COURSE CURRICULUM AND EVALUATION SCHEME

B. Tech. Mechanical Engineering

(w.e.f. session 2018-19)

G. B. Pant Institute of Engineering and Technology,

Ghurdauri, Pauri Garhwal (Uttarakhand), 246194

1st Year Scheme and Syllabus

EVALUATION SCHEME

B. TECH. ME

I-YEAR (I-SEMESTER)

(Effective from session: 2018-19)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TBS-112	Mathematics-I	3	1	0	40	40	80	120	200	4
2.	TBS-114	Physics	3	1	0	40	40	80	120	200	4
3.	TES-113	Basic Electrical Engineering	3	1	0	40	40	80	120	200	4
4.	THS-111	English	2	0	2	30	30	60	90	150	3
PRACTICAL											
5.	PBS-114	Physics Lab	0	0	2	10	15	25	25	50	1
6.	PES-113	Basic Electrical Engineering Lab	0	0	2	10	15	25	25	50	1
7.	PES-114	Engineering Graphics and Design	1	0	4	30	45	75	75	150	3
8.	GPP-111	General Proficiency *	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**12**	**3**	**10**	**200**	**225**	**425**	**575**	**1000**	**20**

Mathematics – I

TBS – 112 L T P: 3 1 0

Course Objectives

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and Matrices. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Particulars

Unit-I: Calculus (I):

Evaluation of definite integral, Beta and Gamma functions and their properties, Applications of definite integrals to evaluate surface areas and Volumes of revolutions in Cartesian form.

Unit-II: Calculus(II):

Rolle's theorem and Lagrange's Mean value theorem(without proof),Expansion of functions by Taylor's theorem and Maclaurin theorem, Maxima and Minima of single variable, Curve Tracing (Cartesian Form), Indeterminate forms and L'Hospital's rule.

Unit-III: Infinite series:

Sequence, series, convergence and divergence of infinite series, D'Alembert ratio test, Raabe's test, Cauchy root test, Cauchy Integral test, Comparison test, Fourier series: Half rang Sine series and half range Cosine series, Parseval's theorem.

Unit-IV: Multivariable Calculus

Partial derivatives, total derivative, Jacobians and their properties, Maxima, minima and saddle points of several variables, Method of Lagrange multipliers, Gradient, divergence and curl, Green's theorem and Gauss divergence theorem(without proof).

Unit-V: Matrices

Inverse and Rank of a matrix: Normal form &Echelon form, Consistency of system of linear equations, Symmetric, skew-symmetric, Hermitian, Skew-Hermitian matrices and orthogonal matrices, Eigen values and Eigen vectors, Diagonalization of matrices, Cayley-Hamilton Theorem.

References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
5. V.N.Kala & Rakesh Bhadula , Engineering Mathematics-I,Scientific International Pvt.Ltd.,New Delhi.
6. V.N.Kala & R.Rana,Matrices,Laxmi Publication(University Press),New Delhi
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
8. H.K.Dass, Enginering Mathematics, I semester, S. Chand & Company, New Delhi.
9. A.R.V & Rajesh Dangwal, calculus, Krishna publication.
10. A.R.V & Rajesh Dangwal, Differential Equations, Krishna publication.
11. A.R.V & Rajesh Dangwal, Matrices, Krishna publication.

Course Outcomes

The students will learn

CO1: To apply differential and integral calculus.Apart from some other applications they will have a basic understanding of Beta and Gamma functions.

CO2: The fallouts of Rolle's Theorem and Lagrange's Mean value theorem that are fundamental to application of analysis to Engineering problems.

CO3: The tool of infinite series and Fourier series for advanced Engineering Mathematics.

CO4: To deal with functions of several variables that are essential in most branches of engineering.

CO5: The essential tool of matrices in a comprehensive manner.

Physics

TBS – 114 L T P: 3 1 0

Course Objective

To introduce the basic knowledge of Electrostatic, Magnetostatics, Electromagnetic waves and their applications in engineering.

Unit-I:

Electrostatics: Coordinate Systems (Cartesian, cylindrical and spherical), Differential elements of length, surface and volume, Transformation of scalars and vectors under Rotation transformation; Gradient, Divergence and curl, Coulomb's law, Electric field, continuous charge distribution, Gauss's law and its applications, Divergence and curl of electrostatic field; Electric Potential, Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Unit-II:

Electrostatics in a linear dielectric medium: Electrostatic field and potential of a dipole. Dielectric polarization, Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Unit-III

Magnetostatics: Bio-Savart law and applications, Ampere,s law and applications, Divergence and curl of static magnetic field; magnetic vector and scalar potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector magnetic potential and its solution for given current densities, Forces and torques in magnetic field. Magnetic dipole moment.

Unit-IV

Magnetostatics in a linear magnetic medium: Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Magnetic Materials: magnetic susceptibility and permeability; dia, para and ferromagnetic materials, Hysteresis curve and its applications, Boundary conditions for $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnets like a bar magnet; Qualitative discussion of magnetic field in presence of magnetic materials.

UNIT-V

Electromagnetic waves: Magnetic flux, Electromagnetic Induction, Faraday's law, Lenz's law; motional EMF; Continuity equation; Displacement current, Maxwell's equation in vacuum and non-conducting medium; Boundary conditions, The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Energy and Momentum in electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non- conducting medium-vacuum interface for normal and oblique incidence.

References

1. David J. Griffiths, Introduction to Electrodynamics; Prentice Hall of India.
2. Electromagnetics, Schaum's Outline Series; McGraw Hill Education.
3. Engineering Electromagnetics, Hayt & Buck; McGraw Hill Education.
4. Electricity, magnetism and light, W. Saslow; Academic Press.
5. Electromagnetic Theroy Fundamentals, Guru & Hiziroglu; Thomson Learning & Vikas Publishing House.

Course Outcomes

CO1: To give the knowledge of Electrostatics.

CO2: To give the knowledge of Electrostatics in medium.

CO3: To give the knowledge of Magnetostatics.

CO4: To give the knowledge of Magnetostatics in medium.

CO5: To give the knowledge of Electromagnetic waves and Maxwell's equations.

Basic Electrical Engineering

TES – 113 L T P: 3 1 0

Unit 1: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit 2: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

Unit 3: Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit 4: Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit 5: Power Converters and Electrical Installations

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

References

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Course Outcomes

CO1: At the end of this course, students will demonstrate the ability

CO2: To understand and analyse basic electric and magnetic circuits.

CO3: To study the working principles of electrical machines and power converters.

CO4: To introduce the components of low-voltage electrical installations.

English

THS – 111 L T P: 2 0 2

Particulars

1. Communication & Vocabulary Building

1.1 Communication Meaning, Definition and importance of communication

1.2 The concept of Word Formation ,Root words from foreign languages and their use in English

1.3Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

1.4 Synonyms, antonyms, and standard abbreviations.

2. Basic Writing Skills

2.1 Sentence Structures

2.2 Use of phrases and clauses in sentences

2.3 Importance of proper punctuation

2.4 Report- meaning, features, types, style, format, structure and importance

2.5 Creating coherence , Organizing principles of paragraphs in documents

2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing

3.1 Subject-verb agreement

3.2 Noun-pronoun agreement

3.3 Misplaced modifiers

3.4 Articles

3.5 Prepositions

3.6 Redundancies

3.7 Clichés

4. Nature and Style of sensible Writing

4.1 Describing

4.2 Defining

4.3 Classifying

4.4 Providing examples or evidence

4.5 Writing introduction and conclusion

5. Writing Practices

5.1 Comprehension

5.2 Précis Writing

5.3 Essay Writing

5.4 : Principles, features, types, format and layout of business letter

6. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations
- Suggested Readings:

References

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Course Outcomes

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Physics Lab

PBS – 114 L T P: 0 0 2

List of experiments

1. To verify Stefan's law by electrical method.
2. To determine the residence per unit length of Carey Foster's bridge wire and to determine the specific resistance of a giving wire.
3. To determine the variation of magnetic field along the axis of current carrying coil and then to estimate the radius of the coil.
4. To draw hysteresis curve and hysteresis loss of a given sample of ferromagnetic material and from this to determine magnetic susceptibility and permeability of the given specimen.
5. (***i***) to obtain hysteresis curve (B.H. curve) for a given ferromagnetic material (thin rod or thin wires) on a C.R.O. using a solenoid and then to determine the related magnetic constants from it. (***ii***) To determine hysteresis loss C.R.O.
6. To calibrate a given voltmeter and ammeter by means of a potentiometer.
7. To study the Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect set up.
8. To determine the wavelength of sodium light by Newton's rings.
9. To determine the wavelength of sodium light (monochromatic source) with the help of Fresnel's Biprism
10. To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verity the formula $\frac{1}{F}=\frac{1}{f1}+\frac{1}{f2}-\frac{x}{f1\,f2}$ and to locate the cardinal points of a system of two thin convergent lenses separated by a distance and then to verify the formulae, $L_1h_1=\frac{xF}{f2}$, *and* $L_2h_2=\frac{xf}{f1}$.
11. To determine the specific rotation of cane sugar solution with the help of polarimeter.
12. To determine the wavelength of prominent spectral lines of mercury light by plane diffraction grating.
13. To determine the resistivity and energy band gap of a semiconductor (Germanium) using four probe method. (***ii***) To determine the band gap in a semiconductor using a PN junction diode.
14. (i)To determine ballistic constant K of a moving coil ballistic galvanometer with a standard condenser of known capacity.

    (*ii*) To calibrate a ballistic galvanometer with a standard solenoid and then to fine ballistic constant.
15. (***i***) To determine the coefficient of viscosity of water, by Poiseuille's method.

    (***ii***) To determine the coefficient of viscosity of water by rotating cylinder method.
16. To determine the Height of a Building using a Sextant.

17. To determine the Moment of Inertia of a Flywheel.
18. To determine the moment of inertia of an irregular body by inertia table.
19. To study the variation of moment of inertia of a system with the variation in the distribution of mass and hence to verify the theorem of parallel axes.
20. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
21. To determine g by Bar Pendulum.
22. To determine g by Kater's Pendulum.
23. To investigate the motion of coupled oscillators
24. To study Lissajous Figures
25. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
26. To measure the Magnetic susceptibility of Solids.
27. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
28. Melde's experiment – transverse and longitudinal modes.
29. To determine the frequency of A.C. mains with a sonometer using non-magnetic and magnetic wire.
30. Study v-i characteristics of LED and laser sources.
31. To study the characteristics of p-i-n and avalanche photodiode detectors
32. To study the attenuation and bending losses in optical fibers at different wavelengths and to find radius of curvature of the optical fiber.
33. To determine the numerical aperture and to evaluate V-number of a given optical fiber.
34. To measure the optical loss, fiber length and hence determine the attenuation coefficient of optical fiber at both LED and ILD wavelengths.
35. To study of V-I characteristics of fiber optic LED and hence to determine the responsibility of photo receiver.
36. Comparison of P-I characteristics of LED and ILD and hence determine the region of operations and laser threshold current.
37. To find out the fill factor of given solar cell
38. Determination of e/m by thomson's method
39. To determine of v-i characteristics of the diode and determination of the energy gap of the semiconductor
40. To determine the velocity of sound in air at room temperature with Kund's tube.

Basic Electrical Engineering lab

PES – 113 L T P: 0 0 2

List of experiments

1. Verification of KCL and KVL.

2. Verification of Thevenin's and Norton's Theorems.

3. Verification of Maximum power transfer and Superposition theorems.

4. Measurement of power in a three phase circuit by two wattmeter method.

5. Measurement of efficiency of a single phase transformer by load test.

6. Determination of parameters and losses in a single phase transformer by OC and SC test.

7. Load characteristics of DC generator.

8. Speed control of dc shunt motor.

9. Study of running and reversing of a three phase induction motor.

10. Calibration of a single phase energy meter.

Engineering graphics and design

PES – 114 L T P: 1 0 4

Course objective

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

- To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- To prepare you to communicate effectively
- To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

Particulars

Unit 1: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of line and dimensions, lettering, Conic sections; Scales – Plain, Diagonal and Vernier Scales;

Unit 2: Principles of Orthographic Projections, Projections of Points and lines; Projections of planes, Auxiliary Planes, Projections of Regular Solids i.e. Prism, Cylinder, Pyramid, Cone, Auxiliary Views.

Unit 3: Principles of Isometric projection, Isometric Scale, Isometric Views, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Unit 4: Introduction of AutoCAD, Drawing Setting- Units, Limits; Basic drawing commands- Ortho, Line, Zoom, Polyline, Circle, Arc, Rectangle, Polygon, Ellipse, Osnap etc.; Editing Drawings- Select, Erase, Move, Copy, Break, Fillet, Trim, Extend, Rotate, Offset, Mirror, Stretch, Chamfer, Array; Intermediate Drawing Commands- Layers, Change, Fill, Hatch, Block, Insert, etc.

Unit 5: Dimensioning- Associative, Base-line, Linear, Angular, Center Mark, Diameter, Leader, Radius; 3-Dimensioning Drafting- Iso commands, 3D Shapes, Draw cycloidal curves i.e. Cycloid, Epicycloid, and Hypocycloid

References

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers (Corresponding set of) CAD Software Theory and User Manuals

Course outcomes:

At the end of the course, students will achieve following outcomes:

CO1: Students understand basic knowledge of engineering graphics with using letter writing, different type of scales, lines and dimensions.

CO2: Student will be able to draw orthographic projections of points, lines, planes and solids.

CO3: Student will be able to understand principle of isometric projection and develop isometric views by different methods.

CO4: Students will become familiar with Auto CAD 2-D and 3-D drawings and learn various commands used in Auto CAD.

CO5: Students will be able to use appropriate computer technology and to work as a team.

EVALUATION SCHEME

B. TECH. ME

I-YEAR (II-SEMESTER)

(Effective from session: 2018-19)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TBS-121	Chemistry	3	1	0	40	40	80	120	200	4
2.	TBS-125	Mathematics-II	3	1	0	40	40	80	120	200	4
3.	TES-121	Programming for Problem Solving	3	1	0	40	40	80	120	200	4
4.	TMC-121	Environmental Science*	2	0	0	20	20	40	60	100	0
PRACTICAL											
5.	PBS-121	Chemistry Lab	0	0	2	10	15	25	25	50	1
6.	PES-121	Programming for Problem Solving Lab	0	0	2	10	15	25	25	50	1
7.	PES-122	Workshop Practice	1	0	4	30	45	75	75	150	3
8.	GPP-121	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**12**	**3**	**8**	**170**	**195**	**365**	**485**	**850**	**17**

Chemistry

TBS – 121 L T P: 3 1 0

Course Objective

The objective of the Chemistry-1 is to lay foundation for the application of chemistry in engineering and technology disciplines. The course will build upon chemistry and materials developed in the properties of matter and extend the principles of quantum chemistry to real chemical systems in the inorganic and organic chemistry domain.

The introduction of the latest (R&D oriented) topics like water and corrosion chemistry, UV, NMR and MRI spectroscopy will make the engineering student upgraded with the new technologies.

Particulars

Unit 1 Atomic and molecular structure

Introduction to atomic theory and initial idea as atomic nuclear models, Heisenberg's uncertainty principle, de Broglie concept, Schrodinger wave equation for hydrogen, VBT and MOT of Di atomic molecules as H_2, O_2, N_2, H_2O, NH_3, XeO_3, XeO_4 etc, Crystal field theory and magnetic properties of transition metal ion, Bonding in metals (Band Theory), Intermolecular forces: dipole and Vander walls interactions, Hydrogen bonding.

Unit -2 Thermodynamic functions

I and II law of thermodynamics, energy, entropy and free energy, EMF cell potential, Nernst Equation and applications. Acid and base, Oxidation- reduction and solubility equilibrium. Use of free energy consideration in metallurgy through Ellingham diagram.

Unit-3 Water chemistry and Corrosion

Hardness of water different process of water treatment, Clark's process, Lime-Soda Process, Zeolite process. Reverse osmosis process, Industrial water treatment, alkalinity of water.

Theories of corrosion, types of corrosion, mechanism and control.

Unit-4 Inorganic Chemistry: an over view (periodic properties)

Periodic table, electronic configuration, atomic and ionic size, ionization energies, electron affinity, electro negativity oxidation state coordination number, Effective Nuclear Charge (concept of shielding effect).

Stereo Isomerism: Geometrical and optical isomerism, E-Z and R-S configuration, enantiomers and diastereomers. Isomerism in transitional metal compounds

Unit-5 Spectroscopic Technique and applications, organic reaction and synthesis of a drug

Principal of Spectroscopy and selection rule, Electronic vibration and rotational spectroscopy, application, NMR Spectroscopy, MRI

Type of organic reactions, addition elimination, substitution, cyclization(Diels-Alder reaction) Drug synthesis any one(Asprin, Phenacetin, Melubrin and Novalgin)

References

1. B.H. Mahan, University Chemistry
2. M.J. Sienko and R.A. Plane, Chemistry: Principal and Applications
3. C.N.Banwell, Fundamentals of Molecular spectroscopy
4. B.L.Temble, Kamaluddin and M.S. Krishnan, Engineering Chemistry,NPTEL web book
5. P.W. Atkins, Physical Chemistry Oxford
6. Silverstein and Bassler, Spectrometric identification of organic compound, John Wiley and sons
7. Morrison and BoyD, Organic Chemistry, Pearson Education
8. Sen Gupta, Organic Chemistry, Oxford
9. R.N. Goyal and H.Goel, Engineering Chemistry, Ane publication
10. A.K. Pahari and B.S. Chauhan, Engineering Chemistry, Laxmi Publicaion
11. S.K. Singh, Fundamental of Engineering Chemistry, New Age
12. Malik, Tuli and Madan, Selected topics in Inorganic Chemistry, Ramnath publication

Course outcomes

CO1: The development of several concepts in chemistry that will aid technical knowledge increasingly based on electronic, atomic and molecular level modifications.

CO2: To give knowledge of chemical aspect of water and its treatment and different type of corrosions

CO3: To give knowledge of Periodic properties and Coordination chemistry.

CO4: To give brief knowledge of different advance techniques of Instrumental Chemistry like: Ultra Violet spectroscopy, NMR and MRI spectroscopy.

CO5: To give an idea of chemistry of synthesis of Drugs.

Mathematics – II

TBS – 125 L T P: 3 1 0

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in multiple integration, ordinary differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Particulars

Unit I: Multiple Integration

Multiple Integration: double integral in Cartesian & polar form, triple integral in Cartesian form, change of order of Integration in double integrals, Change of variables (Cartesian to polar), Applications: Dirichlet's theorem and evaluation of area by double integration.

Unit II: First order ordinary differential equations

Ordinary differential equations of first order, Exact differential equations, Homogeneous differential equations, Variable separable form, Linear differential equations of first order, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit III: Ordinary differential equations of higher orders

Linear differential equations of nth order with constant coefficients, Complementary functions and Particular integrals, solving simultaneous linear differential equations with constant coefficients, Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit IV: Complex Variable –I

Differentiation, Analytic functions, Cauchy-Riemann equations in Cartesian and polar form, harmonic functions, finding harmonic conjugate, Construction of analytic function by Milne's Thomson's method ,Radius of convergence of power series, Conformal mappings.

Unit V: Complex Variable –II

Contour integrals, Cauchy integral theorem, Cauchy Integral formula, Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem, Evaluation of definite integral involving sine and cosine.

References

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
4. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
5. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc- Graw Hill, 2004.

Course Outcomes

The students will learn

CO1: The mathematical tools needed in evaluating multiple integrals and their usage.

CO2: The essential tool of first order ordinary differential equations in a comprehensive manner.

CO3: To understand the ordinary differential equations of higher orders for learning advanced engineering problems.

CO4: To understand the concept of analytic function by Cauchy Riemann equation and their application to solve definite integral involving sine and cosine.

CO5: The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Programming for Problem Solving

TES – 121 L T P: 3 1 0

Particulars

UNIT I

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT II

Arithmetic expressions and precedence , Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

UNIT III

Arrays, Arrays (1-D, 2-D), Character arrays and Strings. Function, Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT IV

Basic Algorithms, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT V

Structure: Structures, Defining structures and Array of Structures, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation).
File handling (only if time is available, otherwise should be done as part of the lab)

References

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course outcomes

CO1: Illustrate the flowchart and design an algorithm for a given problem and to develop IC programs using operators

CO2: Develop conditional and iterative statements to write C programs

CO3: Exercise user defined functions to solve real time problems

CO4: Inscribe C programs that use Pointers to access arrays, strings and functions.

CO5: Exercise user defined data types including structures and unions to solve problems

CO6: Inscribe C programs using pointers and to allocate memory using dynamic memory management functions.

CO7: Exercise files concept to show input and output of files in C

Environmental Science

TMC – 121 L T P: 2 0 0

Course Objectives

- To give an understanding about the various resources and their distribution
- To give an understanding about the concept of ecosystem and the different ecosystems.
- To expose the students about biodiversity and the human activities that are adversely affecting the environment
- To highlight to the students the problems of pollution and the various measures that have been employed to curb the problem.

Particulars

Unit 1: Introduction and Natural Resources

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.
- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over exploitation of surface and ground water, floods, conflicts over water (international & inter-state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 2: Ecosystems

- Concept of an ecosystem. Structure and function of ecosystem; Energy flow in an ecosystem: food chains; food webs and ecological succession, Case studies of the following ecosystems:

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, systems, lakes, rivers, oceans, estuaries)

Unit 3: Biodiversity and Conservation

- Levels of biological diversity: genetic species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India

- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value.

Unit 4: Environmental Pollution, Policies & Practices

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.
- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 5: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management movements: Floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

References

1. Environmental Studies by Anubha Kaushik & CP Kaushik, New age International Publisher.
2. Environmental studies by Daniel. Wiley.
3. Environmental studies by Erach Bharucha, University press.
4. Ecology, Environmental Science and Conservation by JS Singh,SP Singh and SR Gupta. S. Chand Pubs Delhi.

Course outcomes

After the end of the course student

CO1: Will possess an understanding about the different resources and their distribution

CO2: Will possess knowledge about ecosystem and its kind

CO3: Will have exposure to the different human activities that are adversely affecting the biodiversity and environment

CO4: Will be having clear understanding about pollution and the various measures that are set out to curb pollution

Chemistry lab

PBS – 121 L T P: 0 0 2

Course Objective

This course will provide, students the practical knowledge of quantitative analysis of materials and instrumental methods for developing experimental skills in building technical competence.

List of Experiments (Any Ten)

1. Determination of viscosity by Ostwald Viscometer and the molecular weight of a polymer by viscosity measurement.
2. Determination of surface tension of liquid by Stalagmometer.
3. Determination of chloride content of water by Mohr's method.
4. Determination of Cell constant and conductance of a solution using Conductive meter.
5. Determination of saponification/acid value of oil.
6. Synthesis of Aspirin Drug in the lab.
7. Chemical analysis of a given salt.
8. Determination of the partition coefficient of a solute in two immiscible liquids.
9. Determination of adsorption of acetic acid by charcoal.
10. Removal of Hardness of water by Ion exchange column.
11. Determination of Rf value using Paper/Thin layer chromatography.
12. Determination of temporary and permanent hardness of water by complexometric titration.
13. Determination of rate constant of a reaction.

References

1. Vogel's , Taxtbook of Quantitative Chemical Analysis, ELBS Longman
2. R.N. Goyal and H.Goel, Engineering Chemistry, Ane publication

Course outcomes

CO1: Enhancing knowledge of different analytical technique of chemistry

CO2: Provides an idea about volumetric and gravimetric methods of analysis.

CO3: Increase knowledge about several volumetric methods used in several industries like: water, hospitals, dying, metallurgies etc.

CO4: Increase awareness about some of the old and latest instrumental aspects of analysis like: Surface Tension, Viscometric methods, Conductometric analysis.

CO5: Give an idea about some useful techniques of industries like: Chromatography, Partition coefficient, hardness determination, salt analysis etc.

Programming for problem solving lab

PBS – 121 L T P: 0 0 2

The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

Workshop Practice

PES – 112/122 L T P: 1 0 4

Course objective:

Ability to prepare simple objects using machines and machine tools. To make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Particulars

Lectures

Manufacturing methods-casting, forming, machining, joining, advanced manufacturing methods, CNC machining and additive manufacturing, Fitting operations and power tools, Electrical and electronics, Study of carpentry tools, equipment's and different joints, Plastic moulding and glass cutting, Metal casting, Welding (arc and gas welding) and brazing

Laboratory

Machine shop

- Study of machine tools in particular lathe machine
- Demonstration of different operations on lathe machine
- Practice of facing, plane turning, step turning, taper turning, knurling and parting.
- Study of quick return mechanism in shaper
- To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual

Fitting and sheet metal shop

- Study of fitting and sheet metal shops tools
- Making perfect male-female joint
- Simple exercise involving drilling/tapping/dieing
- To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint.

Carpentry

- Study of tools and operation and carpentry joints
- Simple exercise using jack plain
- To prepare half- lap corner joint, mortise and Tenon joints as per drawing provided in the lab manual Simple exercise on woodworking lathe

Electrical and electronics

- Soldering and desoldering application in electronic equipment's

- Introduction to house wiring and different types of cables
- Types of power supply, types of motors and starters, distribution of power supply and electric wiring symbol

Welding shop

- Instruction of BI standards and reading of welding drawings
- To prepare Butt and Lap joints using metal arc welding machine as per given manual and drawing Hand on experience with MIG, TIG and gas welding

Foundry shop

- Study of tools and operations
- Demo of mould preparation
- Practice and preparation of mould of any pattern
- Casting of any simple pattern

Smithy shop

- Study of tools and operations
- Simple exercises based on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging

Minor Project:

To make a minor project by the students in batches comprising the operations performed in different shops

References:

1. A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwansh Dhanpat Rai & Co.(P) Ltd.
2. Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.
3. Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi

Course outcomes

At the end of the course, the student will

CO1: Have Capability to identify hand tools and instruments for machining and other workshop practices.

CO2: Obtain basic skills in the trades of fitting, carpentry, welding and machining.

CO3: Acquire measuring skills, using standard workshop instruments & tools.

CO4: Gain eye hand co-ordination, enhance psycho motor skills and attitude.

CO5: Be able to apply basic electrical engineering knowledge for house wiring practice.

2^{nd} Year Scheme and Syllabus

EVALUATION SCHEME

B. TECH. ME

II-YEAR (III-SEMESTER)

(Effective from session: 2019-20)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TME-231	Materials Engineering	3	0	0	30	30	60	90	150	3
2.	TME-232	Basic Thermodynamics	3	1	0	40	40	80	120	200	4
3.	TES-234	Engineering Mechanics	3	1	0	40	40	80	120	200	4
4.	TES-235	Introduction to Electronics and Communication Engineering	3	0	0	30	30	60	90	150	3
5.	TBS-231	Mathematics – III	3	1	0	40	40	80	120	200	4
PRACTICAL											
6.	PME-231	Material Science and Testing Lab	0	0	2	10	15	25	25	50	1
7.	PME-232	M/C Drawing and Solid Modelling Lab	0	0	2	10	15	25	25	50	1
8.	PES-234	Introduction to MATLAB Programming- Phase I*	0	0	2	10	15	25	25	50	0
9.	PES-235	Electronics Lab	0	0	2	10	15	25	25	50	1
10.	GPP-231	General Proficiency *	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**3**	**8**	**210**	**225**	**435**	**615**	**1050**	**21**

Materials Engineering

TME – 231 L T P: 3 0 0

Course objectives:

Understanding of the correlation between the internal structure of materials, their mechanical properties, various methods to quantify their mechanical integrity and failure criteria, the behaviour of the mechanical properties under static and dynamic loading, interpretation of equilibrium phase diagrams & heat treatment methods to tailor the properties of Fe-C alloys.

Particulars

Unit 1

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Mechanical Property measurement: Mechanical Properties measurement Tensile, compression and torsion tests, strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Unit 2

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non- destructive testing (NDT).

Unit 3

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Unit 4

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves TTT diagram, and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Unit 5

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys .

References

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

Course Outcomes

CO1: Student will be able to identify crystal structures for various materials and understand the defects in such structures.

CO2: Student will be able to understand how to tailor material properties of ferrous and non-ferrous alloys.

CO3: Student will be able to explain detailed interpretation of equilibrium phase diagrams.

CO4: Student will be able to understand how to quantify mechanical integrity and failure in materials.

CO5: Student will be able to explain the different metals and alloys.

Basic Thermodynamics

TME – 232 L T P: 3 1 0

Course objective

To learn about different governing laws of thermodynamics and their applications. To understand the concept of energy as low and high grade and its use in exergy analysis. To evaluate the changes in properties of pure substances in various processes.

Particulars

Unit 1: Introduction to thermodynamics

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers.

Unit 2: First law of thermodynamics

Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy; Demonstration that energy is a property; Various modes of energy, Internal energy and Enthalpy. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Unit 3: Pure substances

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier’s chart.

Unit 4: Second law of thermodynamics and Entropy

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy; Demonstration that entropy is a property; Evaluation of entropy for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables-

Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles.

Unit 5: Availability, Irreversibility and Power cycles

Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work, Exergy balance equation, and Exergy analysis.

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

References

1. Cengel, Y.A. and Boles, M.A., "Thermodynamics: An Engineering Approach", 8th Ed 2017 Tata McGraw.
2. Nag, P.K, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd. 2013.
3. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., Fundamentals of Thermodynamics, John Wiley& Sons.
4. Jones, J. B. and Duggan, R. E., Engineering Thermodynamics, Prentice-Hall of India.
5. Moran, M. J. and Shapiro, H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Course outcomes

At the end of the course, student will able to

CO1: Apply energy balance to systems and control volumes, in situations involving heat and work interactions

CO2: Evaluate changes in thermodynamic properties of pure substances

CO3: Evaluate the performance of energy conversion devices

CO4: Differentiate between high grade and low-grade energies

CO5: Understand the importance of thermodynamic relations

Engineering Mechanics

TES – 234 L T P: 3 1 0

Course objectives

To provide an introductory treatment of Engineering Mechanics with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. Moreover, a working knowledge of statics with emphasis on force equilibrium and free body diagrams also provided with this course. This course also helps to provide an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems. At the last outset, an understanding of the mechanical behavior of materials under various load conditions.

Particulars

Unit 1:

Introduction to Engineering Mechanics: Force Systems, Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy.

Unit 2:

Basic Structural Analysis: Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.

Centroid and Centre of Gravity: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Unit 3:

Virtual Work and Energy Method: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Review of particle dynamics: Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton’s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Unit 4:

Introduction to Kinetics of Rigid Bodies: Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

Unit 5:

Mechanical Vibrations: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.

References

1. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics.
2. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications.
3. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
4. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications.
5. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall.
6. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill.
7. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
8. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press.
9. Shanes and Rao (2006), Engineering Mechanics, Pearson Education.
10. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.

Course outcomes

At the end of the course, students are able to

CO1: apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.

CO2: understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).

CO3: apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution.

CO4: extend all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces).

CO5: solve dynamics problems and appraise given information and determine which concepts apply, and choose an appropriate solution strategy.

Introduction to Electronics & Communication Engineering

TES – 235 L T P: 3 0 0

Course Objective: To provide an overview of electronic device components to Mechanical engineering students

Unit 1

Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, Zener diode and its characteristics, Zener diode as voltage regulator, Introduction to BJT, its input-output and transfer characteristics, biasing circuits, BJT as a single stage CE amplifier.

Unit 2

Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Unit 3

Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as a stable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Unit 4

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K-map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

Unit 5

Electronic Communication Systems: The elements of communication system, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

References

1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the principles of semiconductor devices and their applications.

CO2: Design an application using Operational amplifier.

CO3: Understand the working of timing circuits and oscillators.

CO4: Understand logic gates, flip flop as a building block of digital systems.

CO5: Learn the basics of Electronic communication system.

Mathematics – III

TBS – 231 L T P: 3 1 0

Course Objectives

To provide an overview of partial differential equations, probability and statistics to engineers.

Particulars

Unit I: Partial Differential equations and applications

Introduction of partial differential equations, formation of partial differential equations, linear partial differential equations with constant coefficient of second order. Method of separation of variables, one dimensional Wave equation, Heat conduction equations of one dimensional.

Unit II: Basic Probability

Addition and multiplication laws of probability, Conditional probability, independent and dependent events, mutually exclusive events, use of Binomial expansion, use of Multinomial expansion, Bay's theorem, expectation of random variables, inverse probability.

Unit III: Basic Statistics

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation, Karl Pearson's coefficient of correlation.

Unit IV: Applied Statistics

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Statistical quality control method, control charts, means chart, R-chart, P- chart.

Unit V: Sampling Theory

Sampling, testing a hypothesis, Null hypothesis, errors, level of significance, test of significance, confidence limits, the t-distribution for small sample, chi-square test of goodness of fit.

References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.Wiley, 1968.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

Course Outcomes

The students will learn

CO1: The tool of partial differential equations for learning advanced engineering problems.

CO2: To understand the basic probability in comprehensive manners.

CO3: To understand the measures of central tendency and their usage.

CO4: To understand applied statistics in curve fitting and statistical quality control method.

CO5: To understand the concept of sampling theory and their usage.

Material science and testing lab

PME – 231 L T P: 0 0 2

Course objective

To understand and perform the set of material science experiments to correlate the mechanical properties with the microstructure and to study the effect of heat treatment on the mechanical & physical properties of different engineering materials. To understand and perform the set destructive type and non-destructive type experiments to find out the different mechanical and tribological properties of the different engineering materials.

Particulars

List of experiments

Minimum 12 experiments out of following (or similar experiment).

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Study of corrosion and its effects.
7. Study of microstructure of welded component and HAZ, Macro and Micro Examination.
8. Suitable experiment on Magnetic/ Electrical/ Electronic materials.
9. To perform Tensile Test on Mild-steel specimen and draw stress strain curve.
10. To perform Izod, Charpy Impact test on standard specimen.
11. To perform Brinell, Rockwell, Vicker Hardness Test on standard specimen.
12. To calculate spring stiffness.
13. To calculate Torsional Rigidity.
14. To calculate Fatigue strength on Fatigue Testing Machine
15. To calculate Modulus of Elasticity by Non Destructive Testing.
16. Detection of cracks by Ultrasonic Testing Machine.
17. Detection of cracks by Dye Penetration Technique.
18. Detection of cracks by Eddy Current Tester.
19. To perform Wear Test

References

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.
5. Strength of Materials by R. Subramaniam, Oxford University Press, New Delhi, 2007.
6. Strength of Materials by B.C. Punamia, Laxmi Publications, 2015

Course outcomes

CO1: Able to performer the different material science experiments and to correlate the microstructure with the mechanical & physical properties of given set of engineering materials.
CO2: Able to performer the different heat treatment experiments and to study the microstructure with the mechanical & physical properties of given set of engineering materials.
CO3: Able to performer the different destructive type experiments and to find out the mechanical properties of given set of engineering materials.
CO4: Able to performer the different nondestructive type experiments and to find out any irregularities in the given set of engineering materials.
CO5: Able to performer the different types of tribological experiments and to find out wear rate of given set of engineering materials.

Machine Drawing and Solid Modelling Lab

PME – 232 L T P: 0 0 2

Course objective

The objective of this course is to use engineering graphic skills as a means of communicating technical ideas, information and instructions. Use of Sectional views, Part sectioning, Assembly drawings and Layouts forms a part of this learning. Student uses manual drafting and design software for this communication.

Particulars

Unit 1

Introduction to Engineering Drawing, Classification of Engineering Drawings, Machine Drawing and representation of materials, Representation of different types of lines, Representation of geometrical and dimensional tolerance and surface roughness symbols.

Unit 2

Conversion of Isometric Views into Orthographic Projection, Symbols for weldments, process flow, electrical and instrumentation Units, IS/ISO codes.

Projections, Sectional views and sectioning of parts and assemblies.

Unit 3

Introduction of shapes of rivet heads. Caulking and Fullering pitch, Diagonal pitch, Margin, Back pitch, etc. Types of riveting (lap and butt joint, zigzag and chain structure, Boiler joint.

Drawing of Machine Elements and simple parts: Views of any three sets of the following machine elements and parts; Popular forms of Screw threads, bolts, nuts, stud bolts.

Keys, cotter joints and knuckle joint.

Shaft coupling, Hook;s joint, knuckle joint Journal, pivot and collar and foot step bearings.

Unit 4

Assembly Drawings: Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions; (any one)

a) Engine parts – connecting rod, piston assembly.

b) Other machine parts - Screws jacks, Machine Vices, Plummer block, Tailstock.

c) Valves: Steam stop valve, spring loaded safety valve, feed check valve and air cock

Unit 5

Engineering Graphics Software, Co-ordinate Systems, Drafting and Modelling, Evolution of geometric modeling, Advantages of solid modeling, Definition, Advantages and disadvantages of wireframe models, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG). Solid modeling: Use of modeling software, Part model, Assembly.

References

1. Bhatt.N.D. and Panchal.V.M., Machine Drawing, Charotar Publishing House Pvt. Ltd. Anand (Gujrat), 388001, 49thEdition, 2014.
2. Dhawan R.K, A Textbook of Machine Drawing, S. Chand Publishing, New Delhi-110055.
3. Narayana.K.L, Kannaiah P. & Reddy K. Venkata, Machine Drawing, New Age International (P) Ltd. Publishers, NewDelhi-110002,4thEdition,2012.
4. Sidheswar. N, Kannaiah. P, & Sastry V.V.S., Machine Drawing, McGraw-Hill Education (India) Private Limited, NewDelhi-110016,2001
5. Pohit. Goutam&Ghosh. Goutam,Machine Drawing with AutoCAD, Pearson Education, Delhi.
6. John. K.C, A Textbook of Machine Drawing, PHI Learning, Delhi.
7. Gill P.S, A Textbook of Machine Drawing, S. K. Kataria & Sons Publishers, New Delhi-110002, 18th Edition,2013

Course outcomes

CO1: Helping the student in drafting their technical ideas.

CO2: Creating knowledge about the various practices with regard to the dimensioning, sectioning and development of views.

CO3: Understanding the importance of the linking functional and visualization aspects in the preparation of the part drawings.

CO4: Preparation of the part or assembly drawings as per the conventions.

CO5: Interpretation of machine drawings that in turn help the students in the preparation of the production drawings.

Introduction to MATLAB Programming- Phase I

PES – 234 L T P: 0 0 2

Course objectives

This is elementary course of computer programming for those having little or no hand on experience of programming. The programming language MATLAB helps to solve the complex problems in few modules of computer programs. MATLAB is widely accepted in all disciplines of engineering, to finance, and beyond, and it is heavily used in industry. Thus, a strong background of MATLAB is highly a value addition to UG students and this course is an indispensable skill in today's job market.

Particulars

Module 1: Starting with MATLAB

Working in the command window, arithmetic operations with scalars , using MATLAB as a calculator, display formats, elementary math built-in functions, defining scalar variables, useful commands for managing variables, script files, examples of MATLAB applications.

Module 2: Creating arrays

Creating a one-dimensional array (vector), creating a two-dimensional array (matrix), notes about variables in MATLAB, the transpose operator array addressing, using a colon : in addressing arrays, adding elements to existing variables, deleting elements, built-in functions for handling arrays, strings and strings as variables problems.

Module 3: Mathematical operations with ARRAY

Addition and subtraction, array multiplication, array division, element-by-element operations, using arrays in MATLAB built-in math functions, built-in functions for analyzing arrays, generation of random numbers, examples of MATLAB applications.

Module 4: Using Script Files and Managing Data

MATLAB workspace and the workspace window, input to a script file, output commands, the save and load commands, importing and exporting data, examples of MATLAB applications.

Module 5: Two-Dimensional Plots

The plot command, plot of given data, plot of a function, the fplot command, plotting multiple graphs in the same plot, formatting a plot, plots with logarithmic axes, plots with error bars, plots with special graphics, histograms, polar plots, putting multiple plots on the same page, multiple figure windows, examples of MATLAB application

References

1. Amos Gilat. MATLAB an introduction with applications. John Wiley& Sons.
2. Fausett L.V.(2007) Applied Numerical Analysis Using MATLAB, 2nd Ed.,Pearson Education.
3. Chapra S.C. and Canale R.P.(2006) Numerical Methods for Engineers, 5th Ed., McGraw Hill.

Course outcomes

After this course students are capable of:

CO1: Forming the 1 and 2-dimensional array.

CO2: Managing script files and data.

CO3: Preparing 2 dimensional plots using MATLAB.

CO4: Understanding the engineering problem domain.

CO5: Applying the logic for solving the complex problem.

Electronics Lab

PES – 235 L T P: 0 0 2

List of experiments

1. To determine the energy band gap of a semiconductor material.
2. To determine and plot V-I characteristics of P-N junction in both forward bias and reverse bias.
3. To determine and plot the wave shapes of a clipping and champing circuits.
4. To determine the ripple in output of a half wave and a full wave rectifiers at different loads.
5. To determine and plot V-I characteristics of Zener diode in both forward bias and reverse bias.
6. To determine and input and output characteristics of an npn & pnp bipolar junction transistor in common emitter and common base mode.
7. To determine and plot input and output characteristics of a field-effect transistor.
8. To determine and plot input and output characteristics of a metal-oxide semiconductor field-effect transistor.
9. To determine and plot the frequency response of an amplifier.
10. Realization and verification of the truth table of various logic gates.
11. Realization and verification of the basic logic gates using NAND and NOR gates.

EVALUATION SCHEME

B. TECH. ME

II-YEAR (IV-SEMESTER)

(Effective from session: 2019-20)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TME-241	Applied Thermodynamics	3	1	0	40	40	80	120	200	4
2.	TME-242	Fluid Mechanics and Fluid Machines	3	1	0	40	40	80	120	200	4
3.	TME-243	Manufacturing science and technology - I	3	0	0	30	30	60	90	150	3
4.	TME-244	Strength of Material	3	1	0	40	40	80	120	200	4
5.	THS- 243	Operation Research	3	1	0	40	40	80	120	200	4
6.	TMC-241	Constitution of India*	2	0	0	20	20	40	60	100	0
PRACTICAL											
7.	PME-241	Thermodynamics Lab	0	0	2	10	15	25	25	50	1
8.	PME-242	Fluid Mechanics and Machine Lab	0	0	2	10	15	25	25	50	1
9.	PME-243	Manufacturing science and technology - I Lab	0	0	2	10	15	25	25	50	1
10.	GPP-241	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**17**	**4**	**6**	**220**	**235**	**455**	**645**	**1100**	**22**

Applied Thermodynamics

TME- 241 L T P: 3 1 0

Course objectives

To learn about of I law for reacting systems and heating value of fuels. Moreover, this course also explores about gas and vapor cycles and their first law and second law efficiencies. The properties dry and wet air and the principles of psychrometry also covers in this course. At last the studies about gas dynamics of air flow and steam through nozzles and performance of rotatory and reciprocating compressors also included as primitive objective of this course.

Particulars

Unit 1

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Unit 2

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

Unit 3

Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Unit 4

Basics of compressible flow, Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation-compressible flow in diffusers, efficiency of nozzle and diffuser.

Unit 5

Rotatory compressors, reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines.

References

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Course outcomes:

CO1: Understand the importance of different type of fuel and their analysis.

CO2: Get a good understanding of various practical power cycles and heat pump cycles.

CO3: Understand the working phenomenon of the refrigeration and air conditioning systems.

CO4: able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.

CO5: Understand the basics of different turbines used for electricity generation.

Fluid Mechanics and Fluid Machines

TME – 242 L T P: 3 1 0

Course objective

The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Particulars

Unit 1: Introduction, Kinematics of Fluid Flow

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.

Unit 2: Fluid static and Dynamics of fluid flow

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.

Unit 3: Dimensional Analysis and Hydraulic Similitude

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model Analysis.

Unit 4: Centrifugal and Positive Displacement Pumps:

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps-Reciprocating pump – working principle.

Unit 5: Hydraulic Turbines

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbine.

References

1. Fox, Introduction to Fluid Mechanics, 7ed, Wiley India
2. Zoeb Hussain, Basic Fluid Mechanics & Hydraulic Machines, B S Publications
3. S Narasimhan: First Course in Fluid Mechanics, University Press
4. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, 2000, 2nd edition.
5. M M Das: Fluid Mechanics & Turbomachines, Oxford University Press
6. Vijay Gupta and S.K.Gupta, " Fluid Mechanics and its Applications", Wiley Eastern Ltd, 1984.

Course outcomes

At the end of this course, student is able

CO1: To learn about the application of mass and momentum conservation laws for fluid flows.
CO2: To obtain the velocity and pressure variations in various types of simple flows.
CO3: To understand the importance of dimensional analysis.
CO4: To analyse the flow in water pumps.
CO5: To understand the flow in turbines.

Manufacturing science and technology - I

TME – 244 L T P: 3 0 0

Course objective

To understand the different metal casting processes, different metal forming and sheet metal operations along with the force calculations. To understand the different unconventional metal forming processes, powder metallurgy, plastic component manufacturing and metrology.

Unit 1

Introduction: Importance of manufacturing, Economic & technological considerations in manufacturing. Classification of manufacturing processes, Materials & manufacturing processes for common items.

Casting: Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design considerations, Gating, Riser, Runnes, Core. Solidification of casting,. Sand casting, defects & remedies and inspection. Die Casting, Centrifugal casting. Investment casting, CO2 casting and Stir casting etc.

Unit 2

Metal Forming Processes: Elastic & plastic deformation, yield criteria, Hot working vs. cold working. Analysis (equilibrium equation method) of forging process for load estimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. Analysis of Wire/strip drawing and maximum- education, Tube drawing, Extrusion and its application.

Unit 3

Rolling: Condition for Rolling force and power in rolling, Rolling mills & rolled-sections. Design, lubrication and defects in metal forming processes.

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism. Blanking vs. Piercing. Compound vs Progressive die. Flat-face vs. Inclined-face punch and Load (capacity) needed. Analysis of forming process like cup/deep drawing. Bending & spring-back.

Unit 4

Unconventional Metal forming processes: Unconventional metal forming processes such as explosive forming, electromagnetic, electro-hydraulic forming.

Powder Metallurgy: Powder metallurgy manufacturing process. The need, process, advantage and applications.

Manufacturing of Plastic components: Injection moulding, Extrusion of plastic section, Welding of plastics.

Unit 5

Jigs & Fixtures: Locating & Clamping devices & principles, Jigs and Fixtures and its applications.

Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances, measurement of geometric forms like straightness, flatness and roundness; linear and angular measurement devices and systems; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods.

References

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing
4. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi
5. PN Rao, " Manufacturing Technology", Tata McGraw Hill, 2017.

Course outcomes

At the end of this course, student will

CO1: Able to explain the different metal casting processes.

CO2: Able to explain the different metal forming and sheet metal operations along with the force calculations.

CO3: Able to explain the theory of rolling and sheet metal work.

CO4: Able to explain the different unconventional metal forming processes, powder metallurgy and manufacturing of plastic component.

CO5: Able to explain the jigs and fixture use and metrology.

Strength of material

TME – 245 L T P: 3 1 0

Course objectives

To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads and to calculate the elastic deformation occurring in various simple geometries for different types of loading.

Particulars

Unit 1

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

Unit 2

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Unit 3

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Unit 4

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Unit 5

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Rankine Jordan Formulae, Examples of columns in mechanical equipment's and machines.

References

1. Strength of Materials by R. Subramaniam, Oxford University Press, New Delhi, 2007.
2. Strength of Materials by B.C. Punamia, Laxmi Publications, 2015
3. Gere J. M., Timoshenko S.P., Mechanics of materials, CBS Publication, 2nd edition, ISBN-8123908946.
4. Popov Eger P.,"Engg. Mechanics of solids", Prentice Hall, New Delhi, 2nd edition, ISBN-0135713560.
5. Hibbeler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 9th edition, ISBN-0133254429.
6. Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi.
7. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw-Hill Publishing Co. Ltd., New Delhi 2005

Course outcomes

At the end of this course

CO1: Students should be able to recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components.

CO2: The ability to analyze determinate beams and trusses to determine shear forces, bending moments and axial forces.

CO3: A sufficient knowledge in designing shafts to transmit required power and also spring for its maximum energy storage capacities.

CO4: Identify modes of failure in components.

CO5: An ability to identify, formulate and solve engineering problems.

Operation research

THS – 243 L T P: 3 1 0

Course objective

This course provides an overview of operations research.

Particulars

Unit 1: Introduction and Linear Programming Problems

Introduction: Linear programming, Definition, scope of Operations Research (OR) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution methods.

Linear Programming Problems: The simplex method - slack, surplus and artificial variables. Concept of duality, Big-M method, Two-phase method, degeneracy, and procedure for resolving degenerate cases, Dual Simplex method.

Unit 2: Transportation and Assignment Problem

Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems.

Assignment Problem: Formulation, unbalanced assignment problem, traveling problem.

Unit 3: Game Theory and Decision Theory

Game Theory: Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property, mixed strategy (3x3 games).

Decision Theory: Steps in Decision theory approach - Decision making Environments-Making under conditions of Certainty, Uncertainty, Conditions of Risk, Decision making conditions – problems, Decision trees. - Utility Theory.

Unit 4: Queuing Theory

Queuing systems and concepts, Queuing system characteristics, classification of queuing situations; Kendall’s notation, solution of queuing problems, single channel, single stage, finite and infinite queues with Poisson arrival and exponential service time, Steady state performance analyzing of M/M/ 1 and M/M/C queuing model, applications to industrial problems, Birth-Death Model.

Unit 5: Dynamic Programming and Goal Programming

Dynamic Programming: Deterministic and stochastic example.

Goal Programming: Formulations Goal Programming Solutions Complexity of Simplex Algorithm.

References

1. P. K. Gupta and D. S. Hira, "Operations Research", S. Chand.
2. Fredric. S. Hilleer and Gerold J. Lieberman, "Introduction to Operation Research", 2nd Edition, CBS, 1974.
3. Taha H. A. - Operations Research, Pearson.
4. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, Wiley India ltd
5. AM Natarajan, P. Balasubramani , A Tamilaravari "Operation research" Pearson 2005
6. Introduction to operation research: Theory and Applications, Springer BSP, Hyderabad
7. S D Sharma-Operations Research, Kedarnath Ramnath

Course outcomes

CO1: To identify and develop operational research models from the verbal description of the real system and to formulate a real-time situation into a mathematical model.
CO2: Understand the mathematical tools that are needed to solve optimization problems.
CO3: To understand the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type.
CO4: To understand the need and importance of modelling the industrial problem.
CO5: To Make right decisions in operations management using game theory, decision theory, queuing theory, transportation models, assignment models, dynamic programming and goal programming.

Thermodynamics lab

PME – 241 L T P: 0 0 2

Course objective

To understand the basics of applied thermodynamics by working models and experiments.

Particulars

List of experiments (Minimum 10 of the followings)

1. Study of Fire and Water Tube boiler
2. Study and working of two and four stroke petrol Engine
3. Determination of Indicated H.P. of I.C. Engine by Morse Test
4. Prepare the heat balance for Petrol and Diesel Engine test rig
5. Study and working of two and four stroke Diesel Engine
6. Study of Impulse & Reaction turbine
7. Study of steam Engine model.
8. Study of Gas Turbine Model
9. Experiment on refrigeration test ring and calculation of various performance parameters.
10. To study different types of expansion devices used in refrigeration system.
11. To study basic components of air-conditioning system.
12. Experiment on air-conditioning test rig & calculation of various performance parameters.
13. Study of window air conditioner.
14. Study of Velocity compounded steam turbine
15. Study of Pressure compounded steam turbine

References

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India

3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Course outcomes

CO1: Understand the basics of working of boilers, mountings and accessories used for industrial application.

CO2: Grasp the principle and working of two strokes and four strokes internal combustion engines used in automobiles.

CO3: Understand working of turbines used for power generation application.

CO4: Evaluate the working and COP of the Refrigeration and Air conditions systems used in various industrial and domestic applications.

CO5: Analyse the performance of steam turbines.

Fluid mechanics and fluid machines lab

PME – 242 L T P: 0 0 2

Course objective

To understand the basics of fluid mechanics and fluid machinery by experiments.

Particulars

List of experiments (Minimum 10 of the followings)

1. To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.
2. To determine the coefficient of discharge of an orifice of a given shape and also determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the coefficient of discharge with the Reynolds number.
4. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
5. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
6. To study the variation of friction factor f for turbulent flow in commercial pipes.
7. Turbine exp. on Pelton wheel.
8. Turbine exp. on Francis turbine.
9. Turbine exp. on Kaplan turbine.
10. Exp. on reciprocating pump.
11. Exp. on centrifugal pump.

References

1. Fox, Introduction to Fluid Mechanics, 7ed, Wiley India.
2. Zoeb Hussain, Basic Fluid Mechanics & Hydraulic Machines, B S Publications.
3. S Narasimhan: First Course in Fluid Mechanics, University Press
4. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, 2000, 2nd edition.
5. M M Das: Fluid Mechanics & Turbomachines, Oxford University Press
6. Vijay Gupta and S.K.Gupta, “ Fluid Mechanics and its Applications”, Wiley Eastern Ltd, 1984.

Course outcomes

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

CO1: Working of flow meters.

CO2: Concept of flow transition from laminar to turbulent.

CO3: Different forms of energy of fluid flow.

CO4: Various losses in pipes.

CO5: Performance of pumps and turbines.

Manufacturing science and technology – I Lab

PME – 243 L T P: 0 0 2

Course objective

The objective of this lab is to provide the knowledge and trained the students to perform metal casting experiments, metal forming experiments, experiments on jigs and fixtures, experiments on metrology.

Particulars

List of Experiments:

Minimum 10 experiments out of following.

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testing (at least one such as grain fineness number determination)
5. Forging: hand forging processes.
6. Forging: power hammer study & operation
7. Bending & spring back.
8. Powder metallurgy experiment.
9. Jigs & Fixture experiment.
10. Study of Linear Measuring Instruments.
11. Measurement of Taper Angle Using Slips, Rollers & Sine bar
12. Tool Makers Microscope.
13. Measurement of Surface Finish.
14. Machine Tool Alignment Tests.

References

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.
4. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi.
5. PN Rao, "Manufacturing Technology", Tata McGraw Hill, 2017.

Course outcomes

At the end of this course, student is

CO1: Able to perform the different experiments on metal casting.

CO2: Able to perform the different experiments on metal forming.

CO3: Able to perform the different experiments on jigs and fixture.

CO4: Able to perform the different experiments on powder metallurgy.

CO5: Able to perform the different experiments on metrology.

3rd Year Scheme and Syllabus

EVALUATION SCHEME
B. TECH. ME
III-YEAR (V-SEMESTER)
(Effective from session: 2020-21)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TME-351	Heat and Mass Transfer	3	1	0	40	40	80	120	200	4
2.	TME- 352	Manufacturing science and technology - II	3	0	0	30	30	60	90	150	3
3.	TME-353	Kinematics and Theory of Machines	3	1	0	40	40	80	120	200	4
4.	EME-31X	Department Elective – I	3	0	0	30	30	60	90	150	3
5.	TOE-XY	Open Elective – I	3	0	0	30	30	60	90	150	3
PRACTICAL											
6.	PME-351	Heat and Mass Transfer Lab	0	0	2	10	15	25	25	50	1
7.	PME-352	Manufacturing science and technology - II	0	0	2	10	15	25	25	50	1
8.	PME-353	Summer Industry Internship	0	0	2	10	15	25	25	50	1
9.	PME-354	Industrial Tour*	0	0	0	0	25	25	25	50	0
10.	PES- 351	Introduction to MATLAB Programming- Phase II*	0	0	2	10	15	25	25	50	0
11.	GPP-351	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**2**	**8**	**200**	**215**	**415**	**585**	**1000**	**20**

Department Elective-1

EME-311	Industrial engineering and management
EME-312	Operation management
EME-313	Energy conservation and management
EME-314	Artificial intelligence
EME-315	Mechatronic systems

Heat and Mass Transfer

TME – 351 L T P: 3 1 0

Course objective

The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation. Moreover, rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations. This course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Particulars

Unit 1

Introduction to Heat Transfer: Concepts of heat flows: conduction, convection and radiation, effect of temperature on thermal conductivity of materials, introduction to combined heat transfer. **Conduction:** One-dimensional general heat conduction equation in the cartesian, cylindrical and spherical coordinates. Initial and boundary conditions.

Steady State One-dimensional Heat conduction: Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation, thermal resistance concept, Analogy between heat and electricity flow, thermal contact resistance, Overall heat transfer coefficient, critical thickness of insulation.

Unit 2

Types of fins, Fins of uniform cross-sectional area, errors of measurement of temperature in thermometer wells.

Transient Conduction: Transient heat conduction Lumped capacitance method, unsteady state heat conduction in one dimension only, Heisler charts.

Unit 3

Forced Convection: Basic concepts, hydrodynamic boundary layer, thermal boundary layer, flow over a flat plate, flow across a single cylinder and a sphere, flow inside ducts, empirical heat transfer relations, relation between fluid friction and heat transfer, liquid metal heat transfer.

Natural Convection: Physical mechanism of natural convection, buoyant force, and empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders and sphere.

Unit 4

Thermal Radiation: Basic radiation concepts, radiation properties of surfaces, black body radiation laws, shape factor, black-body radiation exchange, Radiation exchange between non-blackbodies in an enclosure, Infinite parallel planes, radiation shields.

Unit 5

Heat Exchanger: Types of heat exchangers, fouling factors, overall heat transfer coefficient, logarithmic mean temperature difference (LMTD) method, effectiveness-NTU method, compact heat exchangers.

Condensation and Boiling: Introduction to condensation phenomena, heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube, boiling modes: pool boiling curve, forced convective boiling.

Introduction to Mass Transfer: Introduction: Fick's law of diffusion, steady state equimolar counter diffusion, steady state diffusion though a stagnant gas film.

References

1. Elements of Heat transfer by Cengel, TMH.
2. Heat and mass transfer, M.Thirumaleswar, Pearson.
3. Fundamentals of Heat & Mass Transfer by Incropera Wiley India.
4. Heat & Mass Transfer by Khurmi, Schand, New Delhi.
5. A. Bejan, Heat Transfer Jone Wiley, 1993.
6. J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.

Course Outcomes

CO1: Understand the basic laws of heat transfer and consequence of heat transfer in thermal analyses of engineering systems.

CO2: Analyse problems involving steady state heat conduction in simple geometries and develop solutions for transient heat conduction in simple geometries.

CO3: Understand the fundamentals of convective heat transfer process and evaluate heat transfer coefficients for natural convection and forced convection inside ducts, over exterior surfaces.

CO4: Calculate radiation heat transfer between black body surfaces and radiation heat exchange between gray body surfaces.

CO5: Analyse heat exchanger performance by using the method of log mean temperature difference and analyse heat exchanger performance by using the method of heat exchanger effectiveness.

Manufacturing science and technology - II

TME – 352 L T P: 3 0 0

Course objective

To understand the mechanics of metal cutting, tool geometry, power required, and force calculations. To understand the structure of various machine tools. To understand the finishing operations, welding and unconventional manufacturing processes.

Unit 1

Metal Cutting: Mechanics of metal cutting, Geometry of tool and nomenclature, ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.

Unit 2

Machine Tools:

Lathe : Principle, types, operations, Turret/capstan, semi/Automatic, Tool layout.

Shaper, slotter, planer : operations & drives.

Milling : Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.

Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills.

Unit 3

Grinding & super finishing: Grinding: Grinding wheels, abrasive, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. Super finishing: Honing, lapping, and polishing.

Unit 4

Metal Joining (Welding):

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding: spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Thermodynamic and Metallurgical aspects in welding and weld,. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ.

Unit 5

Introduction to non-conventional Manufacturing Process: Benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Non-conventional welding processes: LBW, USW, EBW, Plasma arc welding, Explosive welding.

References

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi.
3. PN Rao, "Manufacturing Technology", Tata McGraw Hill, 2017.
4. Modern Machining Processes by P.C. Pandey& H.S. Shan.
5. Manufacturing science by Degarmo, Wiley India.
6. Manufacturing Process by Sontosh Bhatnagar, BSP Hyderabad.

Course outcomes

At the end of this course, student will

CO1: Able to explain the principal and classification of metal cutting.

CO2: Able to explain the different types of machine tools and their uses.

CO3: Able to explain the grinding and super finishing operations.

CO4: Able to explain the basic of welding and classification of welding processes.

CO5: Able to explain the unconventional machining and welding processes.

Kinematics and Theory of Machines

TME – 353 L T P: 3 1 0

Course objectives

To learn about mechanism, links and machines, motion of linked mechanism in terms of the displacement, velocity and acceleration at any point in a rigid link. To understand the kinematics of gear trains and to find out the power transmission through gears.

Particulars

Unit 1

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- 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 mechanism, straight line generators- Universal Joint- Rocker mechanisms.

Unit 2

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics-

Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation.

Unit 3

Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

Unit 4

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Unit 5

Surface contacts- Types of friction, limiting friction, Laws of Friction, Static and Dynamic Friction; sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes.

References

1. Rattan, S. S, “Theory of Machines”, McGraw-Hill Education, 4th edition, 2015.
2. John J Uicker, Gordon R Pennock, Joseph E Shigley, “Theory of Machines and Mechanisms”, Oxford University Press, 4thEdition, 2014.
3. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
4. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
5. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
6. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East- West Pvt. Ltd, New Delhi, 1988.

Course outcomes

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

CO1: Know the basics of mechanism and perform kinematic analysis.

CO2: Implement the synthesis mechanism.

CO3: Construct various cam profiles based on follower motion and perform kinematic analysis.

CO4: Deduce the number of teeth in gears and torque transmitted in epicyclic gear trains.

CO5: Understand and apply the aspects of friction in clutches and belt rope drives.

Heat and mass transfer lab

PME – 351 L T P: 0 0 2

Course objective

This course provides the necessary background for the student to understand the fundamental modes of heat transfer and mass transfer.

Particulars

List of experiments (minimum 10 of the following)

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection.
7. Convection - Heat transfer through tube/fin-forced convection.
8. Determination of Stephan Boltzmann Constant
9. Determination of emissivity.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

References

1. Elements of Heat transfer by Cengel, TMH

2. Heat and mass transfer, M. Thirumaleswar, Pearson

3. Fundamentals of Heat & Mass Transfer by Incropera Wiley India

4. Heat & Mass Transfer by Khurmi, Schand, New Delhi

5. J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.

Course outcomes

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

CO1: Analyze the Insulation thickness effect on heat transfer.

CO2: Evaluate the Conduction, convection and radiation heat transfer.

CO3: Analyze the performance of heat exchangers in parallel and counter flow arrangement.

CO4: Evaluate the thermal conductivity of working fluids of heat transfer.

CO5: Analyze the performance of boiling apparatus.

Manufacturing Science and Technology-II Lab

PME – 352 L T P: 0 0 2

Course objective

The objective of this lab is to provide the knowledge and trained the students to perform metal cutting, welding and unconventional machining and welding experiments.

Particulars

List of Experiments:

Minimum 10 experiments out of following.

1. Bolt (thread) making on Lathe machine.
2. Tool grinding (to provide tool angles) on tool-grinder machine.
3. Gear cutting on milling machine.
4. Machining a block on shaper machine.
5. Finishing of a surface on surface-grinding machine.
6. Drilling holes on drilling machine and study of twist-drill.
7. Experiment on tool wear and tool life.
8. Gas welding experiment
9. Arc welding experiment
10. Resistance welding experiment.
11. Soldering & Brazing experiment
12. Experiment on TIG/MIG Welding.
13. Macro and Microstructure of welding joints, HAZ.
14. Experiment on unconventional machining such as EDM & WEDM.
15. Experiment on unconventional welding.

References

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.
4. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi.
5. PN Rao, "Manufacturing Technology", Tata McGraw Hill, 2017.

Course outcomes

At the end of this course, student is

CO1: Able to perform the different experiments on lathe.

CO2: Able to perform the different experiments on milling, shaper and planer.

CO3: Able to perform the different experiments on grinding.

CO4: Able to perform the different experiments on welding.

CO5: Able to perform the different experiments on unconventional machining processes.

Introduction to MATLAB Programming- Phase II

PES – 351 L T P: 0 0 2

Course objective

The programming language MATLAB helps to solve the complex problems in few modules of computer programs. MATLAB is widely accepted in all disciplines of engineering, to finance, and beyond, and it is heavily used in industry. Thus, a strong background of MATLAB is highly a value addition to UG students and this course is an indispensable skill in today's job market.

Module 1: Programming with MATALAB

Relational and logical operators, conditional statements, the switch-case statement, loops, nested loops and nested conditional statements, the break and continue commands, examples of MATLAB applications.

Module 2: User-Defined Functions and Function Files

Creating a function file, structure of a function file, local and global variables, saving a function file using a user-defined function, examples of simple user-defined functions, comparison between script files and function files, anonymous and inline functions, function functions, subfunctions, nested functions, examples of MATLAB applications

Module 3: Polynomials, Curve Fitting, and Interpolation

Polynomials, value of a polynomial, roots of a polynomial, addition, multiplication, and division of polynomials, derivatives of polynomials, curve fitting, interpolation, the basic fitting interface, examples of MATLAB applications.

Module 4: Applications in Numerical Analysis

Solving an equation with one variable, finding a minimum or a maximum of a function, numerical integration, ordinary differential equations, examples of MATLAB applications. Introductory lesson for differentiation, integration, solving an ordinary differential equation.

Module 5: Three-Dimensional Plots

Line plots, mesh and surface plots, plots with special graphics, the view command, examples of MATLAB applications.

References

1. Amos Gilat. MATLAB an introduction with applications. John Wiley& Sons.

2. Fausett L.V. (2007) Applied Numerical Analysis Using MATLAB, 2nd Ed., Pearson Education.
3. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineers, 5th Ed., McGraw Hill.

Course outcomes

After this course students are capable of

CO1: Preparing 2 and 3 dimensional plots using MATLAB.

CO2: Doing programming in MATLAB

CO3: Writing and applying UDF.

CO4: Doing curve fitting and interpolation.

CO5: Applying MATLAB in numerical analysis.

Industrial engineering and management

EME – 311 L T P: 3 0 0

Course objective

To achieve an understanding of productivity and industrial production system. Apply concepts of depreciation and replacement analysis. study of different type inventory model and understand the industrial management.

Particulars

Unit 1

Productivity: Introduction, definition, measurement, productivity index, ways to improve productivity, Types of Production System.

Work study: Meaning and benefits of work study, time & motion study. Micro motion study P.M.T.S. man machine Diagram flow chart. Motion economy, Method study, work measurement, Work sampling, standard time.

Unit 2

Plant layout and materials Handling: Plant location, type of layout, principles of facility layout principles of material handling, Material Handling equipment's.

Replacement Analysis: Depreciation causes, obsolescence, service life of assets, Replacement of items.

Maintenance Management: Maintenance Planning & Control, Maintenance Strategy

Unit 3

Inventory - Control: Introduction, Classification of Inventory, Inventory function, cost, deterministic models, ABC- Analysis.

Break Even Analysis: Introduction, Assumption in Break-Even Analysis, Effect of Increase or Decrease in Fixed Cost and Variable Cost on BEF.

Introduction of PERT and CPM: Introduction, objectives of CPM and PERT, rules for network construction, estimation of activity time.

Unit 4

MRP: Concept of MRP, Inputs to MRP, MRP Processing, MRP outputs, Benefits and Limitations of MRP, Introduction of MRP II.

Job Analysis and Merit Rating: Objectives of Job Evaluation, Principle of Job Evaluation, Method Job Evaluation, Merit Rating, Selection of Factors in setting up Rating Method.

Unit 5

Introduction to Management: Theories of management: Traditional behavioral, contingency and systems approach, Organization as a system, Design of organization structure, leadership styles and managerial grid, Japanese management techniques, Case studies.

References

1. Principles of management. An analysis of management functions-H. Koontz & C.O. Donnel. Tata Mc-Graw-Hall Co.
2. Motion and Time Study Design and Measurement of Work, 7ed, Barnes, Wiley India
3. Manufacturing Management-J Moore Prentice Hall Englewood Cliffs: New Jersey.
4. Modern production operations Management-Buffa, E.S. Wiley Eastern.
5. Industrial Engineering & Management O.P. Khanna.
6. Industrial Engineering by Ravi Shanker.
7. Industrial Engineering by Mahajan.

Course outcomes

At the end of this course, student have

CO1: Ability to analyses the Productivity and various methods of improving Productivity.

CO2: Ability to understand the layout of industries.

CO3: Capability to analyses Economic Order Quantity.

CO4: Knowledge of basic principal of maintenance.

CO5: Ability to analyses Quality control and understand the industrial organization structure.

Operation management

EME – 312 L T P: 3 0 0

Course objective

The course is designed to make the students familiar with different types of production, plant layout and material handling, operations planning and control, inventory management, quality management etc. and to acquaint them with appropriate tools and techniques needed for understanding the operational situation and also understanding the logistics management.

Particulars

Unit 1

Operations Management: An overview, Definition of production and operations management, Production Cycle, Classification of operations, New Product Development, Product Design, Plant Location, Layout Planning.

Unit 2

Forecasting: Forecasting as a planning tool, forecasting types and methods, Exponential smoothening, Measurement of errors, Monitoring and Controlling forecasting models, Box- Jenkins Method. Productivity and Work study, Method study, Work Measurement.

Basic Concept & Philosophy of Supply Chain Management; Essential features, Various flows (cash, value and information)

Unit 3

Recent Issues in SCM: Role of Computer / IT in Supply Chain Management, CRM Vs SCM, Benchmarking concept, Features and Implementation, Outsourcing-basic concept, Value Addition in SCM-concept of demand chain management.

Production Planning techniques, Routing Decisions, Line of Balance, Scheduling types & principles, master production schedule.

Unit 4

Inventory Management: Objectives, Factors, Process, Inventory control techniques- ABC, VED, EOQ, SED, FSN analysis. Basic concepts of quality, dimensions of quality, Juran's quality trilogy, Deming's 14 principles, PDCA cycle, Quality circles, Quality improvement and cost reduction- 7QC tools and 7 new QC tools, ISO 9000-2000 clauses, coverage QS 9000 clauses, coverage. Six Sigma, Total Productive Maintenance (TPM).

Unit 5

Logistics Management: Logistics as part of SCM, Logistics costs, different models, logistics sub-system, inbound and outbound logistics, bullwhip effect in logistics, Distribution and warehousing management.

Purchasing & Vendor management: Centralized and Decentralized purchasing, functions of purchase department and purchase policies. Use of mathematical model for vendor rating / evaluation, single vendor concept, management of stores, accounting for materials.

References

1. Muhlemann: Production & Operation management (PEARSON).
2. Bisen & Singh-Operation & Logistics Management (Excel Books).
3. R.V. Badi & N.V. Badi - Production & Operation Management (Vrinda Publications 3rd Edition).
4. Chary - Production and Operations Management (Tata McGraw-Hill, 1997, 9th Edition).
5. Raghuram G. (I.I.M.A.) - Logistics and Supply Chain Management (Macmillan, 1st Ed.)
6. Krishnan Dr. Gopal - Material Management, (Pearson, New Delhi, 5th Ed.).
7. Adam Jr Everetl E. R J – Production and Operations Management (Prentice-Hall, 2000, 5th Edition).

Course outcomes

At the end of course, student will able to

CO1: Understand the principles of Production Management.

CO2: Acquire knowledge on Inventory Management and Work study.

CO3: Perform Job evaluation and Scheduling.

CO4: Plan and execute Project.

CO5: Implement and assure Quality in Management.

Energy conservation and management

EME – 313 L T P: 3 0 0

Course objectives

To understand the energy data from industries and carry out energy audit for energy savings.

Particulars

Unit 1

Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Unit 2

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Unit 3

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Unit 4

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.

Unit 5

Energy Economics, discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

References

1. Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988.

2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
4. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

Course outcomes

At the end of this course, student is able to

CO1: Understand different types of energy audits and perform the energy auditing for the energy consumption of industries.
CO2: Find the energy conservation opportunities in different lighting systems.
CO3: Discuss the steam system, steam recovery system, insulations and refractories used in industrial sectors.
CO4: Understand the combustion analysis of fuel and discuss the energy saving opportunities form different industrial equipment's.
CO5: Discuss the economics of the energy conservation techniques and calculate the payback period, internal rate of return.

Artificial intelligence

EME – 314 L T P: 3 0 0

Course objective

To Understand basic concepts of artificial intelligence. Identify and use various search and matching techniques used in artificial intelligence.

Particulars

Unit 1 Introduction to Artificial Intelligence

History, Definition of AI and Emulation of human cognitive process Agents: An abstract view of modeling and Elementary knowledge, Computational and Predicate logic, Analysis of compound statements using simple logic, Connectives, Nature of Environments.

Unit 2: Problem Solving Agents

Problem Definition, formulating problems and Searching for solutions, Examples using production rules, Search /Strategies: Uninformed or Blinded search and Breadth first search, Uniform cost search: Depth first search, Depth limited Search, Iterative deepening, Depth first search and Bi –directional search, comparing uniformed search strategies and Informed search strategies, Heuristic information and Hill climbing methods, Best First Search; Greedy Best First Search, Branch-and-Bound Search.

Unit 3: Knowledge Organization and Communication

Knowledge organization, manipulation and acquisition, Indexing and Retrieval techniques and Integration of knowledge in memory organization systems, Matching Techniques: Need for matching and simple Matching problems, Partial matching, Fuzzy matching and RETE matching Algorithm, Natural language: Overview of linguistics and Basic semantic analysis, Representation structures and Natural language generation, Uncertainty, Bayesian Networks and Bayesian Inference.

Unit 4: Programming Language

Introduction to LISP: syntax, Input output statements, Numeric functions, User defined Functions, Predicate Logic and declaration of local variables, Interaction and recursion functions, Property list and arrays.

Unit 5: Expert Systems

Introduction to Expert Systems, Activities of an expert system, Interpretation, Prediction and Diagnosis, Design, Planning and Monitoring, Debugging and Repair, Instruction and Control, Acquisition module frames of expert systems, Knowledge base, Production rules, Semantic nets, Inference engines, Backward chaining and forward chaining.

References

1. Schalkoff, R.J., “Artificial Intelligence: An Engineering Approach”, McGraw-Hill, 1990.
2. Elaine Rich and Kelvin Knight, “Artificial Intelligence”, Tata McGraw Hill, New Delhi, 1991.
3. Stuart Russell and Peter Norvig, “Artificial Intelligence: A modern approach”. Prentice Hall, New Jersey, 1995.
4. Donald A. Waterman, “A Guide to Expert Systems”, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA ©1985 ISBN:0-201-08313-2.
5. Nilson, N. J., “Principles of Artificial Intelligence”, Springer Verlag, Berlin, 1980.
6. Eugene Charniak and Drew McDermott, “Introduction to Artificial Intelligence”, Addison Wesley Longman Inc., 1998.
7. Patterson, “Introduction to Artificial Intelligence and Expert systems”, Prentice Hall of India, New Delhi, 1990.

Course outcomes

At the end of this course, student is

CO1: To be able to understand the concept of artificial Intelligence.
CO2: To be able to understand the various problem-solving agents for AI.
CO3: Understand the concept of knowledge organization and communication for AI.
CO4: To be able to understand the importance of programming language.
CO5: Understand the importance of activities of an expert system.

Mechatronic systems

EME – 315 L T P: 3 0 0

Course objective

To understand the working of modern mechanical system, deals with sensors, actuators and controllers in specific Sensors and Transducers Actuation Systems. System Models and Controllers Programming Logic Controllers and Design of Mechatronics Systems.

Particulars

Unit 1

Review of Microprocessors and Micro Controllers: Concepts, Binary numbers to hexadecimal details, information on flipflops, gates, registers, counters, memory, polling and interrupts etc. Architecture, instruction set for 8085, 8051 and assembly level language. Difference between microprocessors and micro controllers. Introduction to programming. Signal and Data Processing: Concepts and principles, analogue signal conditioning, signal level changes, linearization, conversion, filtering. Impedance matching passive circuits. Specifications and circuits in instrumentation. Digital signal conditioning.

Unit 2

Ladder Diagram Fundamentals: Basic Components and their symbols, Fundamentals of ladder diagrams, Machine Control Terminology. The Programmable Logic Controller: A Brief History, PLC configurations, System Block Diagrams, Update Solve the ladder – Update, Update, Solve the Ladder

Unit 3

Fundamentals of PLC Programming: Physical Components Vs Program, components, Lighting Control Example, Internal Relays, Disagreement Circuit, Majority Circuit, Oscillator, holding contacts, Always ON and Always OFF Contacts, Ladder Diagram Having more than one rung. Programming On/Off Inputs, to produce on – off outputs: Introduction, PLC input instructions, outputs: Coils, Indicators and others, Operational procedures, Contact and Coil Input output programming Examples, Fail Safe Circuits, Industrial Process Examples.

Unit 4

Creating Ladder Diagrams from Process Control Descriptions: Introductions, Ladder Diagrams, Sequence Listings. Large Process Ladder Diagram Constructions, Flowcharting as programming Method. Introduction to Robotics: Elementary treatment on anatomy, drives, transmission and end effectors of Robotics.

Unit 5

Material Handling: Generations Considerations, Applications in material transfer and loading unloading Assembly and Inspections: Assembly and robot assembly automations, Parts presentations methods. Assembly operations, Assembly system configurations inspection automation. Introduction to Nano-technology.

References

1. Programmable Logic Controller – Principles and Applications" 5/e, J. W. Webb, R. A. Reis; Prentice Hall of India Ltd. ISBN 81-203-2308-4.
2. Industrial Robotics – Technology, Programming and Applications"; M. P. Groover, M. Weiss, R. N. Nagel, N. G. Ordey; McGraw Hill International Editions, Industrial Engineering Series, ISBN 0-0-100442-4.
3. Programmable Logic Controller – Programming methods and Applications" Hackworth JohnR. And Hackworth Frederick D. Jr.; Pearson Education LCE, ISBN 81-297-0340-8.
4. Introduction to 8085 – Gaonkar.

Course outcomes

At the end of this course, student is

CO1: Able to develop a simulation model for simple physical systems and explain mechatronics design process.

CO2: Capable to outline appropriate sensors and actuators for an engineering application.

CO3: Able to write simple microcontroller programs.

CO4: Able to explain linearization of nonlinear systems and elements of data acquisition.

CO5: Able to explain various applications of design of mechatronic systems.

EVALUATION SCHEME

B. TECH. ME

III-YEAR (VI-SEMESTER)

(Effective from session: 2020-21)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TME-361	Design of Machine Elements	3	1	0	40	40	80	120	200	4
2.	TME-362	Instrumentation and Control	3	0	0	30	30	60	90	150	3
3.	TME-363	Solid Mechanics	3	1	0	40	40	80	120	200	4
4.	EME-32X	Department Elective - 2	3	0	0	30	30	60	90	150	3
5.	TOE – XY	Open Elective - 2	3	0	0	30	30	60	90	150	3
6.	TMC-362	Essence of Indian Traditional Knowledge*	2	0	0	20	20	40	60	100	0
PRACTICAL											
7.	PME-361	Design of Machine and Mechanism Lab	0	0	2	10	15	25	25	50	1
8.	PME - 362	Instrumentation and Control Lab	0	0	2	10	15	25	25	50	1
9.	PME-364	Mini Project	0	0	4	20	30	50	50	100	2
10.	PME-365	Aptitude Building: Placement Oriented Modules*	0	0	2	10	15	25	25	50	0
11.	GPP-361	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**17**	**2**	**10**	**210**	**230**	**440**	**610**	**1050**	**21**

Department Elective- 2

EME-321	I.C Engines
EME-322	Optimization techniques in engineering
EME-323	Finite element analysis
EME-324	Welding technology
EME-325	Process planning and cost estimation

Design of machine elements

TME – 361 L T P: 3 1 0

Course objective

This course seeks to introduce the design of machine elements commonly encountered in mechanical engineering practice, through a strong background in mechanics of materials-based failure criteria underpinning the safety-critical design of machine components. Moreover, the course also provides an appreciation of the relationships between component level design and overall machine system design and performance

Particulars

Unit 1

Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure), Design of shafts under static and fatigue loadings.

Unit 2

Analysis and design of sliding and rolling contact bearings, Design of transmission elements: belt and chain drives.

Unit 3

Design of transmission elements: spur, helical, bevel and worm gears

Unit 4

Design of springs: helical compression, tension, torsional and leaf springs, Design of joints: threaded fasteners, pre-loaded bolts and welded joints

Unit 5

Analysis and applications of power screws and couplings, Analysis of clutches and brakes

References

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.

5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.
6. V. B. Bhandari, Design of Machine Elements, Tata McGraw Education Hill Pvt Ltd India.

Course outcomes

Upon completion of this course, students will be able to

CO1: Design and analyze the shafts under static and fatigue load.

CO2: Design and analyze bearings, belt and chain drives.

CO3: Design and analyze of different types of gears.

CO4: Design and of springs and joints.

CO5: Design and analyze power screw and couplings.

Instrumentation and control

TME- 362 L T P: 3 0 0

Course objective:

To provide a basic knowledge about measurement systems and their components. This course also provides ample regime to learn about various sensors used for measurement of mechanical quantities learn about system stability and control.

Particulars

Unit 1

Mechanical Measurements

Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, Units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error.

Unit 2

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

Time related measurements: Counters, stroboscope, frequency measurement by direct comparison, measurement of displacement.

Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers, Measurement of very low pressures.

Unit 3

Strain measurement: Types of strain gauges and their working, calibration.

Measurements of force and torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems.

Temperature measurement: Thermometers, bimetallic thermocouples, thermistors.

Measurement of geometric forms: Straightness, flatness, roundness. Tool maker's microscope.

Measurement of Acceleration and Vibration: Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.

Unit 4

Concept of Automatic Controls: Open loop & closed loop systems. Servomechanism. Block diagrams. Laplace Transform and its applications, force-voltage and force current analogy, Electrical analog of simple mechanical system.

Time Response analysis: Standard test signals, time response of second order systems and their Specifications, P, PI and PID Controllers.

Unit 5

Frequency response Analysis: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots. Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant.

Stability Analysis: Concept of stability, Routh-Hurwitz criteria and its limitations.

References

1. Theory and Design for Mechanical Measurements, 3ed, w/CD, Figliola, Wiley India.
2. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
3. Doeblein E.O., “Measurement Systems, Application Design”, McGraw Hill, 1990.
4. Nagrath & Gopal, “Control System Engineering”, 4th Edition, New age International.
5. B.C. Kuo , “Automatic Control System” Wiley India.
6. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes.

Course outcomes

At the end of this course, student will have

CO1: Ability to understand the measuring instruments

CO2: Ability to understand different types of sensors

CO3: Knowledge of basic principal of measurement

CO4: Ability to understand the open loop & closed loop systems

CO5: Capability to analyses frequency response

Solid mechanics

TME – 363 L T P: 3 1 0

Course objective

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Particulars

Unit 1

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions.

Unit 2

Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.

Unit 3

Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

Unit 4

Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.

Unit 5

Solutions using potentials. Energy methods. Introduction to plasticity.

References

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

Course outcomes

At the end of this course

CO1: Students will be able to understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

CO2: Students will be able to apply the different boundary conditions and superposition theorem to the various type of materials.

CO3: Students will be able to identify and solve the plane stress and plane strain problems subjected to different loads.

CO4: Students will be able to apply the concept of solid mechanics to the cylinders, disks and non-circular cross-sections.

CO5: Students will be able to identify, formulate and solve engineering problems.

Design of machine lab

PME – 361 L T P: 3 0 0

Course objective

The course design to amplify the understanding about designing different mechanism. The student can also learn about the design of different joints. Moreover, the designing different bearings also accumulated in this course.

Particulars

List of experiments (Minimum 10 of the following)

1. Study and Design of 4-bar mechanism
2. Study and Design of Slider Crank Mechanism
3. Study and Design of Ackerman-Devis Steering Mechanism
4. Study and Design of Straight Line Mechanism
5. Design & drawing of Riveted joints for given operating conditions.
6. Design of an eccentrically loaded welded, riveted of bolted joint.
7. Design of bolted joint for fluctuating loads.
8. To study and Design of Spur and Helical Gear
9. To study of Sliding Contact Bearing
10. To study of Rolling Contact Bearing
11. Design a shaft used in some practical application, by actual working and loading conditions
12. Justify the design of single plate clutch of an engine assembly
13. Design of helical and leaf springs
14. Design software in some high-level language or excel sheets for design of a component
15. Failure analysis of machine elements using FEM software

References

1. Rattan, S. S, "Theory of Machines", McGraw-Hill Education, 4th edition, 2015.
2. John J Uicker, Gordon R Pennock, Joseph E Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 4thEdition, 2014.
3. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
4. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
5. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
6. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East- West Pvt. Ltd, New Delhi, 1988.

7. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
8. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
9. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
10. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
11. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.
12. V. B. Bhandari, Design of Machine Elements, Tata McGraw Education Hill Pvt Ltd India

Course outcomes

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

CO1: Analyse and design the different mechanism.

CO2: Evaluate and design the different types of joints.

CO3: Analyse and design the various gears including spur and helical.

CO4: Analyse and design the different bearings.

CO5: Analyse and design the helical and leaf springs.

Instrumentation and control lab

PME – 362 L T P: 3 0 0

Course objective

Particulars

List of experiments (minimum 10 of the following)

1. Study of Pressure & Temperature measuring equipment.
2. Strain gauge measurement.
3. Speed measurement using stroboscope.
4. Flow measurement experiment
5. Vibration/work measuring experiment.
6. Experiment on Dynamometers.
7. To determine response of second order systems for step input for various values of constant K using linear simulator Unit and compare theoretical and practical results.
8. To study P, PI and PID temperature controller for an oven and compare their performance.
9. To study and calibrate temperature using resistance temperature detector (RTD)
10. To study DC position control system
11. To study synchro-transmitter and receiver and obtain output V/S input characteristics
12. To determine speed-torque characteristics of an ac servomotor.
13. To study performance of servo voltage stabilizer at various loads using load bank.
14. To study behaviour of separately excited dc motor in open loop at various loads.

    Software based experiments (Use MATLAB, LABVIEW software etc.)
15. To determine time domain response of a second order systems for step input and obtain performance parameters.
16. To plot root locus diagram of an open loop transfer function and determine range of gain, k for stability.
17. To plot a Bode diagram of an open loop transfer function.
18. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

References

1. Theory and Design for Mechanical Measurements, 3ed, w/CD, Figliola, Wiley India.
2. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
3. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
4. Nagrath & Gopal, "Control System Engineering", 4th Edition, New age International.

5. B.C. Kuo , “Automatic Control System” Wiley India.
6. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes.

Course outcomes

At the end of this course, the student is able to

CO1: Analyze and evaluate the characteristics of measuring instruments.

CO2: Understand the mechanical vibration system.

CO3: Understand the analogy of electric system.

CO4: Analyze the open and close loop system.

CO5: Understand the transfer functions.

Aptitude Building: Placement Oriented Modules

PME – 364 L T P: 0 0 2

Course objective

The objective of the course is to improve the problem-solving techniques by regular practices of verbal, nonverbal and quantitative data reasoning's. This course also helps students to crack the aptitude test organize by the companies coming for placement. Moreover, the employability skills will also improve with this course.

Unit 1

Verbal ability: English grammar, sentence completion, verbal analogies, word groups, instructions, critical reasoning and verbal deduction.

Unit 2

Verbal Reasoning: Verbal Reasoning Problems on Sitting Arrangements, Problems on Comparison, Venn Diagrams, Clock Puzzles, Blood relations, Coding-Decoding, Direction Sense Test.

Unit 3

Non-Verbal Reasoning: Series, Cubes and Dice, Classification

Unit 4

Numerical Abilities: Numbers series, Problems on HCF and LCM, Average, Percentage, Ratio and Proportion, Numerical computation, numerical estimation, numerical reasoning and data interpretation.

Unit 5

Quantitative Aptitude: Time and Distance, Time and Work, Profit and Loss, Probability, Simple interest and Compound interest.

References

1. R.S Aggarwal. A modern approach to Verbal & Non - Verbal Reasoning, S. Chand.
2. R S Aggarwal. Quantitative Aptitude, S. Chand.
3. Abhijit Guha. Quantitative Aptitude for Competitive Examinations, Mc Graw Hill Education.
4. G.K.P. A Complete Reference Book General Aptitude, GK Publication.

Online sources

- http://www.careerbless.com/aptitude/qa/home.php
- http://www.mastguru.com/arithmetic-aptitude-questions-answers/sub-topic/8
- http://www.aptitude-test.com/
- http://placement.freshersworld.com/power-preparation/Aptitude-Preparation

Course outcome

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

CO1: Evaluate critically the verbal reasoning’s and find the optimum solution.
CO2: Evaluate critically the actual ambience by addressing key issues.
CO3: Utilize their innovative thinking skills to project themselves for finding effective ideas towards adversities.
CO4: Demonstrate various principles involved in solving mathematical problems to optimize the time taken for performing job functions.
CO5: Make and evaluate the assumptions used in analyzing quantitative data.

IC Engine

EME – 321 L T P: 3 0 0

Course objective

To understand the operation, combustion, performance and emissions of internal combustion engines.

Particulars

Unit 1: Components of IC Engines

Classification of internal combustion engines, application of IC Engines, Function and operation of two stroke and four stroke engines, Comparison of SI and CI, two stroke and four stroke engines, Effects, limitations, and types of supercharging and scavenging process, performance characteristics of IC engines, problems on performance and heat balance, fuel air cycles and their significance.

Unit 2: IC Engine Auxiliary Systems

Carburetion, mixture requirements at different loads and speeds, simple carburetor. Functional requirements and classification of an injection systems, injection pump, nozzle types, MPFI and EFI systems, Battery and magneto ignition systems, ignition timing and engine parameters. Properties of lubricants, mist, wet and dry sump lubrication systems. Liquid and air cooled cooling system, coolant and antifreeze solutions.

Unit 3: Combustion in SI Engine

Homogeneous and heterogeneous mixture, combustion in spark ignition engines, stages of combustion in spark ignition engines. Flame front propagation, factors influencing flame speed, Rate of pressure rise, abnormal combustion, and phenomenon of knock in SI engines. Effect of engine variables on knock, combustion chambers for SI engines, smooth engine operation. High power output and thermal efficiency, stratified charge engine.

Unit 4: Combustion in CI Engines

Combustion in CI engine, stages of combustion in CI engines. Factors affecting the delay period, compression ratio, engine speed, output, atomization and duration of injection, injection timing, quality of fuel, intake temperature, intake pressure. Phenomenon of knock in CI engines, comparison of knock in SI and CI engines. Combustion chambers for CI engines, Homogeneous charge compression ignition engines.

Unit 5: Alternate Fuels and Emission

Liquid fuels, alcohol, methanol, ethanol; vegetable oil, biodiesel production, properties, advantages and disadvantages. Gaseous fuel – Hydrogen, CNG, LPG. Air pollution due to IC engines, hydrocarbon and CO emission, oxides of nitrogen, aldehydes, Sulphur, lead and phosphorus emissions. Catalytic converter, exhaust gas recirculation. Flame ionization detector, non-dispersive infra-red detector, chemiluminescence analyzer, smoke types, Bosch smoke meter, Emission standards.

References

1. Ganesan.V, "Internal Combustion Engines", Tata McGraw-Hill, New Delhi, 2015.
2. Ramalingam K.K, "Internal Combustion Engines- Theory and practice", SciTech publications India Pvt. Ltd., Chennai, 2010.
3. Thipse S.S, "Internal Combustion Engines", Jaico Publication House, 2010.
4. Thipse S.S, "Alternate Fuels", Jaico Publication House, 2010.
5. Heywood.J.B, "Internal Combustion Engine Fundamentals", McGraw Hill International, New York, 2008.
6. Mathur M.L and Sharma R.P, "A course in Internal Combustion Engines", DhanpatRai& Sons, New Delhi, 2010.

Course outcomes

At the end of this course, student is able to

CO1: Acquire the knowledge of engine operation and performance.
CO2: Understand the working of engine auxiliary systems.
CO3: Understand the combustion aspects of spark ignition engine.
CO4: Understand the combustion aspects of combustion ignition engine.
CO5: Know the various alternate fuels, engine emissions, measuring and control techniques.

Optimization techniques in engineering

EME – 322 L T P: 3 0 0

Course objective

To study the principles of optimization and various techniques which can be used for mechanical engineering optimization along with applications.

Particulars

Unit 1

Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit 2

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit 3

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss Newton, Levenberg - Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linear Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming, Singular Based Optimization, On-Line Real- Time Optimization, Optimization in Econometrics Approaches – Blue.

Unit 4

Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Method and the Runge-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Trapezoidal Rule and Simpson's 1/3 and 3/8 Rules, the Newton Raphson in one and two Dimensions, Jacobi's Iteration Method.

Unit 5

Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maxmin Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Stochastic

Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transhipment Problems, Heuristic Methods.

References

1. Rao Singaresu. S, “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, 2009.
2. Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. Ltd., 2006.
3. Johnson Ray C, “Optimum design of mechanical elements”, Wiley, John & Sons, Digitized 2007
4. Goldberg .D.E, “Genetic algorithms in search, optimization and machine”, Barnen, Addison Wesley, New York, 1989.
5. William Orthwein, “Machine Component Design”, Vol. I and II, Jaico Publishing house, New Edition, 2006.
6. Rao.C.S, “Optimization Techniques”, DhanpatRai& Sons, New Delhi
7. Fox.R.L, “Optimization methods for Engineering Design”, Addison Wesley Pub, Digitized 2007.
8. Garret N. Vanderplaats, “Numerical optimization techniques for engineering”, McGraw-Hill Ryerson, Limited, 1984.

Course outcomes

At the end of this course, student is

CO1: Able to define and use optimization terminology and concepts, and understand how to classify an optimization problem.

CO2: Able to demonstrate the ability to choose and justify optimization techniques that are appropriate for solving realistic engineering problems.

CO3: Able to understand and apply unconstrained optimization theory for continuous problems, including the necessary and sufficient optimality conditions and algorithms

CO4: Able to understand and apply gradient-free and discrete optimization algorithms.

CO5: Able to apply optimization techniques to determine a robust design.

Finite element method

EME – 323 L T P: 3 0 0

Course objective

To illustrate the principle of mathematical modelling of engineering problems and to introduce the basics and application of Finite Element Method.

Particulars

Unit 1

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

Unit 2

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Unit 3

Trusses: Introduction, plane trusses, three dimensional trusses, assembly of global stiffness matrix for the banded and skyline solution.

Beams and Frames: Introduction, finite element formulation, load vector, boundary considerations, shear force and bending moment, plane frames.

Unit 4

Two dimensional equations, variational formulation, finite element formulation, triangular elements-shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Unit 5

Natural coordinate systems, iso-parametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

References

1. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
2. Chandrupatla & Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.
3. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
4. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.

Course outcomes

At the end of this course, student will demonstrate the ability to

CO1: Understand the FEM formulation and its application to simple structural and thermal problems.
CO2: Understand the numerical methods involved in Finite Element Theory.
CO3: Analyze the direct and formal (basic energy and weighted residual) methods for deriving finite element equations.
CO4: Analyze the role and significance of shape functions in finite element formulations and use linear, quadratic, and cubic shape functions for interpolation.
CO5: Design and analyze the complicated systems.

Welding technology

EME – 324 L T P: 3 0 0

Course objective

This course aims to impart knowledge of various parameters and requirements of welding processes and advanced welding practices in industries. It also aims to teach the comparative merits and demerits of various welding processes and accordingly determine the suitable welding technique for a particular joint. Various joint designs adopted in different types of welding techniques will also be taught.

Particulars

Unit 1: Introduction

Importance and application of welding, classification of welding process; Selection of welding process; Arc and Power Source characteristics, Review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding, Resistance welding. Electroslag welding, Friction welding etc., Soldering & Brazing.

Unit 2: Weldability of specific Materials

Weldability of: Carbon steel, High strength low alloy steels, stainless steel, Cast Iron, Copper and its alloys, Aluminum and its alloys, Magnesium and its alloys and Titanium alloys.

Unit 3: Advanced Welding Techniques

Principle, working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding, explosive welding, Underwater welding, Metalizing

Unit 4: Weld Design

Weld defects and distortions and their remedies; Inspection/testing of welds; Weld design for static loading, weld design for fatigue loading

Unit 5: Thermal and Metallurgical Considerations

Temperature distribution, analytical analysis, heating & cooling curves; Macrostructure & microstructure of welds, HAZ and parent metal; Solidification of weld and its properties.

References

1. Welding Engineering & Technology by R. S. Parmar, Khanna Publishers.
2. Welding Processes and Technology by R.S. Parmar, Khanna Publishers.

3. Principles of welding (Processes, Physics, Chemistry, and Metallurgy) Robert W. Messler Wiley Publishers.
4. Advanced Welding Processes by John Norrish, Woodhead Publishing.
5. Welding Metallurgy by Sindo Kou, Wiley-Interscience Publication.
6. Welding Handbook (Vol-2, 3 & 4) by American Welding Society.

Course outcomes

At the end of course, the student is

CO1: Able to acclaimed knowledge regarding various advanced welding practices in industries.

CO2: Able to understand various parameters and requirements of welding processes.

CO3: Able to know the comparative merits and demerits of various welding processes

CO4: Able to understand the right kind of welding techniques suitable for various joints.

CO5: Able to learn about the joint designs adopted in different types of welding techniques.

Process planning and cost estimation

EME – 325 L T P: 3 0 0

Course objective

To introduce the process planning concepts to make cost estimation for various products after process planning.

Particulars

Unit 1: Introduction to Process Planning

Introduction- methods of process planning- drawing interpretation – material evaluation – steps in process selection. Production equipment and tooling selection.

Unit 2: Process Planning Activities

Process parameters calculation for various production processes. Selection of jigs and fixtures, election of quality assurance methods- Set of documents for process planning, Economics of process planning.

Unit 3: Introduction to Cost Estimation

Importance of costing and estimation – methods of costing, elements of cost estimation- types of estimates, Estimating procedure – estimation of labor cost, material cost. Allocation of overhead charges – Calculation of depreciation cost.

Unit 4: Production Cost Estimation

Estimating of different types of jobs- estimation of forging shop, estimation of welding shop, estimation of foundry shop.

Unit 5: Machining Time Calculation

Estimation of Machining Time – importance of machine time calculation. Calculation of machining time for different lathe operation, drilling and boring, milling shaping, planning and grinding.

References

1. Peter Scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology.
2. Russell R.S. and Tailor B.W, Operation Management", 4th Edition, PHI, 2007.
3. Chitale A.V. and Gupta R.C. , "Product Design and Manufacturing", 2nd Edition, PHI, 2002.

Course outcomes

At the end of this course, students will show their ability to

CO1: Apply process planning concepts in industrial perspective to describe the best process for each job.

CO2: Determine systematically engineering processes and systems to manufacture a product economically and competitively.

CO3: Evaluate the process of forecasting the expenses that must be incurred to manufacture a product.

CO4: Predetermination of cost expected to be incurred in production of a component in advance.

CO5: Evaluation of machining time to find the manufacturing cost of a particular job.

4th Year Scheme and Syllabus

EVALUATION SCHEME

B. TECH. ME

IV-YEAR (VII-SEMESTER)

(Effective from session: 2021-22)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TME-471	Automation in Engineering	3	0	0	30	30	60	90	150	3
2.	EME-43X	Department Elective -3	3	0	0	30	30	60	90	150	3
3.	EME-44X	Department Elective -4	3	0	0	30	30	60	90	150	3
4.	EHS-41X	Humanities Elective - 1	3	0	0	30	30	60	90	150	3
5.	TOE-XY	Open Elective – 3	3	0	0	30	30	60	90	150	3
PRACTICAL											
6.	PME-471	Project Stage – 1	0	0	8	50	50	100	100	200	4
7.	PME-472	Summer Industry Internship	0	0	2	10	15	25	25	50	1
8.	PME-473	CAD/CAM Lab	0	0	2	10	15	25	25	50	1
9.	PME-474	Employment Enhancement Program: Value addition Course*	0	0	2	25	25	50	0	50	0
10.	GPP-471	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**0**	**14**	**220**	**230**	**450**	**600**	**1050**	**21**

Department Elective- 3

EME-431 Refrigeration and air conditioning

EME-432 Composite materials

EME-433	Gas dynamics and jet propulsion
EME-434	Advanced fluid mechanics
EME-335	Unconventional manufacturing processes

Department Elective-4

EME-441	Design and dynamics of machine elements
EME-442	Mechanical vibrations
EME-443	Industrial tribology
EME-444	Machine tool design
EME-445	Experimental stress analysis

Humanities Elective – 1

EHS-311	Education and social change
EHS-312	Science, Technology and Society
EHS- 313	Engineering Economics
EHS -314	Industrial Phycology

Automation in engineering

TME – 471 L T P: 3 0 0

Course objective

To familiarize with the components of computer aided manufacturing and computer aided design.

Particulars

Unit 1: Introduction to Automation

Introduction to automation, why automation is needed, Current trends in automation, Industrial control systems in process, discrete manufacturing industries, introduction to robotics, classification of robots and characteristics, introduction to CAD, CAM and CIM.

Unit 2: Types of Automation

Rigid automation – part handling – job orienting and feeding devices, transfer mechanism and feed cut of components in machine tools, Automated Material handling.

Flexible automation – computer control of machine tools and machining centers. NC and NC part programming. CNC adaptive control, Assembly Flexible fixturing.

Unit 3: Manufacturing Support Systems

Fundamentals of CAD, hardware in CAD- Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods.

Computer Aided Manufacturing: CNC technology, PLC, Micro-controller, CNC – Adaptive control.

Unit 4: Low Cost Automation

Mechanical and Electro mechanical systems, design aspect of hydraulic systems like pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. and their selection. Pneumatic fundamentals – control elements, position and pressure sensing – logic circuits, switching circuits.

Practical case studies on hydraulic circuit design and performance analysis.

Unit 5: Modeling and Simulation

Introduction to modeling and simulation, need for system modeling, Product design, process route modeling, Modern tools- Fuzzy decision making and Artificial Neural Networks in manufacturing automation. Case studies and industrial applications of manufacturing systems.

References

1. Mikell P. Groover, Automation, Production Systems and Computer integrated Manufacturing, Prentice Hall.
2. Serope Kalpaljian and Steven R Schmid, Manufacturing- Engineering and Technology, 7th edition, Pearson.
3. N. Viswanandham, Y. Narhari "Performance Modeling of Automated Manufacturing Systems" Prentice-Hall.
4. YoramKoren, Computer control of manufacturing system, 1st edition.
5. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

Course outcomes

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

CO1: Understand the importance of automation in the field of machine tool-based manufacturing.

CO2: get the knowledge of various types of automation.

CO3: Understand the components of manufacturing support systems.

CO4: Know about the low-cost automation system and their implementation.

CO5: Understand the basics of product design and the role of manufacturing automation.

CAD/CAM lab

PME – 471 L T P: 0 0 2

Course objective

To provide an understanding of advanced manufacturing methods.

Particulars

A minimum of 08 experiments from the following (minimum 04 from each):

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and designing steps.
2. Design of machine component or other system experiment: Writing and designing steps.
3. Understanding and use of any 3-D Modeling Software commands.
4. Pro-E, Ideas, CATIA, ANSYS etc. Experiment: Solid modeling of a machine component.
5. Understanding the commands and specific usages in CAD.

B. CAM Experiments

1. To study the characteristic features of CNC machine.
2. Experiment on Robot and programs.
3. Experiment on Transfer line/Material handling.
4. Experiment on difference between ordinary and NC machine, study on Mechatronics and controls.
5. Experiment on study of system devices such as motors and feedback devices.

References

1. Mikell P. Groover, Automation, Production Systems and Computer integrated Manufacturing, Prentice Hall.
2. Serope Kalpaljian and Steven R Schmid, Manufacturing- Engineering and Technology, 7th edition, Pearson.
3. N. Viswanandham, Y. Narhari "Performance Modeling of Automated Manufacturing Systems" Prentice-Hall.
4. YoramKoren, Computer control of manufacturing system, 1st edition.
5. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

Course outcomes

At the end of course, student is

CO1: Able to develop solutions of the problems of mechanical design and manufacturing by the help of computer programming.

CO2: Able to understand and capability for applying software skills in design and manufacturing.

CO3: Review and document the knowledge developed previously and critically assess the relevant technological issues.

CO4: Formulate and do analytical study with modern scientific methods by using software tools.

CO5: Able to Design and validate technological solutions to problems and communicate clearly for the practical application of their work.

Employment enhancement program

PME – 474 L T P: 0 0 2

Course objective

This course expects to sharpen the skills of undergraduate students and encourage them to improve their employability and do well in the professional space. These skills are imperative for students to establish a stronger connect with the environment in which they will work. The understanding of these skills will empower the undergraduate students to manage the placement and post placement challenges effectively.

Particulars

Module 1

Behavioral skills: Develop punctuality, responsibility, accountability & ownership, work culture, Technical English, Communication & Presentation skills including Report writing, Basics of Project management, Basics of Time and Performance, management, Basics of Lean Sigma, Basic Finance management in industries, Confidence building, skills to face interviews.

Module 2

Health safety and environment: HSE Management in Industries, General Safety for Industries – HSE procedures, policies & PPEs, Roles & responsibilities of individuals on HSE, Permit to Work systems, HSE documentations, Hazard Identification & Risk Management, Safety Leadership & Management, HSE Tools & Skills for Engineers.

Module 3

Lateral Thinking: Understanding lateral thinking & appreciating the difference between vertical & lateral thinking, and between convergent & divergent thinking; Understanding brain storming & mind-maps; Solving of problems by an indirect and creative approach, typically through viewing the problem in a new and unusual light; Application of lateral thinking during Group Discussions & Personal Interviews; Application of lateral thinking in college projects and at the workplace.

Module 4

Entrepreneur development: Policies of government of India for entrepreneurship motivation, case studies of some entrepreneur benefitted with the government of India policies.

Module 5

Certification courses:

Solid works, ANSYS modules (Structural + CFD), NDT, MASTER CAM, Quality assurance

** Students can opt any certification course

References

1. Robert B. Cialdini. Influence- The Psychology of Persuasion, Collins Business.
2. Jones M. D. The thinker's toolkit: 14 powerful techniques for problem solving, Random House Digital, Inc.
3. Edward de Bono. Six Thinking Hats, Little, Brown and Company.
4. Joan Emden. Presentation skills for students, Lucinda Becker.

Course outcomes

This course will

CO1: Enhance the behavioral skills of students to take Ownership, Responsibility, Accountability and Punctuality at work.

CO2: Develop the Technical, HSE & behavioral skills of future engineers to a level that is required by industries to recruit & deploy them at work.

CO3: Build the confidence to face interviews and readiness to take up jobs with industries.

CO4: Improve the ability to read and understand the technical documents relevant to the discipline.

CO5: Motivate students to become future entrepreneur.

Refrigeration and air conditioning

EME – 431 L T P: 3 0 0

Course objective

To familiarize with the terminology associated with refrigeration systems and air conditioning. Moreover, this course will also help student to acquire the skills required to model, analyze and design different refrigeration as well as air conditioning processes and components.

Particulars

Unit 1: Introduction to refrigeration system

Methods of refrigeration, Carnot cycle, Reversed Carnot cycle, Carnot refrigerator and heat pump Unit of refrigeration, Air Refrigeration cycle: Open and closed air refrigeration cycles, Bell Coleman or Reversed Brayton air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Simple system, Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART). Steam jet refrigeration.

Unit 2: Vapour Compression System and Refrigerants

Modification in reversed Carnot cycle, Single stage system, Analysis of vapour compression cycle, use of T-s and p-h charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling & superheating of suction vapour on performance of the cycle, Actual vapour compression cycle, Different configuration of multistage system, Cascade system.

Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.

Unit 3: Vapour Absorption system

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison.

Unit 4: Review of Psychrometry and Air-conditioning processes

Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Sensible heat factor (SHF), By pass factor, Apparatus dew point (ADP), Thermal analysis of human body, Design considerations, Effective temperature and comfort chart, Cooling and heating load calculations, Infiltration & ventilation, Internal heat gain, Grand Sensible heat factor (GSHF).

Unit 5: Refrigeration Equipment & Applications

Elementary knowledge of refrigeration & air conditioning equipment's e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, cold storage, Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning, Ozone depletion and global warming issues.

References

1. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
2. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.
3. Refrigeration and Air conditioning by Arora & Domkundwar, Dhanpat Rai.
4. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
5. Refrigeration and Air conditioning by Roy J. Dossat.Pearson
6. Heating Ventilating and Air conditioning by Mcquiston
7. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.

Course outcomes

At the end of this course, student will

CO1: have a good understanding of the working principles of refrigeration and air-conditioning systems and will be Able to Analyze, evaluate and compare the performances of complex vapor compression systems and air-craft refrigeration systems.

CO2: Able to Perform thermodynamic analysis of absorption refrigeration systems and steam jet refrigeration system.

CO3: Able to Classify & designate different types of refrigerants, select the best refrigerant for specific purposes. Evaluate the various sources of heat load on buildings and perform heat load estimation.

CO4: Able to Design summer and winter air conditioning systems.

CO5: Able to Understand the use and working of air-washer, cooling tower cold storage, water cooler etc.

Composite materials

EME – 432 L T P: 3 0 0

Course objective

To learn about different types of composite materials and their applications. To understand the concept of composite fabrication and techniques. To evaluate the performance of various types of composite materials.

Particulars

Unit 1

Definition and Classification of Composites, MMC, PMC, CMC. Reinforcing fibres- Natural fibers (cellulose, jute, coir etc), boron, carbon, ceramic glass, aramids, polyethylene (UHMWPE), polybenz-thiazoles etc.

Unit 2

Particulate fillers-importance of particle shape and size. Matrix resins-thermoplastics and thermosetting matrix resins. Coupling agents-surface treatment of fillers and fibres, significance of interface in composites.

Unit 3

Nano-composites, short and continuous fibre reinforced composites, critical fibre length, anisotropic behaviour, SMC, BMC, DMC etc.

Unit 4

Fabrication techniques, pultrusion, filament winding, prepreg technology, injection and compression moulding, bag moulding, resin transfer moulding, reaction injection moulding.

Unit 5

Properties and performance of composites, Industrial Application of Composite Materials : Civil constructions of structures/pannels, Aerospace industries, Automobile and other surface transport industries, Packaging industries, House hold and sports components etc.

References

1. K.K. Chawla, Composite Materials – Science & Engineering, Springer-Verlag, New York, 1987.

2. F.L. Matthews and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, London, 1994.
3. Dr Navin Chand, Tribology of Natural fiber Composites, Wood Head Publishing Limited, Engg.

Course outcomes

At the end of this course, students will demonstrate their ability to

CO1: Understand the concept of composite materials and their classification.
CO2: Analyse various types of fiber treatment and interfaces.
CO3: Understand the concept of nano-composites.
CO4: Fabricate the composites through various fabrication techniques.
CO5: Understand the importance of composites in various industrial and other applications.

Gas Dynamics and Jet Propulsion

EME – 433 L T P: 3 0 0

Course objective

Define basic concept and importance of gas dynamics and interpret the flow pattern in flow and non-flow systems. Moreover, this course also helps to identify the thrust equation and its usage in jet aircraft and rocket propulsion in an efficient way.

Particulars

Unit 1

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow.

Unit 2

Isentropic flow through variable area ducts, nozzles and diffusers, subsonic and supersonic flow in variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

Unit 3

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

Unit 4

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

Unit 5

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

References

1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S. Mukunda, " Understanding Aerospace Chemical Propulsion" , Interline Publishing, 2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.

4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

Course outcomes

The course provides

CO1: A basic understanding of thermodynamic cycles of jet engines.

CO2: A basic understanding of the compressible fluid flow in inlets and compressors and turbines.

CO3: A basic understanding of the combustion physics in combustion chambers.

CO4: A basic understanding of the rational behind several types of jet engines.

CO5: The ability to analyse jet engines; determine propulsion efficiency and design inlets and nozzles.

Advanced fluid mechanics

EME- 434 L T P: 3 0 0

Course objective

To familiarize the students about the principles and flow aspects of fluid mechanics.

Unit 1: Inviscid Irrotational Flows

The Local Continuity Equation, Path Lines, Streamlines, and Stream Functions, Newton's Momentum Equation, Equation for Newtonian fluid, Vorticity and Circulation, Non-Newtonian fluids, Moving coordinate systems, Irrotational Flows and the Velocity Potential, Singularity Distribution Methods, Forces Acting on a Translating Sphere, Added Mass and the Lagally Theorem, Theorems for Irrotational Flow: Mean Value and Maximum Modulus Theorems, Maximum-Minimum Potential Theorem, Kelvin's Minimum Kinetic Energy Theorem.

Unit 2: Exact Solutions of the Navier Stokes Equations

Solutions to the Steady-State Navier-Stokes Equations, Two-Dimensional Flow Between Parallel Plates, Poiseuille Flow in a Rectangular Conduit, Poiseuille Flow in a Round Conduit, Couette Flow Between Concentric Circular Cylinders, Unsteady Flows: Impulsive Motion of a Plate—Stokes's First Problem, Oscillation of a Plate—Stokes's Second Problem, Plane Stagnation Line Flow, Three-Dimensional Axi-symmetric Stagnation Point Flow, Flow into Convergent or Divergent Channels.

Unit 3: Thermal Effects and Flow Stability

Thermal Boundary Layers, Forced Convection on a Horizontal Flat Plate, The Integral Method for Thermal Convection, Linear Stability Theory of Fluid Flows, Thermal Instability in a Viscous Fluid—Rayleigh-Bénard Convection, Stability of Flow Between Rotating Circular Cylinders: Couette-Taylor Instability.

Unit 4: Turbulent Flows

Statistical Approach—One-Point Averaging, Zero-Equation Turbulent Models, One-Equation Turbulent Models, Two-Equation Turbulent Models, Stress-Equation Models, Equations of Motion in Fourier Space, Quantum Theory Models, Large Eddy Models.

Unit 5: Computational Methods

Numerical Calculus, Numerical Integration of Ordinary Differential Equations, The Finite Element Method, Linear Stability Problems—Invariant Imbedding and Riccati Methods, Errors, Accuracy, and Stiff Systems, Multi-dimensional methods: Relaxation Methods, Surface Singularities, One-Step

Methods: Forward Time, Centered Space, Dufort-Frankel Method, Crank-Nicholson Method, Hybrid Method, Upwind Differencing.

References

1. Graebel. W.P, “Advanced Fluid Mechancis”, 1st Edition, Academic Press, Elsevier Inc., 2007.
2. K. Muralidhar and G. Biswas, “Advanced Engineering Fluid Mechanics”, 3rd Edition, Narosa Publishers, 2015.
3. Stevan A Jones, “Advanced Methods for Practical Applications in Fluid Mechanics”, In Tech Publishers, 2012.
4. Hyoung Woo Oh, “Advanced Fluid Mechancis”, InTech Publishers, 2012.
5. Roger Kinsky, “Fluid Mechanics Advanced Applications”, McGraw-Hill Education Europe, 1997

Course outcomes

At the end of this course

CO1: Students will be able to understand the fundamentals of irrotational flows.
CO2: Students will be able to apply exact solutions of the Navier-Stokes equations.
CO3: Students will be able to understand thermal effects and flow stability.
CO4: Students will be able to analyze turbulent flows using numerical models.
CO5: Students will be able to apply computational methods for fluid flow problems.

Unconventional manufacturing processes

EME- 435 L T P: 3 0 0

Course objective

To impart clear knowledge about different unconventional processes and its latest developments to the students.

Particulars

Unit 1

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes and its classification.

Unit 2

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc.

Unit 3

Principle and working and application of unconventional machining processes such as laser beam machining, Electron beam machining, Ultrasonic machining etc.

Unit 4

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metallising, Plasma are welding/cutting etc.

Unit 5

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc.

References

1. Vijay K. Jain, "Advanced machining processes", Allied publishers, 2007.
2. Mishra P.K, "Non-Conventional Machining", Narosa Publishing House, 2007
3. Bennedict G.F, "Non-Traditional Machining Techniques", Marcel Decker, New York, 1990.

4. Sharma P.C, “A Text book of Production Engineering”, S Chand Publishing, New Delhi, 2009.
5. Pandey P.C. and Shan, “Modern Machining Process”, Tata McGraw Hill, 1980.

Course outcomes

At the end of course, students will

CO1: Able to understand as well as demonstrate the knowledge and the basic techniques of manufacturing processes.

CO2: Able to select any better unconventional method for machine harder material in comparison to regular cutting processes.

CO3: Able to understand the applications of various modern machining methods of thermal action.

CO4: Able to understand the various modern methods of joining two materials.

CO5: Able to understand the importance and criteria to apply an unconventional process for forming of different materials.

Design and dynamics of machine elements

EME-441 L T P: 3 0 0

Course objective

This course helps to know the balancing of machines and gyroscopic couple in aero planes and ships. Moreover, the working and analysis of various types of governors are also explored in this course. Furthermore, the design of cylinders, pressure vessels and engine parts are also covered.

Particulars

Unit 1

Force Analysis, Turning Moment & Fly wheel: Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank & Bar mechanism. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel.

Unit 2

Balancing of machines: Static and dynamic balancing, Balancing of rotating and reciprocating masses, Primary and secondary forces and couples.

Brakes and Dynamometers (Mechanical Type): External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers.

Unit 3

Governors: Dead weight and spring-loaded governors, Sensitivity, Stability, Hunting, Isochronisms, Effort and Power, Friction and Insensitivity, Introduction to inertia governors.

Gyroscopic Motion: Principles, Gyroscopic acceleration, gyroscopic couple and Reaction. Effect of Gyroscopic couple upon the stability of aeroplanes, ship, two & four wheelers.

Unit 4

Design of Cylinders and Pressure Vessels: Thin cylinders, Thin Spherical Vessels, Thick Cylinders, Lame‟s equation, Clavarino‟s and Birnie‟s equation, Compound cylinder, Gaskets, Gasketed Joints, Unfired Pressure Vessels, Thickness of cylindrical and spherical shells.

Unit 5

Design of IC Engine Parts: Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft.

References

1. Rattan, S. S, “Theory of Machines”, McGraw-Hill Education, 4th edition, 2015.
2. John J Uicker, Gordon R Pennock, Joseph E Shigley, “Theory of Machines and Mechanisms”, Oxford University Press, 4thEdition, 2014.
3. V. B. Bhandari, Design of Machine Elements, Tata McGraw Education Hill Pvt Ltd India
4. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
5. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
6. Cleghorn W.L. , Mechanisms of Machines, Oxford University Press, 2005.
7. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
8. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East- West Pvt. Ltd, New Delhi, 1988.
9. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
10. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
11. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
12. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.

Course outcomes

After completing of course, student will able to

CO1: Apply force analysis in piston cylinder reciprocating engine and can also deprived turning moment diagram of flywheels.
CO2: Understand the balancing of machines to reduce undesirable stresses in machine parts.
CO3: Understand the gyroscopic couple in aero planes and ships.
CO4: Design the cylinders and pressure vessels.
CO5: Design the IC engines components.

Mechanical vibrations

EME – 442 L T P: 3 0 0

Course objective

To achieve an understanding of simple harmonic motion and free and forced vibrations. Analysis of different types frequency and critical speed of shafts will also be done.

Particulars

Unit 1: Introduction

Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis; Single Degree Freedom System: Free vibration, Natural frequency, Equivalent Systems, Energy method for determining natural frequency, Response to an initial disturbance; Torsional vibrations, Damped vibrations. Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers.

Unit 2: Forced Vibrations

Single Degree Freedom: Forced vibration, Harmonic Excitation with viscous damping, Steady state vibrations; Forced vibrations with rotating and reciprocating unbalance, Support excitation, vibration isolation, Transmissibility, Vibration measuring instruments- Displacement, Velocity, Acceleration and Frequency measuring instrument.

Unit 3: Two Degree Freedom Systems

Two Degree Freedom System: Introduction, Principal modes, Double pendulum, Torsional system with damping. Coupled System, Undamped dynamic, vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper.

Unit 4: Multi Degree freedom systems

Multi degree Freedom System: Exact Analysis Undamped free and forced vibrations of multidegree system; Influence numbers, Reciprocal Theorem, Torsional vibration of multi rotor system, Vibration of geared system. Principal coordinates, Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circular shafts, Lateral vibration of beams.

Unit 5: Numerical Analysis

Multidegree Freedom System: Numerical Analysis Rayleigh's, Dunkerley's, Holzer's and Stodola's methods, Rayleigh – Ritz method. Critical Speed of Shafts: Shafts with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

References

1. Rao. S.S, “Mechanical Vibrations”, 5th Edition, Pearson Education Inc. Delhi 2009.
2. Kewelpujara, “Vibration and noise for engineers”, Dhanpatrai& Sons, 2009.
3. Rao .J.S and Gupta. K, “Introductory course on theory and practice of mechanical vibrations”, 2nd Edition, New Age International, New Delhi, 2014.
4. Ambekar. A.G, “Mechanical Vibrations and Noise engineering”, PHI New Delhi, 2015.
5. Thomson.W.T, “Theory of Vibration and its Applications”,5th Edition, Prentice Hall, New Delhi, 2001.

Course outcomes

At the end of this course, students will demonstrate the

CO1: Ability to analyze natural frequency.

CO2: Ability to understand single degree of free and forced vibration systems.

CO3: Capability to analyze different types of absorbers.

CO4: Ability to understand the multi degree of free and forced vibration system.

CO5: Understand the critical speed.

Industrial tribology

EME – 443 L T P: 3 0 0

Course objective

To familiarize with important concepts and application of tribology. Various lubrication theories and types of lubrications used in industries will also be taught.

Particulars

Unit 1: Surfaces and Friction

Introduction to the concept of tribology, Tribological problems; Nature of engineering surfaces, Surface topography, Surface profilometer, measurement of surface topography, Contact between surfaces, Sources of sliding Friction Friction due to ploughing, Friction due to adhesion; Friction characteristics of metals and non-metals; Sources of rolling friction, Stick slip motion; Friction of ceramic materials and polymers; Measurement of friction.

Unit 2: Wear

Wear and Types of Wear, Simple theory of sliding wear mechanism, Abrasive wear, Adhesive wear, Corrosive wear, Surface fatigue wear situations, Wear of ceramics, Wear of polymers; Wear measurements.

Unit 3: Film lubrication theory

Coefficient of viscosity, Fluid film in simple shear, Viscous flow between very close parallel plates; Lubricant supply, Lubricant flow rate, Cold jacking, Couette flow; Cavitation, Film rupture, oil whirl; Shear stress variation within the film; Lubrication theory by Osborne Reynolds; Pressure fields for full Sommerfeld, half Sommerfeld; Reynolds boundary conditions.

Unit 4: Lubricants and lubrication types

Introduction, dry friction; Boundary lubrication; classic hydrodynamics, hydrostatic and elasto hydrodynamic lubrication, Functions of lubricants, Types of lubricants and their industrial uses; SAE classification, recycling, disposal of oils, properties of liquid and grease lubricants; lubricant additives, general properties and selection.

Unit 5: Surface Engineering and materials for bearings

Classification of surface modifications and surface coatings; Transformation hardening, surface fusion; Thermo-chemical Processes, Surface coatings; Materials for rolling element bearings, Materials for fluid film bearings, Materials for marginally lubricated and dry bearings.

References

1. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja/PHI.
2. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.
3. Tribology H.G. Phakatkar and R.R. Ghorpade Nirali Publications.
4. Tribology – B.C. Majumdar, McGraw Hill Co Ltd.
5. Standard Hand Book of Lubrication Engg., O'Conner and Royle, McGraw Hills.
6. Introduction to Tribology, Halling, Wykeham Publications Ltd.

Course outcome

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

CO1: Identify the different areas of application of Industrial Tribology.
CO2: Understand the factors contributing to increase in friction and wear.
CO3: Gain the knowledge of various lubrication theories and suitable lubricant for a particular application.
CO4: Understand the preparation of bearing materials.
CO5: Understand different kinds of wear prevalent in different kinds of materials.

Machine tool design

EME – 444 L T P: 3 0 0

Course objective

To impart the clear knowledge about the machine tool design.

Particulars

Unit 1

Introduction to Machine Tool Drives and Mechanisms: Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.

Regulation of Speeds and Feeds: Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

Unit 2

Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.

Unit 3

Design of Guideways, Power Screws and Spindles: Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

Unit 4

Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.

Unit 5

Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness Acceptance Tests.

References

1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 2010.

2. G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2009.
3. D. K Pal, S. K. Basu, "Design of Machine Tools", 5th Edition. Oxford IBH, 2008.
4. N. S. Acherkhan, "Machine Tool Design", Vol. I, II, III and IV, MIR publications, 1968.

Course outcomes

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

CO1: Understand basic motions involved in a machine tool and design machine tool structures.
CO2: Design and analyze systems for specified speeds and feeds.
CO3: Select subsystems for achieving high accuracy in machining.
CO4: Understand control strategies for machine tool operations.
CO5: Apply appropriate quality tests for quality assurance.

Experimental stress analysis

EME – 445 L T P: 3 0 0

Course objective

In this course students learn to apply modern experimental stress analysis techniques to measure strains and stresses in engineering components and structures. The course includes strain gage measurements and analysis, design of strain gage-based transducers, photoelasticity and stress analysis.

Particulars

Unit 1: Elementary Elasticity Stress

Introduction, Stress Equations of Equilibrium, Laws of Stress Transformations, principal Stresses, Two-Dimensional State of Stress, Stresses Relative to Principal Co-ordinate System, Special States of Stress. Strain: Introduction, Displacement and Strain, Strain Transformation Equation, Principal Strains, Compatibility, Volume Dilation, Stress Strain Relations, Strain Transformation Equations and Stress Strain Relations for Two-Dimensional State of Stress.

Unit 2: Strain Measurements

Introduction, Properties of Strain Gage Systems, Types of Strain Gages, Grid- Method of Strain Analysis. Brittle Coating Method: Coating Stresses, Failure Theories, Brittle Coating Crack Patterns, Resin and Ceramic Based Brittle Coating, Test Procedure, Analysis of Brittle Coating Data.

Unit 3: Electrical Resistance Strain Gages

Introduction, Strain Sensitivity in Alloys, Strain Gage Adhesives, Gage Sensitivity and Gage Factor. Strain Gage Circuit: Potentiometer and its Application, Wheat-Stone Bridge, Bridge Sensitivity, Null Balance Bridges. Analysis of Strain Gage Data: Three Element Rectangular Rosette, Delta Rosette, Stress Gage, Plane Shear-Gage.

Unit 4: Theory of Photoelasticity

Introduction, Temporary Double Refraction, Stress Optic Law, Relative Retardation, Stressed Model in Plane Polariscope, Effect of Principal Directions, Effect of Principal Stress Difference, Stressed Model in Circular Polariscope, Light and Dark Field arrangements, Tardy Compensation, Fringe Sharpening and Multiplication by Partial Mirrors.

Unit 5: Two Dimensional Photoelasticity

Introduction, Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, Calibration Methods, Separation Methods, Shear Difference Method, Electrical Analogy Method, Oblique Incidence Method, Materials for Two-dimensional Photo elasticity.

References

1. Experiment Stress Analysis by Dr. Sadhu Singh, Khanna Publishers.
2. Experiment Stress Analysis by James W. Dally and William F. Riley, International Student Edition, McGraw Hill Book Company.

Course outcome

At the end of this course

CO1: Students will be able to demonstrate a basic understanding of experimental methods (e.g. strain gages, photoelasticity, image correlation) commonly used in experimental solid mechanics.

CO2: Students will be able to complete a detailed laboratory report and present their findings in a structured, logical manner.

CO3: Students will be able to apply knowledge learned in previous classes.

CO4: Students will be able to analyse experimental data.

CO5: Students will be able to develop appropriate, logical conclusions based on comparisons to theoretical results and other experimental evidence.

EVALUATION SCHEME

B. TECH. ME

IV-YEAR (VIII-SEMESTER)

(Effective from session: 2021-22)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	EME-45X	Department Elective -5	3	0	0	30	30	60	90	150	3
2.	EME-46X	Department Elective -6	3	0	0	30	30	60	90	150	3
3.	EME-47X	Department Elective -7	3	0	0	30	30	60	90	150	3
4.	TOE-XY	Open Elective – 4	3	0	0	30	30	60	90	150	3
PRACTICAL											
5.	PME-481	Project Stage-2	0	0	12	75	75	150	150	300	6
6.	GPP-481	General Proficiency *	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**12**	**0**	**12**	**195**	**195**	**390**	**510**	**900**	**18**

Department Elective-5

EME-451 Automobile engineering

EME-452 Power plant engineering

EME-453 Energy efficient building

EME-454 Computational fluid dynamics

EME-455 Thermal turbo machinery

Department Elective-6

EME – 461 Total quality management and reliability engineering

EME – 462 Supply chain management

EME – 463 Six sigma and applications

EME – 464 Modelling and simulation

EME – 465 Advanced operation research

Department Elective - 7

EME – 471	Robotics and automation
EME – 472	CAD and CAM
EME – 473	Computer integrated manufacturing
EME – 474	MEMS
EPE – 471	Non-destructive testing’s

Automobile engineering

EME – 451 L T P: 3 0 0

Course objective

On completion of this course, the students are expected to understand the automotive architecture, performance, transmission, wheels, tyres, braking, suspension, steering and electrical system with advances in automotive engineering.

Particulars

Unit 1: Introduction

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems.

Unit 2: Fuel injection and Engine emission

Electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor-based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Unit 3: Transmission of Engine Power

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slipjoints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Unit 4: Controlling Mechanism in Automobiles

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 5: Types of Fuel and its Combustion

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells.

References

1. Kirpal Singh, “Automobile Engineering”, Standard Publishers, Vol-I & II, 2004.
2. Ramalingam, K. K, “Automobile Engineering”, Scitech Publications, 2014.
3. Rajput R K, “A Text book of Automobile Engineering”, Laxmi Publication, 2015.
4. Crouse, W.H., and Anglin, D.L., “Automotive Mechanics”, Tata McGraw Hill, 2005.
5. Narang, G.B., “Automobile Engineering”, Khanna Publishers, 2001.
6. Kamaraju Ramakrishna, “Automobile Engineering”, PHI Learning Pvt. Ltd, 2012.

Course outcomes

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

CO1: Broaden the understanding of automotive architecture and performance.

CO2: Introduce students about the transmission system.

CO3: Familiarize about the wheels, tyres, and braking system.

CO4: Understand the fuel injection and emission.

CO5: Learn about the different types of fuels and their combustion.

Power plant engineering

EME – 452 L T P: 3 0 0

Course objective

To provide an overview of power plants and the associated energy conversion issues.

Particulars

Unit 1

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

Unit 2

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit 3

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit 4

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit 5

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

References

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

Course outcomes

After completion of this course, the students should be able to

CO1: Discuss the energy resources and energy conversion methods available for the production of electric power in India.

CO2: Determine the efficiency and output of a modern Rankine cycle steam power plant from given data, including superheat, reheat, regeneration, and irreversibility.

CO3: Understand the working of different power plant units and discuss the safety measures in power plants.

CO4: Explain the major types of hydro-power and wind-power turbines and estimate power generation potential.

CO5: Discuss the economics of the power plants units and estimate the total operational costs.

Energy efficient buildings

EME – 453 L T P: 3 0 0

Course objective

To enable the students to understand and apply their knowledge to solve energy management issues of buildings.

Particulars

Unit 1: Energy transfer in buildings

Concepts of energy efficient buildings, Calculation of various heating and cooling loads of the building. Heat losses - Internal heat sources. Heat load calculations, Building's energy balance accounting for solar energy gain, Climate and its influence in building design for energy requirement. Low and zero energy buildings.

Unit 2: Passive solar heating and cooling

General principles of passive solar heating, Key design elements of passive heating and cooling, direct solar heat gain by Trombe mass walls, Water walls, evaporative cooling, convective air loops and solar chimney effects, Passive cooling, ventilation, predicting ventilation in buildings, window ventilation calculations, Thermal insulation, load control, air filtration, Odor removal and heat recovery in large buildings.

Unit 3: Lighting systems of buildings

Glazing materials: sources and concepts of day lighting and optical materials, Components of daylight factor – Recommended daylight factors and day lighting analysis, Electric lighting control for day lighted buildings and illumination requirement, selection of luminaries and performance parameters.

Unit 4: Heat control and ventilation

Heat transmission through building sections and effect of heating with orientation of buildings, Design parameters influencing thermal design of buildings, Ventilation requirements and minimum standards for ventilation, Ventilation designs and energy conservation measures, Natural and forced ventilation methods.

Unit 5: Green buildings

Green building features and green construction materials, integrated ecological design, sustainable site and Landscaping, Indoor air quality, water and waste management systems, Green Globe, LEED, GRIHA, IGBC certifications and Standards, Economics, managing initial costs and environment benefits.

References

1. Means R.S., “Green building: project planning and cost estimating”, Kingston, 2006.
2. Kibert C.J., “Sustainable Construction: Green Building Design”, 2nd edition, Wiley, 2007.
3. Boecker J., Scot Horst, Tom Keiter, Andrew Lau, MarkesSheffer, Brian Toevs, Bill Reed, “Integrative Design Guide to Green Building”, Wiley, 2009.
4. Eicker U., “Low Energy Cooling for Sustainable Buildings”, Wiley, 2009.
5. Gevorkian P., “Alternative Energy Systems in Building Design”,McGraw-Hill, 2010.
6. Harvey D.L., “Handbook on Low-Energy Buildings and District-Energy Systems”, Earthscan, 2006.
7. Attmann O., “Green Architecture”, McGraw-Hill, 2010.
8. Majumdar, M., “Energy – Efficient Buildings in India”, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2002.

Course outcomes

At the end of this course

CO1: Students will be able to apply the concept and techniques of Energy efficient buildings systems.
CO2: Students will be able to demonstrate solar passive heating and cooling systems.
CO3: Students will be able to demonstrate day lighting and electrical lighting.
CO4: Students will be able to demonstrate heat control and ventilation methods in buildings.
CO5: Students will be able to demonstrate green buildings and certifications.

Computational fluid dynamics

EME – 454 L T P: 3 0 0

Course objective

To impart knowledge about various computational methods of fluid flow and solve simple fluid flow problems.

Particulars

Unit 1: Mathematical behaviour of partial differential equations

Introduction to computational fluid dynamics, Types of model flow, substantial derivative, Divergence of velocity. Continuity equation in conservation form, integral and differential form; Continuity equation in non-conservation form, integral and differential form; Manipulation of continuity equation, Three-dimensional momentum equation; Navier's Stokes Equation, Energy equation. Different boundary conditions, Classification of PDE Mathematical behavior of PDE.

Unit 2: Discretization techniques

Explanation of finite difference method; Discretization of wave equation, Discretization of Laplace equation; Numerical error types and stability criterion, One-dimensional transient heat conduction equation discretization; Explicit, Crank Nicholson and pure implicit method, Numerical error and stability of One-dimensional transient heat conduction equation; Grid independence test, Optimum step size.

Unit 3: Solution Techniques

Laxwendroff Technique, Maccormmacks Technique, Relaxation Technique and its significance, TDMA Algorithm, Alternative Direction Implicit method, Pressure correction Technique, Staggered Grid; Numerical SIMPLE Algorithm, Stream function and Vorticity method.

Unit 4: Grid generation

Grid transformation of equations, Transformation of aerofoil from physical plane to Computational plane, Transformation of continuity and Laplace equation, Metrices and Jacobians, Stretched grid, Compressed grid, Adaptive grids, Body fitted coordinate system, Grid generation in irregular geometry, Modern development in grid generation.

Unit 5: Finite volume method

Finite Volume methods of Discretization-Central differencing scheme, Upwind scheme, hybrid scheme; One dimensional conduction problems, One dimensional convection problems, One-dimensional convection and diffusion problem with different boundary conditions, Steady state heat conduction problems, Transient heat conduction problems.

References

1. Anderson J.D., "Computational Fluid dynamics", McGraw Hill Int., New York, 2010.
2. Versteeg H.K., and Malalasekera W., "An introduction to computational fluid dynamics, The finite volume method", Longman, 2007.
3. Suhas.V. Patankar, "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2009.
4. Muralidhar.K, and Sundararajan.T, "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, Second Edition, 2008.
5. Ghoshdasdidar. P.S, "Computer simulation of fluid flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.
6. Anil W. Date, "Introduction to computational fluid dynamics", Cambridge University Press, Cambridge, 2009.

Course outcomes

At the end of this course, students will demonstrate the ability to

CO1: Learn the formulation of governing equations for fluid flow and their mathematical behavior.
CO2: Learn various discretization techniques.
CO3: Gain knowledge of different techniques to solve numerical equations related to fluid dynamics.
CO4: Learn to develop various types of grids to solve the problem.
CO5: Study the finite volume approach to discretize the governing equations.

Thermal turbomachinery

EME – 455 L T P: 3 0 0

Course objective

The course aims to teach students about the principles of working of various turbo machines. Constructional details will also be studied in some detail.

Particulars

Unit 1: Basic concepts of Thermal turbo machines

Brief history of turbo machinery, introduction to blowers, pumps, compressors, steam &gas turbines, turbojet, Review of laws of thermodynamics & SFEE in reference to turbomachinery, Energy transfer in turbo machines, Euler's equation, Definition of various efficiencies, Preheat factor, Reheat factor, Blade classification, Blade terminology, Cascade testing, Velocity diagrams for axial and radial turbomachinery and pumps.

Unit 2: Centrifugal compressors and Axial flow compressors

Centrifugal compressors: Principle of operation, work done and pressure rise, Velocity diagram for centrifugal compressor, Slip factor, Stage pressure rise, Loading coefficient, Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guide vanes, characteristic curves.

Axial Flow Compressors: Principle of operation and working, Energy transfer, Velocity diagram for axial compressor, Factors affecting stage pressure ratio, Blockage in compressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance, characteristic curves.

Unit 3: Axial flow turbines

Elementary theory of axial flow turbine, Energy transfer, Velocity diagram, Types of blades, Vortex theory, Choice of blade profile, pitch and chord, Estimation of stage performance, Characteristic curves.

Unit 4: Steam Turbines, Pumps and Radial flow Turbines

Steam turbines: Constructional details, working of steam turbine.

Pumps: Pumps, main components, indicator diagram and modification due to piston acceleration, performance and characteristics, axial flow pumps.

Radial flow turbines: Single velocity triangle Enthalpy- Entropy diagram, State losses, performance, Characteristics.

Unit 5: Gas Turbines

Gas Turbine Starting & Control Systems: Starting ignition system, combustion system types, safety limits & control.

Turbine Blade coding: Cooling techniques, types Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials.

References

1. Yahya.S.M, “Turbines, Fans and Compressors”, 3rd Edition, Tata McGraw Hill Publications, 2010.
2. Seppo A. Korpela., “Priniciple of Turbomachinery”, John Wiley and Sons Ltd, 2012.
3. Fundamentals of Turbomachinery by Venkanna, PHI, India.
4. Gas Turbine- Ganeshan, Tata Mc Graw Hill TME.
5. Gopalakrishnan.G, PrithviRaj.D, “Treatise on Turbomachines”, 1st Edition, Chennai, SciTech Publications, 2006.
6. Dixon.S.L, “Fluid mechanics and Thermodynamics of Turbomachinery”, 5th edition, Elsevier Butterworth Heinemann, 2005.

Course outcomes

At the end of this course, students will demonstrate the ability to

CO1: Learn about velocity triangles of turbo machines for the purpose of analyzing their flow aspects.

CO2: Gain knowledge of design and working of centrifugal compressors and axial flow compressors.

CO3: Familiarize students about working of axial flow turbines including their characteristic curves.

CO4: Learn about working principles of steam turbines, pumps and radial flow turbines.

CO5: Learn about control system and blade coding system of gas turbines.

Total quality management and reliability engineering

EME – 461 L T P: 3 0 0

Course objective

To provide knowledge and understanding about the Total Quality Management (TQM), its concepts, tools and techniques, and to understand the reliability of different systems.

Particulars

Unit 1: Basic concepts

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

Unit 2: TQM principles

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Unit 3: TQM basic tools and techniques

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types. TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Unit 4: Quality systems

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Unit 5: Reliability

Introduction and definition about reliability, Probabilistic nature of failures, Mean failure rate and Mean time between failures (MTBF) of component/system: Problems, Hazard rate and Hazard models: Problems, Weibull model for reliability of components/systems, Reliability of components in

Series configuration, Reliability of components in Parallel configuration, Redundant and Mixed configurations, System reliability improvement, Case studies in reliability of system.

References

1. Joel E. Ross, Susan Perry, “Total Quality Management: Text, Cases, and Readings”,, CRC Press, 3rd Edition, 1999.
2. Srinath, L. S., “Reliability Engineering”, East West Press, New Delhi, 4thEdition 1995.
3. Besterfield D. H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
4. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
5. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
6. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
7. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
8. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.
9. Poornima M charantimath, “Total Quality Management”, Pearson Education, 2nd Edition, 2011.
10. Balagurusamy, E., “Reliability Engineering”, Tata Mc-Graw Hill publishing Co., New Delhi,1984.

Course outcomes

At the end of this course

CO1: Students will be able to gain knowledge and understanding of the philosophies which have enabled the development of organizational quality improvement programs, use of control chart for quality assessment and some parameters of quality management such as quality in design, quality in manufacturing and quality in procurement.

CO2: Students will be able to recognize the contributions of world’s leading experts on quality management and through this, develop the intellectual skills.

CO3: Students will be able to understand the importance of process knowledge and process control and understand how staff, customers and stakeholders are part of the success of an organization.

CO4: Students will be able to understand the scope of quality management be aware of the need to think differently in an organization and develop a glossary of items which relate to the concepts of quality.

CO5: Students will be able to apply the concept of reliability.

Supply chain management

EME – 462 L T P: 3 0 0

Course objective

This course aims to provide an introduction industry demand. Our Supply Chain Management program will prepare you to: Understand fundamental supply chain management concepts. Apply knowledge to evaluate and manage an effective supply chain.

Particulars

Unit 1

Introduction: Understanding supply chain, supply chain performance; supply chain drivers and obstacles.

Unit 2

Planning Demand and Supply in a Supply Chain: Demand forecasting in supply chain, aggregate planning in supply chain, planning supply and demand; managing predictable variability, Economic Order Quantity Models, Reorder Point Models, Multi-echelon Inventory Systems.

Unit 3

Planning and Managing inventories in a Supply Chain: Managing economies of supply chain, managing uncertainty in a supply chain, determining optimal levels of product availability.

Unit 4

Transportation, Network Design and Information Technology: Transportation aspects in a supply chain, facility Decision, Network design in a supply chain, Information technology and its use in supply chain.

Unit 5

Coordination in Supply Chain and effect of E- Business: Role of Coordination and E-business in a supply chain; financial evaluation in a supply chain.

References

1. Hopp W. J., Spearman M. L. and Irwin, "Factory Physics: Foundations of Manufacturing", McGraw-Hill Inc. New York.
2. Sridhar Tayur, Ram Ganeshan and Michael Magazine (editors), "Quantitative Models for Supply Chain Management", Kluwer Academic Publishers, UK.

3. Handfield R.B. and Nochols E.L.Jr., “Introduction to Supply Chain Management”, Prentice Hall Inc. Englewood- Cliff, New Jersey.
4. Viswanadham N. and Narahari Y., “Performance Modeling of Automated Manufacturing Systems”, Prentice Hall of India, New Delhi.
5. Viswanadham N., “Analysis of Manufacturing Enterprises”, Kluwer Academic Publishers, UK.
6. Chopra S. and Meindel P., “Supply Chain Management: Strategy, Planning, and Operation”, Prentice Hall of India, New Delhi.

Course outcomes

At the end of this course, students will be

CO1: Able to apply metrics in supply chains.
CO2: Able to define the principles of scheduling and planning in supply chain management.
CO3: Able to apply the principles of Strategic/Master planning of resource in supply chains.
CO4: Able to identify the principles of customer and supplier relationship management in supply chains.
CO5: Able to define the principles of quality and lean manufacturing.

Six sigma and applications

EME – 463 L T P: 3 0 0

Course objective

Objective of this course is to provide an exposure to well-established methods of quality assurance and management and advanced statistical methods including design of experiments.

Particulars

Unit 1: Quality Concept & Fundamentals of Statistics

Quality concepts and definition, Key concepts in quality management, Fundamentals of Total Quality Management (TQM), Cost of quality and Six Sigma, Fundamentals of statistics, Probability theory and concepts Probability rules and events, Sampling distribution and test of hypothesis.

Unit 2: Tools for TQM

Quality philosophies and standards, Tools for TQM and continuous improvement, Quality Function Deployment (QFD) and Design failure mode effects analysis (DFMEA), Quality awards, benchmarking and service quality.

Unit 3: Project Management

Complexities and examples Project management: Key decisions, Work breakdown structure, schedule development and cost estimation, Project planning and scheduling: Network, critical path method, PERT, crashing.

Unit 4: SPC and Process Capability

Basics of Statistical Process Control, Control charts for variables and attributes, Process capability: Fundamentals and measures, Quality Function Deployment (QFD) and Kano Model, Design of experiment (DOE), Experimental analysis in product realization Factorial experiment, ANOVA.

Unit 5: DMAIC, Zero defect and Six Sigma

Supply Chain Management, Taguchi Product Design Approach, Design for Manufacturing (DFM), Design for Assemble (DFA) and Reliability Analysis, Failure Mode and Effect Analysis (FMEA), Six Sigma: Strategic planning and Implementation, Introduction to software for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

References

1. Mitra, Amitava, Fundamentals of Quality Control and Improvement, Pearson ,2005.
2. Evans, J R and W M Lindsay, An Introduction to Six Sigma and Process Improvement, CENGAGE,2005.
3. Pyzdek, Thomas, The Six Sigma Handbook-Revised and Expanded, Quality America Incorporated. 2005.
4. Montgomery, D C.Design and Analysis of Experiments, 5th ed., Wiley 2007.
5. Evans, J R and W M Lindsay. Total Quality: Management, Organization and Strategy, 4th ed, CENGAGE, 2005.

Course outcomes

At the end of this course, student is able to

CO1: Understand the quality concept and statistics fundamental.

CO2: Understand the quality management tools.

CO3: Understand the aspects of project management.

CO4: Analyse and understand the process capability and statistical process control.

CO5: Understand the aspects of lean manufacturing and six sigma.

Modelling and simulation

EME – 464 L T P: 3 0 0

Course objective

On completion of this course, the students are expected to gain knowledge about modelling and analysis of various systems calculations.

Particulars

Unit 1

Introduction to Modelling: Concept of system, continuous and discrete systems; Types of models and simulation; Discrete event simulation: Time advance mechanisms, components and organization of simulation model, steps in simulation study.

Unit 2

Statistical Models in Simulation: Discrete, continuous, Poisson and empirical distributions, output data analysis for a single system, comparing alternative system configurations, statistical procedures for comparing real world observations with simulation output data, generation of arriving processes, verification and validation of simulation models.

Unit 3

Stochastic Simulation: Random number generation: Properties of random numbers, techniques of generating random numbers, generation of random variates, Monte Carlo simulation and its applications in queuing models and inventory models.

Unit 4

Simulation of Manufacturing and Material Handling Systems: Models of manufacturing systems, models of material handling systems, goals and performance measures; Issues in manufacturing and material handling simulation: Modelling downtime failures, trace driven models.

Unit 5

Case Studies on Simulation Packages: Simulation of queuing system (bank/job shop), simulation of manufacturing and material handling systems.

References

1. Banks, J., Nelson, B.L., Carson, J. S., and Nicol, D., "Discrete Event System Simulation", Pearson Education.

2. Law, A.M., and Kelton, W.D., “Simulation Modeling and Analysis”, McGraw-Hill.
3. Schwarzenbach, J., and Gill, K.F., “System Modeling and Control”, Butterworth-Heinemann.
4. Carrie, A., “Simulation of Manufacturing Systems”, John Wiley & Sons.
5. Viswanadham, N., and Narahari, Y., “Performance Modeling of Automated Manufacturing System”, Prentice-Hall of India.

Course outcomes

At the end of course, students are

CO1: Able to define basic concepts in modelling and simulation (M&S) and to classify various simulation models and give practical examples for each category.

CO2: Able to construct a model for a given set of data and motivate its validity.

CO3: Able to generate and test random number variates and apply them to develop simulation models.

CO4: Able to analyze output data produced by a model and test validity of the model.

CO5: Able to explain parallel and distributed simulation methods.

Advanced operation research

EME – 465 L T P: 3 0 0

Course objective

The course provides an overview of advance topics of OR.

Particulars

Unit 1

Introduction to OR: History, Definition, OR Models, OR Techniques and phases of implementing OR in practice.

Advance Topics in Linear Programming: Duality theory, Dual Simplex method, Revised simplex method, Sensitivity analysis.

Unit 2

Nonlinear programming: Kuhn- Tucker conditions- quadratic programming- Wolfe's algorithm.

Integer programming: Graphical representation. Gomory's cutting plane method, Solving Zero-One Problems, Branch and Bond Algorithm for Integer Programming, Travelling salesman problem, Cargo loading problem, Mixed Integer Linear Programming.

Unit 3

Dynamic Programming: Deterministic and stochastic example.

Goal Programming: Formulations Goal Programming Solutions Complexity of Simplex Algorithm.

Unit 4

Decision Theory: Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, hurwicz criterion, Decision tree.

Unit 5

Special topics: Analytic Hierarchy Process for Decision Making, Extreme Difference Method, Multi-objective Transportation Problem.

References

1. Hiller & Lieberman, Introduction to Operations Research.
2. Hira D. S. &Gupt P. K., Operations Research, S. Chand & Co. 1995.
3. Taha H. A., Operation Research, 7th Ed., Prentice Hall of India, New Delhi, 2002.

4. Wagner H. M., Principles of Operation Research with Applications to Managerial Decisions, 2nd Ed., PHI, 2010.
5. Vohra N.D, Quantitative Techniques in Management, Tata McGraw Hill, 1995.
6. Sharma J. K., Operation Research Theory and Applications, 2nd Ed., Macmillan, 2003.
7. Kasana H. S., Kumar K. D., Introductory Operations Research Theory and Applications, Springer, 2003.
8. Wilkes F. M., Elements of Operational Research, McGraw Hill Co.
9. Levin R. et.al, Quantitative approaches to Mgmt, McGraw Hill Co.
10. Richard Broson, Govindasamy & Naachimuthu, Schaum's Outline of Theory and Problems of Operations Research, II Edition, Tata McGraw Hill , 2004.
11. En R. P., Operations Research Algorithm and Applications, PHI, New Delhi.
12. Shah N. H., Gor R. M., Soni H., Operations Research, PHI, New Delhi, 2007.

Course outcomes

At the end of this course, students will be

CO1: Able to understand the basics of OR and LPP.
CO2: Able to understand and solve the nonlinear programming problems.
CO3: Able to understand dynamic and goal programming.
CO4: Able to understand decision theory.
CO5: Able to understand the advance topics in OR.

Robotics and automation

EME – 471 L T P: 3 0 0

Course objective

To impart knowledge about the engineering aspects of Robots and their applications.

Particulars

Unit 1

Introduction: Brief history, robot terminology, classification, characteristic, physical configuration, structure of industrial robot. Robot and Effectors: Types, mechanical grippers, other types of gripper, tools as end effectors, Robot/end effector interface, design consideration.

Robot Motion Analysis & Control: Introduction to manipulator kinematics, robot dynamics, manipulator dynamics, robot control, task planning.

Unit 2

Sensors: Transducers and sensors, sensors in robotics, tedile sensors, proximity and range sensors, miscellaneous sensors and sensor-based systems, use of sensors in robotics, touch sensors, force-torque sensors.

Machine Vision: Introduction, sensing and digitizing function in machine vision, image processing and analysis, vision system robotic applications.

Unit 3

Programming: Basics of robot programming, languages, commands, communications and data processing. Applications: Welding, electro-plating, painting, spraying, assembling, material handling, inspection, Future applications. Introduction to design of robot in specific applications.

Unit 4

Fundamentals of Manufacturing Automation: Basic Principles of automation, types of automated systems, degrees of automation, Automated flow lines. Automation for machining operations Design and fabrication considerations. Analysis of multi station assembly.

Automated Material Handling: components, operation, types, design of automated guided vehicles and applications. Automated storage / retrieval systems - types, basic components and applications.

Unit 5

Group Technology: Part families, part classification and coding, machine Cell design, Benefits. Computer Aided Process Planning, benefits and limitations.

Automated Inspection and Testing: Automated inspection principles and methods sensors techniques for automated inspection-techniques for automated inspection-contact and noncontact inspection methods-in process gauging, CMM's, construction, types, inspection probes, types, and applications. Machine vision, LASER Micro meter and optical inspection methods.

References

1. Mikell P. Groover, "Industrial Robotics Technology Programming and Applications", McGraw Hill Co., Singapore, 2008.
2. Deb. S.R, "Robotics technology and flexible automation", Tata McGraw Hill publishing company limited, New Delhi, 2010.
3. Klafter R.D, Chmielewski T.A and Noggins, "Robot Engineering: An Integrated Approach", Prentice Hal of India Pvt. Ltd., New Delhi, 2010.
4. Fu K.S, Gonzalez, R.C., & Lee, C.S.G., "Robotics control, sensing, vision and intelligence", McGraw Hill Book Co., Singapore, Digitized 2007.
5. Craig. J. J, "Introduction to Robotics mechanics and control", Addison- Wesley, London, 2008.

Course outcomes

At the end of course, student will able to

CO1: demonstrate the knowledge of relationship between mechanical structures of industrial robots and their operational workspace characteristics.

CO2: demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.

CO3: demonstrate an ability to solve inverse kinematics of simple robot manipulators.

CO4: apply localization and mapping aspects of mobile robotics.

CO5: demonstrate the self-learning capability.

CAD and CAM

EME – 472 L T P: 3 0 0

Course objective

To familiarize with the components of computer aided design and manufacturing.

Particulars

Unit 1

CAD Tools: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, Review of C, C++, statements such as if else for while & switch, functions, pointernotations, structure & class, concept of OOPS.

Geometric Modelling: Output primitives- Bresenham's line drawing and Mid-point circle algorithms. Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves B-splines rational curves.

Unit 2

Surface Modeling: Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

Parametric Representation Of Synthetic Surfaces: Hermite Bicubic surface, Bezier surface, B-Spline surface, COONs surface, Blending surface , Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

Geometric Modelling-3D: Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Unit 3

CAD/CAM Exchange: Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems. Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CAD Engineering applications, its importance & necessity. Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis.

Unit 4

NC Part Programming: Manual (word address format) programming. Examples Drilling and Milling.

Unit 5

System Devices: Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolators: Principle, Digital Differential Analysers. Linear interpolator, circulator Interpolator and its software interpolator. Control of NC Systems- Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control

References

1. Ibrahim Zeid, "Mastering CAD /CAM (Sie)", Tata McGraw-Hill, New Delhi, 2010
2. P.N. Rao, "CAD/CAM Principles and Application",3rd Edition, Tata McGraw-Hill, New Delhi, 2012
3. Chris Mcmahon and Jimmie Browne, "CAD/CAM", AdisionWesly, NewYork, 2000
4. Olek C. Zienkiewicz, Robert L. Taylor, "The Finite Element Method for Solid and Structural Mechanics", Butterworth -Heinemann Ltd, 6th Revised Edition 2005.
5. Newman and Sproul R.F, "Principles of interactive computer graphics", Tata McGraw-Hill, New Delhi, 2007.
6. Mikell P. Groover, Emory W. Zimmers Jr., "CAD/CAM: Computer Aided Design and Manufacturing",
7. Prentice Hall of India Private Ltd., New Delhi, 2008.
8. Donald Hearn and Pauline Baker M, "Computer Graphics C version ", 2nd Edition, Pearson education, 1997
9. Mikell P. Groover, "Automation, Production systems and computer integrated manufacturing", Prentice Hall of India Private Ltd., New Delhi, 2008.
10. YoranKoren, "Computer Control of Manufacturing Systems" Tata McGraw-Hill Edition 2005
11. M.S.Sehrawat, J.S.Narang "CNC Machines" Dhanpat Rai & Company Private Limited, New Delhi,1999
12. James Madison, "CNC Machining Hand Book", Industrial Press Inc., New York,1996.
13. Barry Hawkes, "The CAD/CAM Process", Wheeler Publishing, 1992.
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15. Radhakrishnan. P, Subramanyan. S and Raju. V, "CAD/CAM/CIM", New Age International Publishers, 2000.
16. Rao. P.N, Tewari. N.K and Kundra. T.K, "Computer Aided Manufacturing", Tata McGraw-Hill, New Delhi, 2008

Course outcomes

At the end of this course, students will be able

CO1: To Understand the basic fundamentals of computer aided design and manufacturing.
CO2: To learn 2D and 3D transformations of the basic entities like line, circle and ellipse etc.
CO3: To understand the geometric modelling techniques like solid modelling, surface modelling, feature based modelling etc. and to visualize how components before its manufacturing or fabrication.
CO4: To learn the part programming and use G and M codes efficiently, to learn importance of group technology, computer aided process planning or computer aided quality control.
CO5: To learn the overall configuration and elements of CIM system.

Computer integrated manufacturing

EME – 473 L T P: 3 0 0

Course objective

To impart knowledge on group technology, Flexible manufacturing system and its implementation.

Particulars

Unit 1

Introduction: Introduction to manufacturing system and their analysis. CIM-Basic concepts, Evolution of CIM Manufacturing Automation protocol.

Unit 2

Numerical Control: Introduction- Fundamentals of N. C. Technology, Computer Numerical Controls, Distributed Numerical Control, Application of N.C., Engineering analysis of NC positioning system, N.C. part programming, part programming with APT.

Unit 3

Group Technology: Introduction, Basic layout, process layout, product layout, comparison. Designing process layout. Coding system. Flexible manufacturing System: Introduction, elements of FMS, Cell technology and FMS, optimization of FMS.

Unit 4

Material Handling & Storage: Overview of material handling equipment, automated material handling equipment- A.G.V, features, function, types and safety consideration of AGV, Conveyers. Analysis of material storage system: ASRS and caroused storage, Analysis of storage system.

Unit 5

Manufacturing Support Functions: Introduction to computer aided process planning (CAPP), Just-in-time and Lean Production, MRP I&II, Concurrent engineering.

References

1. Groover M P, Automation, Production Systems, and Computer-Integrated Manufacturing, PHI Learning Pvt. Ltd.
2. Alavudeen A &Venkateshwara N., Computer Integrated Manufacturing, PHI Learning Pvt. Ltd.

3. Cornelius, L.T, “Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes”, World Scientific Publishing Company.
4. Chang, T.-C., Wys k, R. A. and Wang, H.-P. “Computer Aided Manufacturing”, 3rd Ed., Prentice Hall.
5. Rao, P. N., Tiwari, N. K. and Kundra, T.K., “Computer Aided Manufacturing”, Tata McGraw Hill.
6. Sava, M. and Pusztai, J., “Computer Numerical Control Programming”, Prentice Hall.

Course outcomes

At the end of course, student will able to

CO1: Understand the CIM concept and types of manufacturing system.

CO2: Understand and can apply the numerical control technology.

CO3: Identify the Knowledge of group technology (GT) and FMS.

CO4: Identify the ways to improve material handling its storage.

CO5: Understand the concept of lean manufacturing.

Micro-electro mechanical systems

EME – 474 L T P: 3 0 0

Course objective

To educate on the rudiments of micro fabrication techniques and to introduce different types of sensors and actuators. Moreover, the micro systems design are also explored.

Particulars

Unit 1

Overview of MEMS and Microsystems: MEMS and Microsystems, Microsystems and Microelectronics, Microsystems and miniaturization, Application of Microsystem. Working Principles of Microsystem: Microsensors- Acoustic wave sensors, biomedical sensors and bio sensors, chemical sensors, optical sensors, pressure sensors, thermal sensors. Micro actuation- actuation using thermal forces, actuation using shape-memory alloys, actuation using piezoelectric crystals, actuation using electrostatic forces. MEMS and Micro actuators- Micro grippers, micromotors, microvalves, micropumps, micro accelerometers, Microfluidics.

Unit 2

Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, silicon as a substrate material- the ideal substrate for MEMS, single crystal silicon and wafers, crystal structure, the miller indices, mechanical properties of silicon. Silicon compounds- silicon dioxide, silicon carbide, silicon nitride, polycrystalline silicon piezo resistors, Gallium arsenide, polymers for MEMS and Microsystems, conductive polymer, the Langmuir-Blodgett film, packaging materials.

Unit 3

Microsystems Fabrication Processes: Photolithography-photo resists and application, light sources, photo resist development, photo resist removal and post baking. Ion implantation, diffusion, oxidation-thermal oxidation, silicon dioxide, thermal oxidation rates, oxide thickness by color; Chemical vapor deposition- working principle of CVD, chemical reaction s in CVD, rate of deposition, enhanced deposition; physical vapor deposition- sputtering; Deposition by epitaxy; Etching- Chemical etching, plasma etching

Unit 4

Micro manufacturing: Bulk Manufacturing- overview of etching, isotropic and anisotropic etching, wet etchants; etch stop, dry etching, and comparison of wet versus dry etching. Surface micromachining- general description, process in general, mechanical problems associated with surface micromachining. The LIGA Process- general description of the LIGA process, materials for substrates and photo resists, electroplating. The SLIGA process.

Unit 5

Microsystems Design: Design Considerations- Design constraints, selection of materials, selection of manufacturing processes, selection of signal transduction, electromechanical system and packaging Process design- photolithography, thin film fabrications, geometry shaping, Mechanical design- thermo mechanical loading, thermo mechanical stress analysis, dynamic analysis, interfacial fracture analysis. Design of micro fluidic network systems- fluid resistance in microchannels, capillary electrophoresis network systems, mathematical modeling of capillary electrophoresis network systems

References

1. MEMS & Microsystems Design and Manufacture by Tai-Ran Hsu Tata McGraw-Hill
2. Pelesko, J.A., and Bernstein D.H., "Modeling MEMS and NEMS", 1st Ed., Chapman and Hall CRC
3. Beeby, S., Ensell, G., Kraft, M., and White N., "MEMS Mechanical Sensors", 1st Ed., Artech House, Inc.
4. Bao, M., "Analysis and Design Principles of MEMS Devices", 1st Ed., Elsevier B.V.
5. Mohamed Gad-el-Hak (Editor), "The MEMS Handbook", 2nd Ed., Taylor and Francis.
6. Adams, T.M., and Layton, R.A., "Introductory MEMS: Fabrication and Applications", Springer New York.

Course outcomes

At the end of course, student will able to

CO1: describe new applications and directions of modern engineering.

CO2: illustrate the techniques for building microdevices in silicon, polymer, metal and other materials.

CO3: demonstrate the physical, chemical, biological, and engineering principles involved in the design and operation of current and future microdevices.

CO4: critically analyze microsystems technology for technical feasibility as well as practicality.

CO5: outline the limitations and current challenges in microsystems technology.

Non-destructive testing's

EME – 475 L T P: 3 0 0

Course objective

To understand the testing methods of materials without damage of machine parts/structure.

Particulars

Unit 1

Introduction: Scope and advantages of N.D.T. some common NDT methods used since ages – visual inspection, Ringing test, and chalk – test (oil-whiting test) their effectiveness in detecting surface cracks, bond strength and surface defects.

Unit 2

Common NDT methods: Dye – penetrant tests – principle, scope, equipment and techniques. Zyglo testing. Magnetic Particle Tests- Scope of test, Principle equipment and technique. DC And AC magnetization, use of day and wet powders magnaglow testing. Interpretations of results.

Unit 3

Radiographic Methods: X-ray radiography – principle, equipment and methodology. Interpretation of radiographs, Limitations Gamma ray radiography. Principle, equipment, source of radioactive material and technique. Precautions against radiation hazards, Advantage over x-ray radiography methods.

Unit 4

Ultrasonic Testing Methods: Introduction Principle of Operation – piezoelectricity. Ultrasonic probes, cathode ray oscilloscope techniques and advantages limitation and typical applications.

Unit 5

Testing of castings, forgings &weldments Application of NDT methods in inspection of castings, forging sand welded structures with illustrative examples. Case studies. Sample-testing in the lab.

References

1. Baldev Raj, Practical Non – Destructive Testing, Narosa Publishing House ,1997.
2. Hull B. and V.John, Non-Destructive Testing, Macmillan,1988.
3. Krautkramer, Josef and Hebert Krautkramer, Ultrasonic Testing of Materials, Springer Verlag, 1990.

Course outcomes

At the end of this course, students will demonstrate the

CO1: Ability to apply scientific and technical knowledge to the field of non-destructive testing.

CO2: Ability to use the relevant non-destructive testing methods for various engineering practice.

CO3: Ability to recognize and achieve high levels of professionalism in their work.

CO4: Ability of recognition of the need and ability to engage in lifelong learning, thought process and development.

CO5: Ability to monitor, improve or control manufacturing processes.

Open Elective Courses offered by ME:

Sr. No.	Course Code	Course Title
1.	TOE-70	Facility planning and value engineering
2.	TOE-71	Advanced engineering materials
3.	TOE-72	Quality management
4.	TOE-73	Non-conventional energy resources
5.	TOE-74	Reliability and maintenance engineering
6.	TOE-75	Entrepreneurship development
7.	TOE-76	Atomic modelling and simulation
8.	TOE-77	Computational methods in engineering

Facility planning and value engineering

TOE – 70 L T P: 3 0 0

Course objective

Provide students with the ability to apply plant layout design procedure to design a new facility and ability to select a suitable location for new facility with the use of different techniques.

Particulars

Unit 1

Plant layout, material handling and their interrelationship, objectives of a good plant layout, principles of a good layout, classical types of layouts, special types and practical layouts. Factors affecting plant layout: man, material, machine, movement, waiting, service, building and change, features and considerations of each factor, procedure of plant layout, data collection for layout design, layout visualization using templates and 3D models.

Unit 2

Various theories/models of site location like equal weights, variable weights, weight cum rating, composite model and Bridgemannn's model, Weber index, and various subjective techniques, evaluation of layout, computerized layout, flowcharts of various Programmes like CRAFT, ALDEP AND CORELAP.

Unit 3

Principles, factors affecting material handling, objectives, material handling equation, selection of material handling systems and equipments, cranes, conveyors, hoists and industrial trucks, installation of new facilities in the existing setup using median model and gravity model.

Unit 4

Methodology of value engineering, unnecessary costs, use and prestige value, estimation of product quality or performance. Types of functions functional cost and functional worth. Effect of value improvement on profitability, tests for poor value.

Unit 5

Aims and objectives of value engineering, systematic approach. Value engineering, job plan- study of various phases of the job plan. Selection of projects for value analysis. Primary and secondary functions work and sell functions, determining and evaluating functions, assigning equivalence, function-cost matrix evaluation. Function (FAST). Reporting, implementation & follow up.

References

1. Tompkins, J. A., White, J. A., Bozer, Y.A. and Tanchoco, J.M.A., Facilities Planning, John Wiley (2003).
2. Muther, R., Practical Plant Layout, McGraw Hill Book Company (1995).
3. Anil Kumar Mukhopadhyaya, “Value Engineering: Concepts Techniques and applications”, SAGE Publications 2010.

Course outcomes

At the end of this course, student is able

CO1: To select a suitable location amongst the available locations for setting up a new facility.

CO2: To decide about the particular production process flow strategy.

CO3: To design a layout for the new facility to suit the company’s production process structure.

CO4: To select proper type of equipment for storage and movement of material.

CO5: To create the value engineering team and discuss the value engineering case studies.

Advanced engineering materials

TOE-71 L T P: 3 0 0

Course objective

To provide an overview of advanced engineering materials and their applications.

Particulars

Unit 1: Classification and Selection of Materials

Classification of materials, Properties required in Engineering materials. Criteria of selection of materials, Requirements / needs of advance materials.

Unit 2: Non Metallic Materials

Classification of non metallic materials, Rubber : Properties, processing and applications, Plastics : Thermosetting and Thermoplastics, Applications and properties. Ceramics : Properties and applications. Adhesives: Properties and applications, Optical fibers : Properties and applications, Composites : Properties and applications.

Unit 3: High Strength Materials

Methods of strengthening of alloys, Materials available for high strength applications, Properties required for high strength materials, Applications of high strength materials.

Unit 4: Low & High Temperature Materials

Properties required for low temperature applications, Materials available for low temperature applications, Requirements of materials for high temperature applications, Materials available for high temperature applications, Applications of low and high temperature materials.

Unit 5: Nanomaterials

Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials.

References

1. Vlack V. Elements of Material Science And Engineering, 2nd ed., Pearson Education India, 2014.
2. Kodgire V.D. ,Material science and Metallurgy, Everest Publishing House.

3. Askeland D. R. and Phule P. P., The Science and Engineering of Materials, 3rd ed., Thomson Publication,1996.

Course outcomes

At the end of this course, the student is able to

CO1: Differentiate the metallic and non-metallic materials.

CO2: Understand the preparation of high strength materials.

CO3: Suggest materials for low and high temperature applications.

CO4: Integrate knowledge of different types of advanced engineering materials.

CO5: Analyse problem and find appropriate solution for use of materials.

Quality management

TOE – 72 L T P: 3 0 0

Course objective

The objectives of this course is to introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

Particulars

Unit 1

Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type.

Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

Unit 2

Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program.

Human Factor in quality: Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.

Unit 3

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts.

Attributes of Control Chart: Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.

Unit 4

Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit 5

ISO-9000 and its concept of Quality Management ISO 9000 series, Taguchi method, JIT in some details.

References

1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.
2. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992.

Course outcomes

At the end of this course, student will demonstrate the ability to

CO1: Explain the different meanings of the quality concept and its influence.

CO2: Recognize the contributions of world's leading experts on quality management and through this, develop the intellectual skills.

CO3: Understand the importance of control chart.

CO4: Understand the concept of reliability.

CO5: To apply the concept of Quality Management ISO 9000 series and Taguchi method.

Non-conventional energy resources

TOE-73 L T P: 3 0 0

Course objective

To impart the knowledge of basics of different non-conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of non-conventional energy sources particularly when the conventional sources are scarce in nature.

Particulars

Unit 1

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

Unit 2

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

Unit 3

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

Unit 4

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

Unit 5

Bio-mass: Availability of bio-mass and its conversion theory.

Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

References

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.

Course outcomes

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

CO1: Study various non-conventional sources of energy like wind, biomass etc and its applications in remote areas of the country.

CO2: Understand the working principal of solar thermal technology.

CO3: Understand other direct energy conversion systems like magneto-hydrodynamics, thermoelectric and fuel cells.

CO4: Understand the working principal of wind energy technology.

CO5: Understand the biomass use for various purpose and working principal of Waste Recycling Plants.

Reliability and maintenance engineering

TOE-74 L T P: 3 0 0

Course objective

To apply the concept to reliability, concept of maintainability, concept of replacement planning & to apply the concept of maintenance management.

Particulars

Unit 1

Reliability: Introduction and definition about reliability, Probabilistic nature of failures. Mean failure rate and meantime between failures (MTBF) of component/system: Problems Hazard rate and Hazard models Problems Weibull model for reliability of components/systems. Reliability of components in Series configuration. Reliability of components in Parallel configuration. Redundant and Mixed configurations System reliability improvement. Case studies in reliability of system.

Unit 2

Maintainability: Introduction and definition of maintainability, availability. Choice of maintenance strategy. Factors contributing to Mean Down Time (MDT): Problems Mean time to repair (MTTR): Problems Fault diagnosis, and routine testing forum revealed faults. Factors contributing to Mean Maintenance Time (MMT): Problems Types of maintenance Economics of maintenance.

Unit 3

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.

Unit 4

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure. Break down maintenance planning.

Unit 5

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

References

1. Industrial Safety Handbook: William Handley.
2. Introduction to Safety Engineering: David S Gloss & Miriam Gayle Wardle.
3. Industrial Safety: Roland P Blake.
4. Industrial Hazard & Safety Handbook: Ralph King & John Magid.

Course outcomes

At the end of this course, the student is

CO1: Able to explain the concept to reliability.

CO2: Able to explain the concept of maintainability of a system.

CO3: Able to explain the concept of maintenance strategies.

CO4: Able to explain the concept of replacement planning.

CO5: Able to explain the concept of maintenance management.

Entrepreneurship development

TOE-75 L T P: 3 0 0

Course objective

To motivate the development of new entrepreneurs for new India.

Particulars

Unit 1

Foundation of Entrepreneurship Development: Concept and need of entrepreneurship; Characteristics and Types of Entrepreneurship; Entrepreneurship as a career; Entrepreneurship as a style of Management; The changing role of the entrepreneur; Entrepreneurial traits, factors affecting entrepreneur.

Unit 2

Theories of Entrepreneurship: Influences on entrepreneurship development; External influences on entrepreneurship development; Socio-cultural, Political, economical, personal entrepreneurial success and failure: reasons and remedies; Women entrepreneurs: Challenges and achievements of women entrepreneurs.

Unit 3

Business Planning Process: The business plan as an entrepreneurial tool; Elements of business planning; Objectives; Market analysis; development of Product/ idea; Marketing, Finance, Organization and management; Ownership; Critical risk contingencies of the proposal; Scheduling and milestones.

Unit 4

Project Planning for Entrepreneurs: Technical, Financial, Marketing, Personnel, and management feasibility reports; Financial schemes offered by various financial institution, Like Commercial Banks, IDBI, ICICI, SIDBI, SFCs, Foreign currency, Financing; Estimation of Financial requirements.

Unit 5

Entrepreneurship Development and Government: Role of Central Government and State Government in promoting entrepreneurship with various incentives, subsidies, grants, programmed, schemes and challenges. Government initiatives and inclusive entrepreneurial Growth.

References

1. Khanna, S.S., Entrepreneurial Development, S. Chand, New Delhi.
2. Hisrich D. Robert, Michael P. Peters, Dean A. Sheperd, Entrepreneurship, McGraw-Hill, 6th ed.
3. Zimmerer W. Thomas, Norman M. Scarborough, Essentials of Entrepreneurship and Small Business Management, PHI, 4th ed.
4. Holt H. David, Entrepreneurship: New Venture Creation, Prentice- Hall of India, New Delhi, Latest edition.
5. Kuratko, F. Donald, Richard M. Hodgetts, Entrepreneurship: Theory, Process, Practice, Thomson, 7th ed.
6. Desai, Vasant, Dynamics of Entrepreneurship: New Venture Creation, Prentice-Hall of India, New Delhi, Latest edition.
7. Patel, V.G., The Seven Business Crises and How to Beat Them, Tata McGraw-Hill, New Delhi, 1995.
8. Roberts, Edward B.(ed.), Innovation: Driving Product, Process, and Market Change, San Francisco: Jossey Bass, 2002.
9. SIDBI Report on Small Scale Industries Sector, Latest edition.

Course outcomes

At the end of course, students will able to understand

CO1: the basic requirements for entrepreneurship.

CO2: the influence of entrepreneurship on socio-cultural, political and economical regime.

CO3: the entrepreneurial tool.

CO4: the aspects of project planning for entrepreneurs.

CO5: the schemes raised by central and state Government for promoting entrepreneurship.

Atomic modelling and simulation

TOE-76 L T P: 3 0 0

Course objective

The objective of this course is to introduce large scale atomistic modeling techniques and highlight its importance for solving problems in modern engineering sciences. We demonstrate how atomistic modeling can be used to understand how materials fail under extreme loading, involving unfolding of proteins and propagation of cracks.

Particulars

Unit 1: Introduction to Mechanics of Materials

Basic concepts of mechanics: stress and stain, deformation, strength and fracture. Fundamentals of molecular simulations – Ab-initio methods, Hartree-Fock theory, Density functional theory.

Unit 2: Introduction to Classical Molecular Dynamics

Introduction to the molecular dynamics and molecular mechanics. Elementary concepts of temperature, ensembles and fluctuations, partition function, ensemble averaging, ergodicity, force field integration algorithms, periodic box and minimum image convention, long range forces, non-bonded interactions.

Unit 3: Atomic Modeling

Mechanics of ductile materials, Caunchy Born rule – calculation of elastic properties of atomic lattices. Modeling of fracture of a nanocrystal of copper. Simulation codes in detail. Size effect in deformation of materials.

Unit 4: Nano mechanics of Materials

Force and motion on extremely tiny areas of synthetic and biological material and structures. Mechanical properties relation to chemistry, physics and quantum mechanics.

Unit 5: Introduction to LAMMPS and GROMACS

Introduction to modeling and simulation, Molecular dynamics methodology in LAMMPS and GROMACS. Molecular dynamics simulation for polymer and advanced applications.

References

1. Daan Frenkel and Berend Smit, Understanding Molecular Simulation: From Algorithms to Applications, 2e, Academic Press, New York, 2002.
2. K. Binder, The Monte-Carlo Method in Condensed Matter Physics, Berlin: Springer-verlag, 1992.
3. M.P. Allen and D.J. Tildesley, Computer Simulation of Liquids, Clarendon Press, Oxford, 1987.
4. Andrew R. Leach, Molecular modelling: principles and applications, 2e, Pearson, New Delhi, 2001.
5. D. A. McQuarrie, Statistical Mechanics, Harper and Row, New York, 1976.

Course outcomes

At the end of this course, student is able to

CO1: Understand the importance of mechanics of materials at atomistic scale.
CO2: get the knowledge of classical molecular mechanics and molecular dynamics.
CO3: Get insights into the atomic modeling and thereby interpret the property relationships.
CO4: Get a hands-on introduction to engineering materials and biomaterials property at quantum level.
CO5: Understand the basics of famous software like LAMMPS and GROMACS.

Computational Methods in Engineering

TOE – 77 L T P: 3 0 0

Course objective

The objective of this course is to give an overview of computational techniques of interest to process engineer. It introduces the numerical methods to solve various kinds of equation that students encounter in the field of engineering.

Particulars

Unit 1: Introduction

Motivation and applications, Computation and error analysis, Linear systems and equations- matrix representation, Cramer's rule, Gauss Elimination, matrix inversion, LU decomposition, iterative methods, relaxation methods, Eigen values – their physical interpretation.

Unit 2: Conservation Laws and Model Equations

Conservation Laws, Euler Equations, Navier-Strokes Equations, linear convection and diffusion equation, Linear Hyperbolic systems, Differential form and solution in wave space.

Unit 3: Numerical Approximation Methods

Finite Difference Approximations: Space derivative approximations, finite difference operators, construction of differencing schemes of any order, Fourier Error analysis.

Finite Element Approximations: Approximation of Elliptic problems, Piece wise Polynomial Approximation, Evolution Problems

Finite Volume Methods: Model equation in integral form, multidimensional examples.

Unit 4: Ordinary and Partial Differential Equations

ODE's Initial value problem: Euler's methods, Runge-Kutta methods, Predictor-corrector methods, Adaptive step size. Introduction to partial differential equations.

Unit 5: Numerical Differentiation and Integration

Numerical differentiation, higher order formulae, Integral equations- Trapezoidal rules, Simpson's rules, Quadrature.

References

1. Gupta S.K. (1995) Numerical Methods for engineers, New Age Iternational.

2. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineering, 5th edition , Mc Graw Hill.
3. S. P. Venkateshan, Prasanna Swaminathan, Computational Methods in Engineering, Ane Books.
4. Joe D Hoffman, Numerical Methods for Engineers and Scientists, Second Edition, Marcel Dekker (2001).
5. Gilbert Strang, Computational Science and Engineering, Wellesley-Cambridge Press.

Course outcomes

At the end of this course, student is able to

CO1: Understand the importance of mathematical modeling and be able to develop mathematical models of physical phenomena.

CO2: Get the knowledge of solving and applying important engineering equations to different models.

CO3: Able to implement numerical approximations in various problems.

CO4: Able to solve ordinary and partial differential equation analytically and numerically.

CO5: Will learn to solve integral equation analytically as well as numerically.