engineering product.
- Illustrate the steps involved in sheet metal forming processes considering stress strain relations.
- Classify the forming processes and describe the working principles of various equipments.

TEXT BOOKS

1. Fritz Klocke, "Manufacturing Processes 4 - Forming", Springer-Verlag Berlin Heidelberg, 1st Edition, 2013.
2. Narayanasamy.R, "Metal Forming Technology", Ahuja Book Publishers & Distributors, 1st Edition, 1997.

REFERENCES

1. Rao.P N, "Manufacturing Technology : Foundry, Forming & Welding", Tata McGraw-Hill Education, 4th Edition, 2013.
2. Surender Kumar, "Technology of Metal Forming Processes", Prentice Hall India Publications, 2008.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107250/ - (Principles of Metal Forming Technology)
2. https://www.youtube.com/watch?v=xk0gSgLgciY&ab_channel=LiveSessionIITR - (Principles of Metal Forming Technology)

19MEPX25 COMPUTER INTEGRATED MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the basic concepts of Computer Integrated Manufacturing (CIM).
- Provide knowledge on production planning and control and computer aided process planning.
- Impart knowledge on group technology and cellular manufacturing.
- Learn the flexible manufacturing system and various AGVS techniques.
- Understand the functions of the basic components of a robot.

UNIT I: INTRODUCTION 9

Brief introduction to CAD and CAM - Manufacturing planning and control- Introduction to CAD/CAM - Concurrent Engineering - CIM concepts - Computerised elements of CIM system - Types of production - 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 - Master Production Schedule (MPS) - Material Requirement Planning-I (MRP-I) - Capacity Planning - Control Systems - Shop Floor Control (SFC) - Inventory Control - Manufacturing Resource Planning-II (MRP-II) - Enterprise Resource Planning (ERP).

UNIT III: CELLULAR MANUFACTURING 9

Group Technology (GT) - Part Families - Parts classification and coding - Production Flow Analysis (PFA) - 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.

UNIT IV: FLEXIBLE MANUFACTURING SYSTEM AND AUTOMATED GUIDED VEHICLE SYSTEM 9

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

TOTAL: 45 PERIODS

OUTCOMES

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

- Clarify the basic concepts of CAD, CAM and Computer Integrated Manufacturing Systems.

- Summarize the production planning and control and computerized process planning.
- Differentiate the different coding systems used in group technology.
- Enumerate the concepts of Flexible Manufacturing System (FMS) and Automated Guided Vehicle System (AGVS).
- Understand the various types of robots in industrial applications.

TEXT BOOKS

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 3rd Edition, 2012.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", New Age International (P) Ltd., New Delhi, 4th Edition , 2018.

REFERENCES

1. Kant Vajpayee S, Principles of Computer Integrated Manufacturing, Prentice Hall, New Delhi, 2013.
2. Rao.P, N Tewari & T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2012.

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104289/ - (Computer Integrated Manufacturing)
2. https://onlinecourses.nptel.ac.in/noc20_me44/preview - (Computer Integrated Manufacturing)

OPEN ELECTIVE – I

19MEOX01 **MAINTENANCE ENIGNEERING** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Develop the ability in formulating suitable maintenance strategies to achieve reliable and continuous manufacturing system.
- Explain the different maintenance categories in Preventive maintenance.
- Explicate the condition monitoring techniques
- Facilitate about the repair of machine elements.
- Illustrate some of the repair methods for material handling equipment .

UNIT I: PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound Maintenance systems - Factors of availability -Maintenance organization - Maintenance economics

UNIT II: MAINTENANCE POLICIES-PREVENTIVE MAINTENANCE 9

Maintenance categories - 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 offload testing - Methods and instruments for CM - Temperature sensitive tapes - Pistol thermometers

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

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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Implement the maintenance function and different practices in industries for the successful management of maintenance activities.
- Identify the different maintenance categories.

- Execute the condition monitoring techniques.
- Solve the repair methods of machine elements.
- Resolve about repair methods of material handling equipment.

TEXT BOOKS

1. Srivastava S.K., "Maintenance Engineering Principles, Practices & Management", S. Chand and Co., 5th Edition, 2016.
2. Venkataraman.K "Maintancence Engineering and Management", PHI Learning, Pvt.Ltd., 4th Edition, 2015.

REFERENCES

1. Garg M.R., "Industrial Maintenance", S. Chand & Co., 6th Edition, 2017.
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 4th Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105232/
2. https://nptel.ac.in/courses/112/107/112107142/

19MEOX02 PRODUCTION PLANNING AND CONTROL L T P C
3 0 0 3

OBJECTIVES

To enable students to

- Understand the various components and functions of production planning and control.
- Analyse the work study procedures.
- Understand the product planning and process planning process.
- Impart knowledge on production scheduling and inventory control.
- Know the recent trends like Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I: INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of productionjob-batch and continuous-Product development and design-Different aspects. Profit consideration-Standardization, Simplification & specialization- Break even analysis.

UNIT II: WORK STUDY 9

Method study, basic procedure- Development -Implementation - Micro motion and memo motion study – work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III: PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Value analysis-planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing.

UNIT IV: PRODUCTION SCHEDULING 9

Loading and scheduling-Master Scheduling-Scheduling rules-Ganttcharts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling-Batch production scheduling-Production Control systems-Material requirement planning -kanban – Dispatching-Progress reporting and expediting.

UNIT V: INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Twobin system -Ordering cycle system -ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

OUTCOMES

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

- Introduce the concept of production planning and control.
- Demonstrating various work study procedures.
- Prepare production planning and various control activities.
- Compare the various scheduling process with production planning.
- They can plan manufacturing requirements manufacturing requirement Planning andEnterprise Resource Planning anf Inventory control.

TEXT BOOKS

1. 1.Martand Telsang, "Industrial Engineering and Production Management",1st Edition, S.Chand and Company, 2000.
2. James.B.Dilworth,"Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International Edition, 1992.

REFERENCES

1. Jain. K.C & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
2. Chary. S.N. "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.

E-RESOURCES

1. https://nptel.ac.In/courses/112/107/112107143/ -(Production Planning and Control)
2. https://nptel.ac.In/Courses/112/107/112107217/-(Product Design and Development)

19MEOX03 **AUTOMOTIVE SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES

To enable students to:

- Understand the construction and working principle of various automotive engines.
- Impart knowledge on the constructional details and principle of operation of various vehicle frames and steering systems.
- Learn the function of various components in transmission and drive lines of a vehicle.
- Study the concept and working of brakes and suspension systems in automobile.
- Impart knowledge on various alternative energy sources.

UNIT I: AUTOMOTIVE ENGINE AUXILIARY SYSTEMS **9**

Automotive engines- External combustion engines –Internal combustion engines - two stroke engines -four stroke engines- construction and working principles - engine valve timing –port timing diagram- Injection system -Ignition system.

UNIT II: VEHICLE FRAMES AND STEERING SYSTEM **9**

Vehicle construction and different Chassis layouts –classifications of chassis- types of frames-vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system -Steering geometry - types of stub axle – Types of rear axles.

UNIT III: TRANSMISSION SYSTEMS **9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints –- Hotchkiss Drive and Torque Tube Drive- rear axle- Differential.

UNIT IV: SUSPENSION AND BRAKES SYSTEM **9**

Suspension Systems–leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V: ALTERNATIVE ENERGY SOURCE **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Hydrogen in Automobiles- Engine modifications required –Electric and Hybrid Vehicles, Fuel Cell. Turbo charger-Engine emission control by three way catalytic converter system.

TOTAL: 45 PERIODS

OUTCOMES

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

- Demonstrate the operating principles and constructional details of various automotive engines.
- Explicate the function of vehicle frame and steering systems.
- Clarify the function of various components in transmission and drive lines of a vehicle.
- Identify and explain the types of suspension system and braking system.
- Interpret the various alternative energy sources.

TEXT BOOKS

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, 7th Edition, Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

REFERENCES

1. Heinz Heisler, "Advanced Engine Technology", SAE International Publications USA, 1998.
2. Ganesan V. "Internal Combustion Engines", 3rd Edition, Tata McGraw-Hill, 2007.

E-RESOURCES

1. https://nptel.ac.in/courses/107/106/107106088/ - (Fundamentals of Automotive systems)
2. https://nptel.ac.in/courses/121/106/121106014/ - (Conventional Energy sources)

19MEOX04 **PRINCIPLES OF MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Enable the students to study the evolution of Management
- Study the functions and principles of management.
- Learn the application of the principles in an organization.
- Enable the effective and barriers communication in the organization
- Study the system and process of effective controlling in the organization.

UNIT I: INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II: PLANNING **9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III: ORGANISING **9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV: DIRECTING **9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V: CONTROLLING **9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES

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

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, and have same basic knowledge on international aspect of management.
- Understand the planning process in the organization.
- Comprehend the concept of organization.
- Demonstrate the ability to directing, leadership and communicate effectively.
- Analysis isolate issues and formulate best control methods.

TEXT BOOKS

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6t^{h} Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.

REFERENCES

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.
2. S.Bagad, 'Principles of Management', Techinical Publications, 4th edition, 2013.

E- RESOURCES

1. https://nptel.ac.in/courses/110/105/110105146/ (Principles of Management)
2. https://onlinecourses.nptel.ac.in/noc21_mg30/preview (Principles of Management)

19MEOX05 **ELECTRIC VEHICLE TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the working principles of batteries and their types.
- Acquire knowledge on applications of alternative energy sources in vehicles.
- Develop knowledge in hydrogen supply and its storage.
- Understand about electric machine controllers.
- Initiate the electrical drives, mathematical modeling and design considerations.

UNIT I: INTRODUCTION AND BATTERIES **9**

Types of electric vehicle -battery parameters -lead acid batteries -nickel based batteries -battery charging -designer's choice of battery -use of batteries in hybrid vehicles -battery modeling

UNIT II: ALTERNATIVE ENERGY SOURCES AND FUEL CELLS **9**

Solar photovoltaic - wind power - flywheels - super capacitors - supply rails - hydrogen fuel cells -fuel cell thermodynamics - connecting cells in series - water and thermal management in PEM fuel cell.

UNIT III: HYDROGEN SUPPLY AND STORAGE **9**

Introduction - fuel reforming - fuel cell requirements, steam reforming, partial oxidation and auto thermal reforming, further fuel processing, mobile applications - storage as hydrogen -chemical methods

UNIT IV: ELECTRIC MACHINES AND CONTROLLERS **9**

Brushed DC electric motor - DC regulation and voltage conversion - brushless electric motors -motor cooling, efficiency, size and mass - electrical machines for hybrid vehicles

UNIT V: ELECTRIC VEHICLE MODELLING AND DESIGN CONSIDERATIONS **9**

Introduction - tractive effort - modeling vehicle acceleration and electric vehicle range - simulations - aerodynamic considerations - rolling resistance - transmission efficiency - vehicle mass - general issues.

TOTAL: 45 PERIODS

OUTCOMES

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

- Differentiate the types of batteries which are used in electrical vehicles.
- List the types of alternative energy sources and/or working principles of fuel cells.
- Assess the potential of hydrogen energy in vehicles and energy storage techniques.
- Recommend an electrical drive and its controller in vehicular applications.
- Explain the concepts of electric vehicle modeling and design aspects.

TEXT BOOKS

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd., 2015.
2. Iqbal Husain, "Electric and Hybrid Vehicles", 3rd edition., CRC Press, 2021.

REFERENCES

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", 3rd Edition, CRC Press 2018.
2. Chau.K.T, "Electric vehicle machines and drives", Wiley-IEEE Press, 2015.

E-RESOURCES

1. https://nptel.ac.in/courses/108/106/108106170/
2. https://onlinecourses.nptel.ac.in/noc20_ee99/preview

OPEN ELECTIVE – II

19MEOX06 **SENSORS AND TRANSDUCER** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the sensors, transducers and their types.
- Acquire knowledge on Mechanical and electromechanical sensors.
- Study about thermal sensor.
- Understand the magnetic sensor and its types.
- Initiate the sensors and their applications.

UNIT I: INTRODUCTION 9

Definition, classification, static and dynamic parameters, Characterization - Electrical, mechanical, thermal and chemical. Classification of errors - Error analysis, Static and dynamic characteristics of transducers

UNIT II: MECHANICAL AND ELECTROMECHANICAL SENSORS 9

Resistive Potentiometer - strain gauge - Inductive sensors and transducer - capacitive sensors - ultrasonic sensors

UNIT III: THERMAL SENSOR 9

Gas thermometric sensors - acoustic temperature sensors - magnetic thermometer, resistance change - type thermometric sensors

UNIT IV: MAGNETIC SENSOR 9

Force and displacement measurement - Magneto resistive sensors - Hall Effect sensor, Inductance and eddy current sensors - Angular/rotary movement transducer - Electromagnetic flow meter, squid sensor

UNIT V: SENSORS AND THEIR APPLICATIONS 9

Automobile sensor - Home appliance sensor - Aerospace sensors - sensors for manufacturing medical diagnostic sensors - environmental monitoring.

TOTAL: 45 PERIODS

OUTCOMES

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

- Know basic concepts of various sensors and transducers
- Develop knowledge in mechanical and electromechanical sensor
- Differentiate the types of thermal sensor which are used in various applications
- List the types of magnetic sensors and working principles
- Recommend an sensor and its applications

TEXT BOOKS

1. Ernest O Doebelin, Measurement Systems – Applications and Design, Tata McGraw-Hill, 4th edition, 2016.
2. Sawney A K and Puneet Sawney, A Course in Mechanical Measurements and Instrumentation and Control, 14th edition, Dhanpat Rai and Co, New Delhi, 2016.

REFERENCES

1. Patranabis D, Sensors and Transducers, 6th Edition, PHI, New Delhi, 2015.
2. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

E-RESOURCES

1. https://nptel.ac.in/courses/108/108/108108147/
2. https://www.youtube.com/watch?v=1uPTyjxZzyo

19MEOX07 COMPUTER INTEGRATED MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the basic concepts of Computer Integrated Manufacturing (CIM).
- Provide knowledge on production planning and control and computer aided process planning.
- Impart knowledge on group technology and cellular manufacturing.
- Learn the flexible manufacturing system and various AGVS techniques.
- Understand the functions of the basic components of a robot.

UNIT I: INTRODUCTION 9

Brief introduction to CAD and CAM - Manufacturing planning and control- Introduction to CAD/CAM - Concurrent Engineering - CIM concepts - Computerised elements of CIM system - Types of production - 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) - Aggregate Production Planning - Master Production Schedule (MPS) - Material Requirement Planning-I (MRP-I) - Control Systems - Shop Floor Control (SFC) - Inventory Control.

UNIT III: CELLULAR MANUFACTURING 9

Group Technology (GT) - Part Families - Parts classification and coding - Production Flow Analysis (PFA) - Cellular Manufacturing - Composite part concept - Machine cell design and layout.

UNIT IV: FLEXIBLE MANUFACTURING SYSTEM AND AUTOMATED GUIDED VEHICLE SYSTEM 9

Types of flexibility - FMS - Components, application and benefits - Automated Guided Vehicle System (AGVS) - Application.

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.

TOTAL: 45 PERIODS

OUTCOMES

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

- Clarify the basic concepts of CAD, CAM and Computer Integrated Manufacturing Systems.
- Summarize the production planning and control and computerized process planning.
- Differentiate the different coding systems used in group technology.

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- Enumerate the concepts of Flexible Manufacturing System (FMS) and Automated Guided Vehicle System (AGVS).
- Understand the various types of robots in industrial applications.

TEXT BOOKS

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 3rd Edition, 2012.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", New Age International (P) Ltd., New Delhi, 4th Edition , 2018.

REFERENCES

1. Kant Vajpayee S, Principles of Computer Integrated Manufacturing, Prentice Hall, New Delhi, 2013.
2. Rao.P, N Tewari & T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2012.

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104289/ - (Computer Integrated Manufacturing)
2. https://onlinecourses.nptel.ac.in/noc20_me44/preview-(Computer Integrated Manufacturing)

19MEOX08 ENGINEERING ECONOMICS AND COST ANALYSIS L T P C
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Understand the basics of economics.
- Enable students to understand the fundamental economic concepts and value engineering.
- Know the methods by which cost analysis and pricing done in the industry.
- Recognize about the maintenance analysis performed in industries.
- Learn the techniques of incorporating inflation factor in economic decision making.

UNIT I: INTRODUCTION TO ECONOMICS 9

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – P/V ratio.

UNIT II: VALUE ENGINEERING 9

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Examples in all the methods.

UNIT III: CASH FLOW 9

Methods of comparison of alternatives - Present worth method (Revenue dominated cash flow diagram) - Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram - Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), examples in all the methods.

UNIT IV: REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and maintenance analysis - Types of maintenance - Types of replacement problem, determination of economic life of an asset, replacement of an asset with a new asset - Capital recovery with return and concept of challenger and defender.

UNIT V: DEPRECIATION 9

Depreciation – Introduction - Straight line method of depreciation - Declining balance method of depreciation - Sum of the years digits method of depreciation - Sinking fund method of depreciation - Service output method of depreciation.

TOTAL: 45 PERIODS

OUTCOMES

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

- Apply the basics of economics and cost analysis to engineering applications.
- Summarize the steps involved in decision making with economic feasibility.
- Evaluate an alternative by considering the economic factors.
- Conclude the replacement and maintenance policies of industrial equipment.
- Determine the depreciation of industrial equipment over the operating periods using appropriate method.

TEXT BOOKS

1. Panneer Selvam.R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2013.
2. Donald G. Newnan, Ted Eschenbach, Jerome P. Lavelle, "Engineering Economic Analysis", Oxford University Press, 9th Edition, 2010.

REFERENCES

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and Analysis" Engg. Press, Texas, 2010.

E-RESOURCES

1. https://nptel.ac.in/courses/112/107/112107209/ - (Engineering Economic Analysis)
2. https://www.youtube.com/watch?v=TJr_29zC9hc - (Cash Flow Analysis)

19MEOX09	FIBRE REINFORCED PLASTICS	L T P C 3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the various materials for composite structure.
- Equip with the knowledge of sandwich structure technology.
- Explain about fracture mechanics of composites.
- Impart knowledge in fatigue and damping capacity of composite materials.
- Understanding of various manufacturing/fabricating techniques for composite structures.

UNIT I: INTRODUCTION **9**

Definition, Reason for composites, Classifications of composites, Thermosets - Epoxy; Unsaturated polyester resin; vinyl ester, polyimides etc.,-preparation, properties, and uses.

UNIT II: REINFORCEMENTS **9**

Types, Properties, chemistry and applications of fillers such as silica, titanium oxide, talc, mica etc., Manufacturing process, Properties, structure and uses of Glass fiber -.Carbon, Aramid, Boron, jute, sisal, cotton.

UNIT III: FABRICATIONS OF THERMOSET COMPOSITES **9**

Hand layup method, compression and transfer moulding, pressure and vacuum bag process, filament winding, protrusion, reinforced RIM, Injection moulding, of thermosets, SMC and DMC, Advantages and disadvantages of each method.

UNIT IV: TESTING OF COMPOSITES **9**

Destructive and non-destructive tests; Destructive-tensile, compression, flexural, impact strength, Hardness–Fatigue-toughness HDT ,basic concepts of fracture mechanisms.

UNIT V: APPLICATIONS OF COMPOSITES **9**

Aerospace, land transport, marine, structural, chemical plants and corrosion resistant products and energy applications sports, electrical, electronic and communication applications.

TOTAL: 45 PERIODS

OUTCOMES

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

- Select various materials for designing composite structures.
- Apply knowledge of fracture mechanics of composites during designing of composite structures.
- Analyze critically the damping capacity of composite materials.
- Correlate various manufacturing/fabricating techniques for composite structures based on design.
- Compare various composite applications.

TEXT BOOKS

1. Chawla, K.K, "Composite Material s", Fourth Edition, Springer Science in progress, 6th Edition 2019.
2. Balasubramaniam, Composite Materials, John Wiley & Sons, Indian Ed., 4th Edition 2016.

REFERENCES

1. Sharma S.C., "Composite materials", Narosa Publications, 3rd Edition 2015.
2. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2nd Indian Edition, 2017.

E-RESOURCES

1. https://nptel.ac.in/courses/112/105/112105232/
2. https://nptel.ac.in/courses/112/107/112107142/

19MEOX10 **LEAN MANUFACTURING** **L T P C**
3 0 0 3

OBJECTIVES

The main objective of this course is to:

- Introduce the principles of lean manufacturing.
- Acquire knowledge on tools of lean manufacturing.
- Explore various visual management techniques, tpm and lean practices.
- Get knowledge on management and technology drivers of lean manufacturing.
- Know the fundamentals of manufacturing strategy and competitive drivers of lean manufacturing.

UNIT I: LEAN MANUFACTURING PRINCIPLES **9**

Lean manufacturing paradigms - lean manufacturing - origin - Toyota Production System - types of wastes -tools and techniques to eliminate wastes - value stream mapping (VSM) - primary icons - secondary icons - developing the VSM.

UNIT II: LEAN MANUFACTURING TOOLS **9**

5S concepts - stages of 5S and waste elimination - Kaizen - steps of Kaizen - lean manufacturing through Kaizen – Single Minute Exchange of Die - theory of SMED - design for SMED - strategic SMED and waste elimination - pull production through Kanban - one piece flow production.

UNIT III: VISUAL MANAGEMENT, TPM AND LEAN IMPLEMENTATION **9**

Visual management - tools for eliminating wastes - overproduction, inventory, delay, transportation, processing, unnecessary motion, defective parts, underutilization of people - implementation - total productive maintenance - implementation of lean practices.

UNIT IV: MANAGEMENT AND TECHNOLOGY DRIVERS OF LEAN MANUFACTURING **9**

Lean manufacturing - twenty criteria model - management driver - organizational structure - devolution of authority - employee status and involvement - nature of management - business and technical processes - time management - agility through technology driver.

UNIT V: MANUFACTURING STRATEGY AND COMPETITIVE DRIVERS OF LEAN MANUFACTURING **9**

Quick manufacturing setups - quick response - product life cycle management - product service elimination - automation - competitive driver - status of quality and productivity - compatible cost accounting system.

TOTAL: 45 PERIODS

OUTCOMES

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

- Demonstrate the lean manufacturing principles to find and eliminate wastes .
- Identify the lean manufacturing tools and their potential applications.
- Summarize the usage of visual management, TPM and lean practices.
- Compare the technology drivers of lean manufacturing.
- Explain the technology drivers of lean manufacturing.

TEXT BOOKS

1. Devadasan.S.R, Mohan Sivakumar.V, Murugesh.R and Shalij.P.R,"Lean Manufacturing: Theoretical, Practical and Research Futurities", PHI Learning Private Limited, 2012.
2. Pascal Dennis, "Lean Production Simplified", 2nd Edition, Productivity Press, 2007.

REFERENCES

1. Bill Carreira, "Lean Manufacturing That Works", 3rd Edition, PHI Learning Private Limited, 2016.
2. Dennis P. Hobbs, "LEAN Manufacturing Implementation", 5th Edition, Cengage Learning, 2015.

E-RESOURCES

1. https://nptel.ac.in/courses/112/104/112104188/ - (Lean Manufacturing System Technology)
2. https://freevideolectures.com/course/4162/nptel - (Toyota Production system)