B. E. MECHANICAL ENGINEERING (PART TIME)

COURSE OF STUDY AND SCHEME OF EXAMINATIONS
(2018 and onwards)

SEMESTER I

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
THEORY										
18PBEME101	Engineering Mathematics I	1	1,2	3	1	0	4	40	60	100
18PBEME102	Engineering Mechanics	1	1,2,4	3	0	0	3	40	60	100
18PBEME103	Basic Electrical and Electronics Engineering	1	1	3	0	0	3	40	60	100
18PBEME104	Manufacturing Technology	1	4	3	0	0	3	40	60	100
PRACTICAL										
18PBEME111	Computer Aided Design Laboratory	1,3	3,4	0	0	3	2	40	60	100
TOTAL				**16**			**15**	**200**	**300**	**500**

SEMESTER II

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
THEORY										
18PBEME201	Engineering Mathematics II	1	1,2	3	1	0	4	40	60	100
18PBEME202	Strength of Materials	1	1,2,4	3	0	0	3	40	60	100
18PBEME203	Kinematics of Machinery	1	1,2,4	3	0	0	3	40	60	100
18PBEME204	Fundamentals of Computer Programming	2	3,4	3	0	0	3	40	60	100
PRACTICAL										
18PBEME211	Strength of Materials Laboratory	1,3	3,4	0	0	3	2	40	60	100
TOTAL				**16**			**15**	**200**	**300**	**500**

SEMESTER III

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
THEORY										
18PBEME301	Applied Thermodynamics	1	1,2,3	3	1	0	4	40	60	100
18PBEME302	Engineering Materials and Metallurgy	1	3,4,8	3	0	0	3	40	60	100
18PBEME303	Industrial Metrology and Measurements	1	3,4	3	0	0	3	40	60	100
18PBEME304	Fluid Mechanics and Machinery	1	1,2,4	3	0	0	3	40	60	100
PRACTICAL										
18PBEME311	Fluid Mechanics and Metrology Laboratory	1,3	3,4	0	0	3	2	40	60	100
TOTAL				**16**			**15**	**200**	**300**	**500**

SEMESTER IV

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
THEORY										
18PBEME401	Mechatronics	1,3	4,7	3	0	0	3	40	60	100
18PBEME402	Heat and Mass Transfer	1	1,2,3	3	1	0	4	40	60	100
18PBEME403	Dynamics of Machinery	1	1,2,4	3	0	0	3	40	60	100
18PBEME404	Environmental Sciences	1,3	7,8	3	0	0	3	40	60	100
PRACTICAL										
18PBEME411	Thermal Engineering Laboratory	1,3	3,4	0	0	3	2	40	60	100
TOTAL				**16**			**15**	**200**	**300**	**500**

SEMESTER V

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
THEORY										
18PBEME501	Operations Research	1	6,7,9, 10	3	0	0	3	40	60	100
18PBEME502	Design of Machine Elements	1	2,3,4	3	1	0	4	40	60	100
18PBEME503	Computer Integrated Manufacturing	1,3	7,9,1 0	3	0	0	3	40	60	100
18PBEMEE-	Professional Elective - I			3	0	0	3	40	60	100
PRACTICAL										
18PBEME511	Computer Aided Manufacturing Laboratory	1,3	3,4	0	0	3	2	40	60	100
TOTAL				**16**			**15**	**200**	**300**	**500**

SEMESTER VI

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
THEORY										
18PBEME601	Engineering Economics and Financial Management	2	5,6,10	3	0	0	3	40	60	100
18PBEME602	Smart Manufacturing	1,2	7,9	3	0	0	3	40	60	100
18PBEME603	Entrepreneurship Development	2,3	6,10,1 1	3	0	0	3	40	60	100
18PBEMEE-	Professional Elective - II			3	0	0	3	40	60	100
PRACTICAL										
18PBEME611	Computer Aided Analysis Laboratory	1,3	3,4	0	0	3	2	40	60	100
TOTAL				**15**			**14**	**200**	**300**	**500**

SEMESTER VII

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
THEORY										
18PBEME701	Total Quality Management	2,3	5,6,10	3	0	0	3	40	60	100
18PBEMEE-	Professional Elective - III			3	0	0	3	40	60	100
18PBEMEE-	Professional Elective - IV			3	0	0	3	40	60	100
PRACTICAL										
18PBEME791	Project Work and Viva Voce	1,2,3	1,3,4,9	0	0	9	6	40	60	100
TOTAL				**18**			**15**	**160**	**240**	**400**

PROFESSIONAL ELECTIVES

DESIGN ENGINEERING

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
18PBEMEED01	Design of Transmission Systems	1	2,3,4	3	0	0	3	40	60	100
18PBEMEED02	Design of Jigs, Fixtures and Press Tools	1,3	2,3,4	3	0	0	3	40	60	100
18PBEMEED03	Design for Manufacture and Assembly	1,3	2,3,4	3	0	0	3	40	60	100
18PBEMEED04	Hydraulics and Pneumatics Power Control	1,3	4,7	3	0	0	3	40	60	100
18PBEMEED05	Design and Analysis of Experiments	1	2,3,4	3	0	0	3	40	60	100
18PBEMEED06	Advanced Strength of Materials	1	2,3,4	3	0	0	3	40	60	100
18PBEMEED07	Finite Element Methods	1	2,3,4	3	0	0	3	40	60	100
18PBEMEED08	Machine Tool Design	1,3	2,3,4	3	0	0	3	40	60	100
18PBEMEED09	Design of Mechatronic Systems	1,3	3,4,7	3	0	0	3	40	60	100
18PBEMEED10	Tribology	1	2,3,4	3	0	0	3	40	60	100

PRODUCTION ENGINEERING

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
18PBEMEEP01	Advanced Manufacturing Processes	1	4,7	3	0	0	3	40	60	100
18PBEMEEP02	Microprocessor in Automation	1,3	4,7,9	3	0	0	3	40	60	100
18PBEMEEP03	Automation in Manufacturing	1,3	4,7,9	3	0	0	3	40	60	100
18PBEMEEP04	Quality Control and Reliability Engineering	1,2	3,7,	3	0	0	3	40	60	100
18PBEMEEP05	Composite Materials	1	4,7,9	3	0	0	3	40	60	100
18PBEMEEP06	Non Destructive Testing	1,3	4,7,9	3	0	0	3	40	60	100
18PBEMEEP07	Production Planning and Control	1,2	4,7,10	3	0	0	3	40	60	100
18PBEMEEP08	Industrial Robotics	1	4,7,9	3	0	0	3	40	60	100
18PBEMEEP09	Advanced Welding Technology	1	4,7,9	3	0	0	3	40	60	100

THERMAL ENGINEERING

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
18PBEMEET01	Gas Dynamics and Jet Propulsion	1	2,3,4	3	0	0	3	40	60	100
18PBEMEET02	Power Plant Engineering	1	2,3,4	3	0	0	3	40	60	100
18PBEMEET03	Renewable Energy Sources	1	4,5,9	3	0	0	3	40	60	100
18PBEMEET04	Refrigeration and Air Conditioning	1	2,3,4	3	0	0	3	40	60	100
18PBEMEET05	Cogeneration and Waste Heat Recovery Systems	1	4,5,9	3	0	0	3	40	60	100
18PBEMEET06	Computational Fluid Dynamics	1	2,3,4	3	0	0	3	40	60	100
18PBEMEET07	Design of Heat Exchangers	1	2,3,4	3	0	0	3	40	60	100
18PBEMEET08	Cryogenic Engineering	1	2,3,4	3	0	0	3	40	60	100
18PBEMEET09	Advanced Thermodynamics	1	2,3,4	3	0	0	3	40	60	100

AUTOMOTIVE ENGINEERING

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
18PBEMEEA01	Automobile Engineering	1	3,4	3	0	0	3	40	60	100
18PBEMEEA02	Two and Three Wheeler Technology	1,3	3,4	3	0	0	3	40	60	100
18PBEMEEA03	Intelligent Vehicle Technology	1,3	2,3,7,9	3	0	0	3	40	60	100
18PBEMEEA04	Off Road Vehicles	1,3	3,7,8	3	0	0	3	40	60	100
18PBEMEEA05	Vehicle Troubleshooting and Maintenance	1,3	7,8,9	3	0	0	3	40	60	100
18PBEMEEA06	Electric Vehicle Technology	1,3	2,3,7,9	3	0	0	3	40	60	100

MANAGEMENT SYSTEMS

SUB. CODE	TITLE OF THE COURSE	PEO's	PO's	L	T	P	C	CIA	ESE	TOTAL
18PBEMEEM01	Principles of Management	2,3	5,10	3	0	0	3	40	60	100
18PBEMEEM02	Project Management	2,3	5,10	3	0	0	3	40	60	100
18PBEMEEM03	Manufacturing Systems Management	2,3	5,9,10	3	0	0	3	40	60	100
18PBEMEEM04	Marketing Management	2,3	5,10	3	0	0	3	40	60	100
18PBEMEEM05	Industrial Safety Management	2,3	5,7,10	3	0	0	3	40	60	100
18PBEMEEM06	Lean Manufacturing	2,3	5,9,10	3	0	0	3	40	60	100

Total number of credits: 104

L: Lecture Hour **T: Tutorial Hour** **CIA: Continuous Internal Assessment**

P: Practical Hour **C: No. of Credits** **ESE: End Semester Examinations**

18PBEME101 ENGINEERING MATHEMATICS – I SEMESTER – I
4H: 4C

Instruction Hours / Week: - L: 3 T: 1 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To develop analytical skills for solving different technological problems.
2. To understand the concepts of Matrices, sequences and series.
3. To solve problems by applying Differential Calculus and Differential equations.
4. To equip the students will serve them to wards tackling more advanced level of mathematics.
5. To make the students will serve them to find the useful applications in their disciplines.
6. To make the students to solve the real time problems using standard concepts and tools

COURSE OUTCOMES (CO's)

At the end of this course,

1. The prospective engineers will be familiarized with techniques in calculus, multivariate analysis and linear algebra.
2. The students will be equipped 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.
3. The tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. To deal with functions of several variables that are essential in most branches of engineering.
5. The essential tool of matrices and linear algebra in a comprehensive manner.
6. Students can solve real time problems using standard concepts and tools.
7.

UNIT I MATRICES 9+3

Review of Matrix Algebra - Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic forms – Reduction to canonical form through orthogonal reduction.

UNIT II DIFFERENTIAL CALCULUS 9+3

Overview of Derivatives - Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes

UNIT III DIFFERENTIAL EQUATIONS 9+3

Introduction to Ordinary differential equations: linear ordinary differential equations of second and higher order with constant coefficients.

Introduction to Partial differential equations– Linear partial differential equations of second and higher order with constant coefficients

UNIT IV ANALYTIC FUNCTIONS 9+3

Analytic functions – Necessary and Sufficient conditions for an analytic function (Without proof) Cauchy-Riemann equations –Harmonic-Properties of analytic functions- Constructions of an analytic function - Conformal mapping: w = z+a, az, 1/z and bilinear transformation

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transform - Elementary properties – Inverse Z - transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL 45 + 15 = 60 PERIODS

SUGGESTED READINGS

1. Hemamalini. P.T (2014), Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
2. Sundaram, V. Lakhminarayan,K.A. & Balasubramanian,R., (2006), Engineering Mathematics for first year, Vikas Publishing Home , New Delhi.
3. Grewel . B. S., (2016), Higher Engineering Mathematics, Khanna Publications, New Delhi
4. Bhaskar Rao. P. B, Sri Ramachary SKVS, Bhujanga Rao. M (2010), Engineering Mathematics I, BS Publications, India.
5. Ramana. B.V (2017), Higher Engineering Mathematics, Tata McGraw Hill Publishing Company, New Delhi
6. Shahnaz Bathul (2009), Text book of Engineering Mathematics(Special Functions and Complex Variables), PHI Publications, New Delhi
7. Michael D. Greenberg (2009), Advanced Engineering Mathematics, Pearson Education, India
8. www.efunda.com
9. www.mathcentre.ac.uk

10. www.intmath.com/matrices-determinants
11. www.Intmath.com/calculus/calculus-intro.php

18PBEME102 ENGINEERING MECHANICS SEMESTER – I
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To develop capacity to predict the effect of force and motion.
2. To understand the importance of free body diagram for complex machine structure.
3. To perform force analysis using law of mechanics.
4. To introduce the concepts of static equilibrium condition for particles and rigid bodies
5. To Understand the concepts of kinematics of particles and friction.
6. To make the students conversant to solve the problems using equation of motions.

COURSE OUTCOMES

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

1. Understand the basic concepts of force and laws of mechanics.
2. Develop free body diagram for complex machine structure and to perform force analysis.
3. Apply static equilibrium condition for particles and rigid bodies.
4. Locate the center of gravity and moment of inertia for planes and solids.
5. Understand the concepts of kinematics of particles and friction.
6. Solve the problems using equation of motions.

UNIT I STATICS OF PARTICLES 9

Forces – system of forces – concurrent forces in plane and space– resultant – problems involving the equilibrium of a particle–free body diagram–equilibrium of particle in space.

UNIT II STATICS OF RIGID BODIES IN TWO DIMENSIONS 9

Rigid bodies–moment of force about an axis–moments and couples–equivalent system of coplanar forces–Rigid body in equilibrium–problems involving equilibrium of rigid body–types of supports–reactions of beams.

UNIT III CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA 9

Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia – radius of gyration – mass moment of inertia of simple solids.

UNIT IV KINEMATICS OF PARTICLES 9

Introduction – plane, rectilinear motion – time dependent motion – rectangular coordinates – projectile motion.

IMPULSE AND MOMENTUM: Concept of conservation of momentum – Impulse–Momentum principle– Impact – Direct central impact – Oblique central impact – Impact of elastic bodies.

UNIT V KINETICS OF PARTICLES AND FRICTION 9

KINETICS OF PARTICLES: Equations of motion–rectilinear motion–Newton's II law – D'Alembert's principle – Energy – potential energy–kinetic energy–conservation of energy–work done by a force – work energy method.

Laws of friction – coefficient of friction–problems involving dry friction – wedge and ladder friction.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Beer F P and Johnson E.R (2015), Vector Mechanics for Engineers–Statics and Dynamics, Tata Mc–Graw Hill Publishing Co. Ltd., New Delhi
2. Rajasekaran.S and Sankarasubramanian G (2011), Engineering Mechanics–Statics and Dynamics, Vikas Publishing House Pvt. Ltd., New Delhi
3. Bansal R K (2017), Engineering Mechanics, Laxmi Publications Pvt. Ltd., New Delhi
4. Young D H and Timashenko S (2016), Engineering Mechanics, Tata McGraw–Hill, New Delhi
5. Jivan Khachane and Ruchi Shrivastava (2013), Engineering Mechanics: Statics and Dynamics, ANE Books, New Delhi
6. http://nptel.iitm.ac.in/courses/Webcourse–contents/IIT%20Guwahati/engg_mechanics/index.htm
7. http://nptel.iitm.ac.in/video.php?subjectId=112103108
8. http://web.mit.edu/emech/dontindex–build/index.html
9. http://www.indiabix.com/engineering–mechanics/questions–and–answers/

18PBEME103 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING SEMESTER – I 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart the basic knowledge about the Electric circuits.
2. To understand the working of various Electrical Machines.
3. To know about various measuring instruments.
4. To understand the basic concepts in semiconductor devices and digital electronics
5. To study the working principles of electrical machines and power converters.
6. To introduce the components of low-voltage electrical installations

COURSE OUTCOMES (CO's)

Upon successful completion of the course, student should be able to

1. To understand and analyze basic Electric and Magnetic circuits
2. To study the working principles of Electrical Machines and Power Converters.
3. To Know broadly the concepts and functionalities of the electronic devices, tools and instruments
4. Understand and analyze basic electric and magnetic circuits.
5. Acquire knowledge on the working principles of electrical machines and power converters.
6. Understand the components of low-voltage electrical installations.

UNIT I ELECTRIC CIRCUITS & MEASUREMENTS 9

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase balanced Circuits.

UNIT II ELECTRICAL MACHINES 9

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III MEASURING INSTRUMENTS 9

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT IV SEMICONDUCTOR DEVICES AND APPLICATIONS 9

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

UNIT V DIGITAL ELECTRONICS 9

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts).

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Mittle, V.M (2005), Basic Electrical Engineering, Tata McGraw Hill Edition, New Delhi
2. Sedha R.S (2013), Applied Electronics, S. Chand & Co
3. Muthusubramanian R, and Muraleedharan K A (2006), Basic Electrical, Electronics and Computer Engineering, Tata McGraw Hill, Second Edition
4. Nagsarkar T K and Sukhija M S (2011), Basics of Electrical Engineering, Oxford press
5. Mahmood Nahvi and Joseph A. Edminister (2014), Electric Circuits, Schaum' Outline Series, McGraw Hill
6. Premkumar N (2014), Basic Electrical Engineering, Anuradha Publishers

18PBEME104 MANUFACTURING TECHNOLOGY SEMESTER – I
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To familiarize the students to apply suitable molding and casting methods for producing components.
2. To develop an understanding of types of metal joining processes.
3. To explain types of deformation processes.
4. To understand the concept of sheet metal operations and metal forming processes.
5. To provide an overview of various plastic component manufacturing processes for various applications.
6. To Study and acquire knowledge of process variables to manufacture defect free products.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Apply suitable molding and casting methods for producing components.
2. Decide the type of metal joining processes.
3. Select the type of deformation processes.
4. Work with various sheet metal operations and metal forming processes.
5. Select the various plastic component manufacturing processes for various applications.
6. Identify the effect of process variables to manufacture defect free products

UNIT I FOUNDRY EQUIPMENTS AND MATERIALS 8

Patterns. Moulds-types of moulds, moulding sand characteristics and testing procedures. Core making, melting furnaces.

UNIT II PRODUCTION OF CASTINGS 8

Processes-shell moulding, investment castings, centrifugal castings, die casting. Gating and risering. Fettling and cleaning of casting. Inspection and testing of castings. Casting defects and remedies.

UNIT III WELDING 9

GAS WELDING -Oxy-acetylene welding, types of flames, welding torches, welding techniques. ARC WELDING-carbon arc, shielded metal arc, submerged arc, TIG and MIG welding. Welding electrodes-function and characteristics of electrode coating. RESISTANCE WELDING-spot, seam, projection and butt welding, heat flow in welded components. Other welding process, Laser beam welding, Electron beam welding. Friction welding, Friction stir welding and Ultra sonic welding.

UNIT IV METAL FORMING PROCESSES 9

Cold and hot working, rolling, drawing, extrusion and forging, sheet metal cutting, bending. Drawing applications, defects. Types of presses.

UNIT V SPECIAL FORMING METHODS 8

Explosive forming, electro magnetic forming, electro hydraulic forming, powder metallurgy process, composite mouldings.

INTRODUCTION TO SOFTWARE FOR MANUFACTURING APPLICATIONS *(Not for exam)* **3**

Metal forming and flow analysis software (for metallic /plastic components).

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Serope Kalpajian, Steven R.Schmid (2014), Manufacturing Engineering and Technology, Pearson Education, Inc., New Delhi
2. S.Gowri, P.Hariharan, and A.Suresh Babu (2008), Manufacturing Technology 1, Pearson Education, Inc., New Delhi
3. P.N. Rao (2013), Manufacturing Technology Second Edition, Tata McGraw–Hill Publishing Limited, New Delhi
4. P.C. Sharma (2014), A text book of production technology, S. Chand and Company, New Delhi
5. Begman (2005), Manufacturing Process, John Wilely and Sons
6. www.themetalcasting.com
7. www.industrialmetalcastings.com
8. www.purolator–lp.com

9. www.manufacturercompanies.com/manufacturers
10. www.amtonline.org

18PBEME111 COMPUTER AIDED DESIGN LABORATORY SEMESTER – I 3H: 2C

Instruction Hours / Week: - L: 0 T: 0 P: 3 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To introduce the basic concepts and the use of engineering drawing in the design and manufacturing field.
2. Ability to develop 2D and 3D models using modeling software's.
3. To gain practical experience in handling 2D drafting and 3D modeling software systems.
4. To impart training on SOLID WORKS for modelling
5. To provide knowledge on assembly of components
6. To facilitate the understanding of manufacturing drawings from the models created

COURSE OUTCOME

Upon completion of this course, the students can able to

1. use computer and CAD software's for modeling of mechanical components
2. use various options in SolidWorks for modeling of given components
3. create assembly of components
4. prepare manufacturing drawings from the models created
5. use computer and CAD assembly of components
6. to understanding manufacturing drawings

COMPUTER AIDED DESIGN

1. 3D modeling of various machine elements using various options like protrusion, cut, sweep, draft, loft, blend, rib.
2. Assembly – creating assembly from parts – assembly constraints
3. Conversion of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning.
4. Introduction to Surface Modeling.
5. Introduction to File Import, Export – DXF, IGES, STL, STEP

Note: Any one of the 3D MODELING software's like SOLIDWORKS, CREO, CATIA, NX Software, AutoCAD etc.

TOTAL 45 PERIODS

18PBEME201 ENGINEERING MATHEMATICS – II SEMESTER – II
4H: 4C

Instruction Hours / Week: - L: 3 T: 1 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impact analytical skills to the students in the areas of multiple integrals and applications of vector calculus.
2. To understand the concepts and applications of laplace transforms.
3. To study about analytic functions and complex integration
4. To familiarize the prospective engineers with techniques in Multivariate integration.
5. To familiarize the concept of ordinary and partial differential equations and complex variables.
6. To equip the students to deal with advanced level of mathematics and applications

COURSE OUTCOMES (CO's)

Upon completion of t his course, the students will learn

1. The mathematical tools needed in evaluating multiple integrals and their usage.
2. The effective mathematical tools for the solutions of differential equations that model physical processes.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques . engineering problems.
4. The mathematical tools needed in evaluating multiple integrals and their usage.
5. The effective mathematical tools for the solutions of differential equations that model physical processes.
6. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering Problems

UNIT I MULTIPLE INTEGRALS 9+3

Double integration – Cartesian coordinates – Polar coordinates – Change of order of integration – Triple integration in Cartesian co-ordinates – Area as double integrals.

UNIT II VECTOR CALCULUS 9+3

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration - Green's theorem, Gauss divergence theorem and Stoke's theorems (Statement only)- Surfaces : hemisphere and rectangular parallelopipeds

UNIT III FOURIER SERIES 9+3

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

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded).

UNIT V LAPLACE TRANSFORMS 9+3

Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Initial and final value theorems. Inverse Laplace transforms – Convolution theorem – Solution of Ordinary Differential Equations with constant coefficients using Laplace transforms – Transform of periodic functions

TOTAL 45 + 15 = 60 PERIODS

SUGGESTED READINGS

1. Hemamalini. P.T (2014), Engineering Mathematics I & II, McGraw-Hill Education Pvt.Ltd, New Delhi
2. Grewal, B.S. (2014), Higher Engineering Mathematics, Khanna Publishers, Delhi
3. Erwin Kreyszig (2011), Advanced Engineering Mathematics, John Wiley & Sons. Singapore
4. Kandasamy. P, Thilagavathy. K (2008), Engineering Mathematics, S Chand and Co. Ltd, New Delhi
5. Venkataraman, M. K. (2005), Engineering Mathematics, The National Publishing Company, Chennai
6. Narayanan. S, and Ramaniah.G (2002), Advanced Mathematics for Engineering Students, Viswanathan S.(Printers and Publishers) Pvt. Ltd. Chennai
7. www.intimath.com
8. www.efunda.com
9. www.mathcentre.ac.uk
10. www.sosmath.com/diffeq/laplace/basic/basic.html

18PBEME202 STRENGTH OF MATERIALS SEMESTER – II
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.
2. To introduce the Concepts of safe working stresses and load carrying capacity of beams.
3. To enrich the understanding of deflection in beams and columns in engineering applications.
4. To understand the importance of the effect of torsion on shafts and springs.
5. To provide knowledge on principal stresses and analyze thin cylinders and shells subjected to pressure forces.
6. To provide knowledge on components subjected to various loadings with the help of various theories of failures

COURSE OUTCOMES (CO's)

After completing this course, the students should be able

1. 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.
2. To evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.
3. Estimate the deflection in beams and columns in engineering applications.
4. Analyze the effect of torsion on shafts and springs.
5. Determine principal stresses and analyze thin cylinders and shells subjected to pressure forces.
6. Design the components subjected to various loadings with the help of various theories of failures

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT II BEAMS – LOADS AND STRESSES 9

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Relationship between load, shear force and bending moment – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III BEAM DEFLECTION 9

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Macaulay Method – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine's formula for columns

UNIT IV TORSION 9

Analysis of torsion of circular bars – Torsional Shear stress – Bars of solid and hollow circular section – Stepped shaft – Torsional rigidity – Compound shafts – Fixed and simply supported shafts – Application to close–coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress – Strain energy in bending and torsion.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Punmia B.C and Jain A.K (2015), Strength of Materials and Theory of Structures – Vol.1, Laxmi Publications New Delhi
2. Ramamrutham S and Narayan R (2008), Strength of Materials, Dhanpat Rai and Sons., New Delhi
3. Jindal U C (2012), Textbook on Strength of Materials, Asian Books Pvt, Ltd, Chennai
4. Don H Morris, and Leroy D Sturges (2006), Mechanics of Materials, John Wiley and Sons Inc
5. Bedi D S (1984), Strength of Materials, S Chand and Co. Ltd., New Delhi
6. www.engineersedge.com
7. http://en.wikiversity.org
8. www.globalsources.com
9. www.dspace.cusat.ac.in

18PBEME203 KINEMATICS OF MACHINERY SEMESTER – II
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the basic components and layout of linkages in the assembly of a system / machine.
2. To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3. To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
4. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.
5. Understand the theory of cams, gears and gear trains.
6. Understand the role of friction in belt, rope and chain drives.

COURSE OUTCOME (CO's)

At the end of the course students are able to :

1. Understand the basic principles of mechanisms in mechanical engineering.
2. Apply the kinematic analysis in subsequent courses in the design and analysis of various machine components.
3. Understand the importance of cams, gears and gear trains in real time practice.
4. Explain the role of friction in industrial drives.
5. analyze a mechanism for displacement, velocity and acceleration at any point
6. Understand the concept of machines, mechanisms and related terminologies

UNIT I BASICS OF MECHANISMS 9

Terminology and Definitions–Degree of Freedom – Mobility–Kutzbach criterion–Grashoff's law–Kinematic Inversions of four bar chain and slider crank –Mechanical Advantage–Transmission angle –—Single, double and offset slider mechanisms – Quick return mechanisms – Ratchets and escapements – Indexing Mechanisms – Straight line generators.

UNIT II KINEMATICS 9

Displacement, velocity and acceleration – analysis in simple mechanisms – Graphical Method –velocity and acceleration polygons – Kinematic analysis by Complex Algebra methods–Vector Approach, Instantaneous center – Coriolis Acceleration.

UNIT III KINEMATICS OF CAM 9

Classifications – Displacement diagrams–parabolic, Simple harmonic and Cycloidal motions – Layout of plate cam profiles – Derivatives of Follower motion – High speed cams – circular arc and tangent cams – Standard cam motion – Pressure angle and undercutting.

UNIT IV GEARS 9

Spur gear - Terminology and definitions–Fundamental Law of toothed gearing and involute gearing–Interchangeable gears–gear tooth action – Terminology – Interference and undercutting–Non standard gear teeth– Helical, Bevel, Worm, Rack and Pinion gears (Basics only)–Gear trains–Parallel axis gear trains–Epicyclic gear trains.

UNIT V FRICTION IN DRIVES 9

Surface contacts–Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt and rope drives, Friction aspects in Brakes.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Rattan S.S (2014), Theory of Machines, Tata McGraw–Hill, New Delhi
2. Shigley J.E, Uicker J J (2014), Theory of Machines and Mechanisms, McGraw–Hill, Inc, New York
3. Thomas Bevan (2011), Theory of Machines, CBS Publishers and Distributors, New Delhi
4. Ghosh A, Mallick A.K (2006), Theory of Mechanisms and Machines, Affiliated East–West Pvt. Ltd., New Delhi
5. Rao J.S, Dukkipati R.V (2007), Mechanics of Machines, Wiley–Eastern Ltd., New Delhi

18PBEME204 FUNDAMENTALS OF COMPUTER PROGRAMMING SEMESTER – II 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To have knowledge on computer hardwares and softwares
2. To understand the various data representation techniques
3. To make the students to get knowledge on software engineering methodologies
4. To know the correct and efficient ways of solving problems
5. To learn to develop algorithm for simple problem solving
6. To learn to program in C

COURSE OUTCOMES

1. To formulate simple algorithms for arithmetic and logical problems
2. To translate the algorithms to programs (in C language)
3. To test and execute the programs and correct syntax and logical errors
4. To implement conditional branching, iteration and recursion
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach
6. To use arrays, pointers and structures to formulate algorithms and programs

UNIT I COMPUTER BASICS 9

Evolution of computers- Generations of computers- Classification of computers-Applications of computers- Computer Organization and Architecture- Computer Memory and Storage- Input Output Devices

UNIT II SOFTWARE, PROGRAMMING AND INTERNET 9

Algorithm- Flowchart- Pseudo code – Program control structures- Programming paradigms- Programming languages- Generations of Programming languages- Computer Software- Definition- Categories of Software - Internet- Evolution- Basic Internet terms- Internet-Applications

UNIT III C FUNDAMENTALS 9

Introduction to C- Constants- Variables- Data types- Operators and Expressions-Managing Input and Output operations- Decision Making and Branching- Looping

UNIT IV ARRAYS AND FUNCTIONS 9

Arrays- Character Arrays and Strings- User defined functions- Storage Classes

UNIT V STRUCTURES AND FILES 9

Structures- Definition- Initialization- Array of Structures- Structures within structures- Structures and Functions- Unions- File Management in C

TOTAL 45 PERIODS

SUGGESTED READINGS

1. E. Balagurusamy (2017), Computing Fundamentals and C Programming, Mcgraw Higher Ed
2. ITL Education Solutions Ltd (2008), Introduction to Information Technology, Pearson Education. Delhi
3. Rajaraman, V (2006), Fundamentals of Computers. IV Edition, Prentice Hall, New Delhi
4. Byron Gottfried (2002), Programming with C Second Edition, TMH, New Delhi

18PBEME211 STRENGTH OF MATERIALS LABORATORY SEMESTER – II
3H: 2C

Instruction Hours / Week: - L: 0 T: 0 P: 3 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To perform different destructive testing
2. To learn the characteristic materials.
3. To understand the stress and strain relationship.
4. To determine the shear force for various materials.
5. To determine the impact load for various materials.
6. To determine the hardness for various materials

COURSE OUTCOMES

1. Ability to perform different destructive testing
1. Ability to characteristic materials
2. Understand the stress and strain relationship.
3. Determine the shear force for various materials.
4. Determine the impact load for various materials.
5. Determine the hardness for various materials

LIST OF EXPERIMENTS

1. Tensile test on metals–stress strain characteristics
2. Cupping test on metal sheets–load deformation characteristics, cupping load, cupping number.
3. Hardness test on metals–Brinell, Vicker and Rockwell Hardness tests.
4. Impact test on metals–Charpy, Izod impact tests.
5. Shear test on metals–direct shear strength, single shear, double shear.
6. Tests on helical springs–compression, tension springs–load deformation characteristics, stiffness, shear stress, modulus of rigidity, energy.
7. Torsion test on beams–torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.

TOTAL 45 PERIODS

18PBEME301 APPLIED THERMODYNAMICS SEMESTER – III
4H: 4C

Instruction Hours / Week: - L: 3 T: 1 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.
2. To apply the thermodynamic concepts into various thermal application like IC engines, Refrigeration and Air conditioning systems
3. To Study and acquire knowledge on various thermodynamic properties of pure substances in real time problems.
4. To establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
5. To facilitate the understanding of properties of air using psychometric chart.
6. To acquaint the student with the concepts and applications of the thermodynamics to the various real-life systems

COURSE OUTCOMES (CO's)

After completing this course,

1. The students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interaction.
2. Students can evaluate changes in thermodynamic properties of substances and evaluate the performance of energy conversion devices
3. Identify the various thermodynamic properties of pure substances in real time problems.
4. Establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
5. Calculate the properties of air using psychometric chart.
6. Explain the basic principles and applications of the thermodynamics to the various real life systems.

UNIT I BASIC CONCEPTS AND FIRST LAW 9+3

Basic concepts - Classical and Statistical approaches - Thermodynamic systems - closed, open, isolated. Property – State - Process-adiabatic - Quasi-static process – Cycle - Point and Path function – Energy - Work transfer - Concept of temperature and heat- Zeroth law of thermodynamics - Concept of ideal gases - First law of thermodynamics –PMM1, internal energy, specific heat capacities, enthalpy, and its application to closed system and open system-steady flow energy equation.

UNIT II SECOND LAW AND ENTROPY 9+3

Physical description of the second law - Kelvin-Planck and Clausius statements –Equivalence - Reversible processes and cycles- Carnot cycle – Corollaries - Absolute temperature scale – Clausius Theorem, inequality - Entropy- Principle, transfer, generation, balance - Third law of thermodynamics

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLES 9+3

Pure substance - Phase change process - Property diagrams - PVT surface - Steam – types, dryness fraction. Mollier diagram, steam tables, Rankine Cycle – incomplete evaporation – superheated steam –modified cycle.

UNIT IV GAS POWER CYCLES AND IC ENGINES 9+3

Otto, Diesel, Dual, Brayton cycles – Calculation of mean effective pressure and air standard efficiency – actual and theoretical PV and TS diagrams of two stroke and four stroke engines–valve timing diagram and port timing diagram – calculation of engine performance, heat balance sheet, retardation – Morse test.

UNIT V PSYCHROMETRY, REFRIGERATION AND AIR CONDITIONING 9+3

Psychrometry - Psychrometric charts - Property calculations of air vapour mixtures- Psychrometric process-Adiabatic mixing - Evaporative cooling.. Fundamentals of refrigeration – COP – Vapour compression refrigeration system – cycle, p–h chart, Vapour absorption system – comparison, properties of refrigerants. Fundamentals of air conditioning system, cycle, controls, air handling and distribution, simple cooling and heat load estimation

TOTAL 45 + 15 = 60 PERIODS

SUGGESTED READINGS

1. Nag P K (2013), Engineering Thermodynamics, Tata McGraw-Hill, New Delhi
2. Rajput R.K (2015), Thermal Engineering, Sixth edition, Laxmi Publications, New Delhi
3. Arora C.P (2016), Refrigeration and Air conditioning, Tata McGraw–Hill, New Delhi
4. Cengel (2015), Thermodynamics-An Engineering Approach, Tata McGraw-Hill, New Delhi
5. Kothandaraman C.P, and Domkundwar A.V (2016), A course in Thermal Engineering, Fifth Edition, Dhanpat Rai and Sons, Delhi
6. http://nptel.iitm.ac.in/courses/Webcourse–contents/IIT%20Guwahati/engg_mechanics/index.htm
7. www.kruse–ltc.com

8. www.grc.nasa.gov
9. www.poweronsite.org

18PBEME302 ENGINEERING MATERIALS AND METALLURGY SEMESTER – III 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge on metallurgical aspects of metals.
2. To understand heat treatment processes on different grades of steel.
3. To familiarize on selection of ferrous and non-ferrous materials for various applications.
4. To impart knowledge on non-metallic materials
5. To learn about the strengthening mechanisms for Non-ferrous alloys.
6. To comprehend the significance of Non-Destructive Testing (NDT) methods

COURSE OUTCOMES

Learners should be able to

1. Identify the metallurgical aspects of metals.
2. Identify suitable heat treatment processes for various applications.
3. Select appropriate ferrous and non-ferrous materials for various applications.
4. Identify and select suitable non-metallic materials.
5. Identify suitable strengthening mechanisms for Non-ferrous alloys.
6. Work with non-destructive testing methods.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

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

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on TTT diagram, CCT - Hardenability, Jominy end quench test – Austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

UNIT III FERROUS AND NON FERROUS METALS 9

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA - maraging steels – Gray, White malleable, Spheroidal Graphite irons - Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu – precipitation, strengthening treatment – Bearing alloys.

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and Applications of thermoplastics (PP, PVC, ABS, and PMMA) and thermosetting plastics (PF, UF, MF) –Engineering Ceramics.

UNIT V TESTING OF MECHANICAL PROPERTIES AND INSPECTION 9

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep test, S-N curve.

Non Destructive Testing: Non Destructive Testing basic principles and testing method of Radiographic testing, Ultrasonic testing, Magnetic particle test and Liquid penetrant test, Eddy current testing.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Kenneth G.Budinski and Michael K.Budinski (2011), Engineering Materials, Prentice-Hall of India Private Limited, New Delhi
2. William D. Callister & David G. Rethwisch (2016), Material Science and Engineering, John Wiley and Sons, Delhi
3. Raghavan.V (2015), Materials Science and Engineering, Prentice Hall of India Pvt., Ltd, New Delhi

4. Shackelford. J.F (2014), Introduction to Materials Science for Engineers, Pearson Edition
5. www.materials.unsw.edu.au
6. ocw.MIT.edu
7. www.istl.org
8. metalurgy-screw-tutorial.tobyavujo.com

18PBEME303 INDUSTRIAL METROLOGY AND MEASUREMENTS SEMESTER – III 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To provide knowledge on various Metrological equipment available to measure the dimension of the components.
2. To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
3. To understand the technique for conducting computer aided inspection
4. To understand the concepts of measurement used for industrial components
5. To understand the mechanical properties in industrial applications
6. To understand the temperature properties in industrial applications

COURSE OUTCOME (CO's)

1. Describe the concepts of measurements to apply in various metrological instruments
2. Outline the principles of linear and angular measurement tools used for industrial applications
3. Explain the procedure for conducting computer aided inspection
4. Demonstrate the techniques of form measurement used for industrial components
5. Discuss various measuring techniques of mechanical properties in industrial applications
6. Discuss various measuring techniques of temperature properties in industrial applications

UNIT I CONCEPT OF MEASUREMENT 9

General concept – Generalised measurement systems – units and standards–measuring instruments– sensitivity, readability, range of accuracy, precision–static and dynamic response–repeatability–systematic and random errors – correction, calibration, interchangeability – Basics of Measurement System Analysis.

UNIT II LINEAR AND ANGULAR MEASUREMENT 9

Definition of metrology–Linear measuring instruments: Vernier, micrometer, interval measurement, Slip gauges and classification, limit gauges– Comparators: Mechanical, pneumatic and electrical types, applications – Angular measurements: –Sine bar, auto-collimeter, angle Decker.

UNIT III FORM MEASUREMENT 9

Measurement of screw threads – Thread gauges, floating carriage micrometer–measurement of gears–tooth thickness – constant chord and base tangent method – Eccentricity Measurements – radius measurements–surface finish, straightness, flatness and roundness measurements.

UNIT IV LASER AND ADVANCES IN METROLOGY 9

Precision instruments based on laser–Principles– laser interferometer–application in linear, angular measurements and machine tool metrology - Coordinate measuring machine (CMM) – computer aided inspection - Nano metrology, techniques and applications-TEM,SEM,STM,XRD,AFM.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE RELATED PROPERTIES 9

Force, torque, strain:–mechanical and electrical type – Flow measurement: Venturi, orifice, rotometer, – Electrical pressure transducers, Temperature: Thermocouples, Resistance temperature detectors, bimetallic strip thermometers, thermister, pyrometry

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Jain R.K (2003), Engineering Metrology, Khanna Publishers, Delhi
2. Alan S. Morris (1997), The Essence of Measurement, Prentice Hall of India, New Delhi
3. N.V. Raghavendra and L. Krishnamurthy (2013), Engineering Metrology and Measurements, Oxford University press of India
4. Gupta S.V (2012), Engineering Metrology, Dhanpat rai Publications, New Delhi
5. Tayal A.K (2013), Instrumentation and Mechanical Measurements, Galgotia Publications, New Delhi
6. Beckwith T.G and N. Lewis Buck N (2007), Mechanical Measurements, Addison Wesley, New York

7. www.tms.org
8. www.arci.res.in/
9. www.fbh–berlin.com
10. www.lasermetrology.com/
11. www.lasermetrology.com/

18PBEME304 FLUID MECHANICS AND MACHINERY SEMESTER – III 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. The applications of the conservation laws to flow through pipes and hydraulic machines are studied
2. To understand the importance of dimensional analysis.
3. To understand the importance of various types of flow in pumps and turbines.
4. To enrich the understanding of fluid properties
5. To make the students conversant with types of flow and calculate Major and minor loses in pipes.
6. To acquaint the student with the concepts of Buckingham's π theorem

COURSE OUTCOME (CO's)

Upon completion of this course, the students can able to

1. Demonstrate basic knowledge of fluid properties
2. Find types of flow and calculate Major and minor loses in pipes.
3. Apply Buckingham's π theorem for problem solving.
4 .Understand the working of different pumps
5. Understand the working of different turbines.
6. Produce analytical solutions to various simple problems.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Fluid properties: Mass density, weight density, specific gravity, viscosity, compressibility, surface tension and capillarity. Buoyancy and floatation– metacentre and metacentric height (definition only)

Flow characteristics: concepts of system and control volume, application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR PIPES 9

Hydraulic and energy gradient – Types of fluid flow – Laminar flow through circular conduits – Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor – Moody diagram – commercial pipes – minor losses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS 9

Dimension and units, dimensional homogeneity, applications of Buckingham's π theorem, model and similitude, similarity laws.

UNIT IV HYDRAULIC TURBINES 9

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

UNIT V HYDRAULIC PUMPS 9

Classification of pumps – centrifugal pump–working principle–head, discharge, efficiencies and losses – performance curves – specific speed. Reciprocating pump–components and working–slip–indicator diagram – air vessel – Jet pump – Gear pump – Submersible pump.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Streeter V.L, Wylie E.B (2010), Fluid Mechanics, McGraw–Hill, New Delhi
2. Kumar K.L (2015), Engineering Fluid Mechanics, S. Chand & Co
3. Bansal. R.K (2016), Fluid Mechanics and Hydraulics Machines, Laxmi publications (P) Ltd, New Delhi
4. White. F.M (2016), Fluid Mechanics, Tata McGraw–Hill, New Delhi
5. Fox and McDonald (2015), Fluid Mechanics, John Wiley

6. www.imeche.org
7. openlibrary.org
8. nptel.iitg.ernet.in
9. www.tecquipment.com

18PBEME311 FLUID MECHANICS AND METROLOGY LABORATORY SEMESTER – III 3H: 2C

Instruction Hours / Week: - L: 0 T: 0 P: 3 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. Ability to use the measurement equipment for flow measurement
2. Ability to do performance trust on different fluid machinery
3. To explain the Calibration of Rotameter.
4. To understand the importance of friction factor for flow through pipes.
5. To impart knowledge on the performance of various pumps.
6. To impart knowledge on the performance of turbines.

COURSE OUTCOME (CO's)

1. Calculate the coefficient of discharge for Orifice meter and Venturimeter.
2. Calibrate the Rotameter
3. Estimate the friction factor for flow through pipes.
4. Asses the performance of centrifugal pump and submergible pump.
5. Asses the performance of reciprocating pump and gear pump.
6. Asses the performance of turbines.

LIST OF EXPERIMENTS

- **FLUID MECHANICS**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump
6. Conducting experiments and drawing the characteristic curves of submergible pump
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
8. Conducting experiments and drawing the characteristic curves of Gear pump.
9. Conducting experiments and drawing the characteristic curves of Pelton wheel.
10. Conducting experiments and drawing the characteristics curves of Francis turbine.

- **METROLOGY**

1. Calibration of Vernier / Micrometer / Dial gauge
2. Checking dimensions of part using slip gauges
3. Measurement of gear tooth dimensions – addendum, dedendum, pitch circle diameter and tooth thickness
4. Measurement of taper angle using sine bar / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters

7. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)
8. Surface finish measurement

TOTAL 45 PERIODS

18PBEME401 MECHATRONICS SEMESTER – IV 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
2. To understand the concepts of sensors and transducers.
3. To provide an overview of actuation systems.
4. To expose students to controller model for electrical, mechanical and thermal systems.
5. To provide knowledge about various types of controllers
6. To facilitate the understanding of PLC program using ladder logic.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Implement the concepts of sensors and transducers.
2. Design the actuation systems.
3. Develop the controller model for electrical, mechanical and thermal systems.
4. Explain about various types of controllers
5. Create the PLC program using ladder logic.
6. Design Mechatronics system.

UNIT I MECHATRONICS SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics – Systems – Measurement Systems – Control Systems –Traditional design – Microprocessor based Controllers. Introduction to sensors – Performance Terminology – Static and Dynamic characteristics – Displacement – Position and Proximity – Velocity and Motion – Fluid Pressure – Temperature Sensors – Light Sensors – Selection of Sensors – Signal processing – Servo systems.

UNIT II ACTUATORS AND SYSTEM MODELS 9

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors.
Introduction to system models– Building block of Mechanical, Electrical, Fluid and Thermal Systems.

UNIT III MICROPROCESSORS IN MECHATRONICS 9

Introduction – Architecture – pin configuration Instruction set – Programming of Microprocessors using 8085 instructions – Interfacing. Input and output devices – interfacing D/A converters and A/D converters – Application – Temperature control – Stepper motor control.

UNIT IV CONTROLLERS 9

Introduction –Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers –Digital Controllers – Adaptive Control – Digital Logic Control – Micro Processors Control. Introduction to PLC – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Data Handling – Analog Input / Output – Selection of a PLC.

UNIT DESIGN OF MECHATRONIC SYSTEMS 9

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design – Possible Design Solutions – Case Studies of Mechatronics Systems, Pick and place robot – automatic Car Park Systems – Engine Management Systems – Introduction to MEMS.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Bolton W (2015), Mechatronics, Pearson Education, Delhi
2. Michael B. Histand David G. Alciatore (2017), Introduction to Mechatronics and Measurement Systems, McGraw–Hill

International Editions, New York
3. Bradley D, Buru N.C and Loader A.J (2000), Mechatronics, Chapman and Hall, Pearson Education Asia, New Delhi
4. Ghosh P.K and Sridhar P.R (2010), Introduction to Microprocessors for Engineers and Scientist, Prentice Hall of India, New Delhi
5. www.cs.indiana.edu

18PBEME402 HEAT AND MASS TRANSFER SEMESTER – IV 4H: 4C

Instruction Hours / Week: - L: 3 T: 1 P: 0 **Marks: - Internal: 40 External: 60 Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To Study and acquire knowledge on heat transfer for conduction.
2. To introduce the concepts of heat transfer coefficients for natural and forced convection for different fluid flows.
3. To understand the performance of heat exchanger.
4. To study the features of radiation heat transfer between the surfaces.
5. To give exposure to mass transfer.
6. To make the students conversant to solve complex problems where heat and mass transfer takes place.

COURSE OUTCOMES

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

1. Determine the rate of heat transfer for conduction.
2. Evaluate heat transfer coefficients for natural and forced convection for different fluid flows.
3. Analyze performance of heat exchanger.
4. Estimate the radiation heat transfer between the surfaces.
5. Calculate the coefficient of mass transfer.
6. Solve complex problems where heat and mass transfer takes place.

UNIT I CONDUCTION 9 + 3

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

UNIT II CONVECTION 9 + 3

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9 + 3

Nusselts theory of condensation–pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

UNIT IV RADIATION 9 + 3

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law –Black Body Radiation –Grey body radiation - Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation.

UNIT V MASS TRANSFER 9 + 3

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

TOTAL 45 + 15 = 60 PERIODS

(Permitted to use standard Heat and Mass Transfer Table in the examination)

SUGGESTED READINGS

1. Sachdeva R.C (2012), Fundamentals of Engineering Heat and Mass Transfer, New Age International, New Delhi

2. Frank P. Incropera and David P. DeWitt (2011), Fundamentals of Heat and Mass Transfer, John Wiley and Sons, New Delhi
3. Ozisik M.N (1994), Heat Transfer, McGraw–Hill Book Co, New Delhi
4. Kothandaraman C.P (2012), Fundamentals of Heat and Mass Transfer, New Age International, New Delhi
5. http://nptel.iitm.ac.in/courses/Webcourse–contents/IISc–BANG/Heat%20and%20Mass%20Transfer/New_index1.html
6. http://www.learnerstv.com/Free–Engineering–Video–lectures–ltv084–Page1.htm
7. http://en.wikipedia.org/wiki/Heat_transfer

18PBEME403 DYNAMICS OF MACHINERY SEMESTER – IV 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
2. To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
3. To understand the effect of dynamics of undesirable vibrations.
4. To understand the principles in mechanisms used for speed control and stability control.
5. To understand the concepts of various vibrations
6. To understand the concepts of control mechanism

COURSE OUTCOMES (CO's)

After completing this course, the students can do

1. force analysis and balance rotating masses
2. solve balancing related problems
3. solve dynamics of undesirable vibrations
4. Estimate the stability of components
5. Analyze the vibration related problems
6. Solve governor related problems

UNIT I FORCE ANALYSIS 9

Rigid Body dynamics in general plane motion – Equations of motion – Dynamic force analysis – Inertia force and Inertia torque – D'Alemberts principle – The principle of superposition – Dynamic Analysis in Reciprocating Engines – Gas Forces – Equivalent masses – Bearing loads – Crank shaft Torque – Turning moment diagrams – Fly wheels.

UNIT II BALANCING 9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder Engine – Balancing Multi–cylinder Engines – Partial balancing in locomotive Engines.

UNIT III FREE VIBRATION 9

Basic features of vibratory systems – idealized models – Basic elements and lumping of parameters – Degrees of freedom – Single degree of freedom – Free vibration – Equations of motion – natural frequency – Damping Types of Damping – Damped vibration, critical speeds of simple shaft.

UNIT IV FORCED VIBRATION AND TORSIONAL VIBRATION 9

Response to periodic forcing – Harmonic Forcing – Forcing caused by unbalance – Support motion – Force transmissibility and amplitude transmissibility – Vibration isolation.
Torsional systems; Natural frequency of free torsional vibrations, Natural frequency of two and three rotor systems.

UNIT V MECHANISMS FOR CONTROL 9

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling Force – other Governor mechanisms.
Gyroscopes – Gyroscopic forces and Torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Rattan S.S (2014), Theory of Machines, Tata McGraw–Hill Publishing Company Ltd., New Delhi
2. Shigley J.E, Uicker J.J (2014), Theory of Machines and Mechanisms, McGraw–Hill, New York
3. Rao J.S., Dukkipati R.V (2011), Mechanism and Machine Theory, Wiley– Eastern Limited, New Delhi
4. John Hannah and Stephens R.C (2005), Mechanics of Machines, Viva Books Pvt Ltd
5. Thomas Bevan (2011), Theory of Machines, CBS Publishers and Distributors, New Delhi

6. http://freevideolectures.com/Course/2364/Dynamics–of–Machines
7. http://en.wikipedia.org/wiki/Balancing_of_rotating_masses
8. http://www.efunda.com/formulae/vibrations/sdof_free_damped.cfm
9. http://www.roymech.co.uk/Useful_Tables/Vibrations/Free_Vibrations.html

18PBEME404 ENVIRONMENTAL SCIENCE SEMESTER – IV 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To give a comprehensive insight into natural resources, ecosystem and biodiversity.
2. To educate the ways and means of the environment
3. To protect the environment from various types of pollution.
4. To impart some fundamental knowledge on human welfare measures.
5. To develop writing and oral communication needed to conduct high-level work as interdisciplinary scholars and / or practitioners.
6. To Learn about the systems concepts and methodologies to analyze and understand interactions.

COURSE OUTCOME (CO's)

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURALRESOURCES 9

Definition, Scope and Importance – Need for public awareness -Forest resources: Use and over-exploitation, deforestation- Water resources-Use and over-utilization of surface and ground water, floods, drought, conflicts over water- Land resources-Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources- Food resources- World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture- Energy resources- Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources- role of an individual in conservation of natural resources.

UNIT II ECOSYSTEM 9

Chemistry and Environment- Environmental segments, Composition and Structure of atmosphere- Concept of an ecosystem- Structure, components and function of an ecosystem Energy flow in the ecosystem – Food chain, food web and ecological pyramids, Structure and function of Terrestrial ecosystem (Forest, Desert and Grassland ecosystem) and Aquatic ecosystem (Fresh water and Marine ecosystem)

UNIT III BIODIVERSITY 9

Introduction to biodiversity, Definition- Genetic diversity, Species diversity and Ecosystem diversity, Biogeographical classification of India, Importance of biodiversity-Value of biodiversity - Hot Spots of biodiversity-Threats to biodiversity - Endangered and Endemic Species of India – Conservation of biodiversity- In-Situ and Ex-Situ conservation of biodiversity.

UNIT IV ENVIRONMENTAL POLLUTION 9

Definition – Causes, effects and control Measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution and Thermal pollution. Solid waste management-.Causes, effects and control measures of urban and industrial wastes– Role of an individual in prevention of pollution–Disaster management:-earthquake, tsunami, cyclone and landslides.

UNIT V SOCIAL ISSUES AND ENVIRONMENT 9

From unsustainable to Sustainable development,Urban problems related to energy sources, water conservation, Rain water harvesting and watershed management, Resettlement and rehabilitation of people, its problems and concerns,

Environmental ethics- Issues and possible solutions- Climate change- Green house effect and global warming, acid rain, ozone layer depletion, Wasteland reclamation- Environment Protection Act- Human Rights-Value Education, Role of Information Technology in Environment and human health-Population growth, variation of population among nations-Population explosion.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Ravikrishnan, A (2012), Environmental Science, Sri Krishna Hi tech Publishing Company Private Ltd., Chennai
2. Anubha kaushik C.P. Kaushik (2010), Environmental Science and Engineering, New Age International (p) Ltd., New Delhi
3. Linda D. Williams (2005), Environmental Science Demystified, Tata Mc Graw -Hill Publishing Company Limited, New Delhi
4. Tyler Miller G. Jr (2004), Environmental Science, Thomson & Thomson Publishers, New Delhi
5. http://people.eku.edu/ritchisong/envscinotes1.html
6. http://nptel.ac.in/courses.php?disciplineId=120 3.www.newagepublishers.com/samplechapter/001281.
7. www.unesco.org/ext/field/beijing/scienceb.htm,
8. www.infinitepower.org/education.htm

18PBEME411 THERMAL ENGINEERING LABORATORY SEMESTER – IV 3H: 2C

Instruction Hours / Week: - L: 0 T: 0 P: 3 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. Ability to conduct experiment on IC engine to study the characteristic and performance of IC design/ steam turbines.
2. To appreciate concepts learnt in fundamental laws of thermodynamics.
3. To learn ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.
4. To communicate effectively the concepts of internal combustion engines.
5. To make the students to prepare them to carry out experimental investigation and analysis at later stages of graduation.
6. To make the students to think beyond curriculum in alternative sources of energy.

COURSE OUTCOMES

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

1. conduct experiment on IC engine to study the characteristic and performance of IC Engine
2. conduct experiment to find the thermo physical properties of given fluid.
3. Understand the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.
4. Can formulate power production based on the fundamental laws of thermal engineering.
5. Understand instill upon to envisage appropriate experiments related to heat engines.
6. Understand and investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.

LIST OF EXPERIMENTS

I C ENGINES AND FUELS

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4–stroke Diesel Engine.
3. Heat Balance Test on 4–stroke Diesel Engine.
4. Load test on 4–stroke Diesel Engine.
5. Morse Test on multicylinder Petrol Engine.
6. Retardation Test to find Frictional Power of a Diesel Engine.
7. Determination of Viscosity – Red Wood Viscometer.

8. Determination of Flash Point and Fire Point.
9. Study of Steam Generators and Turbines.
10. Performance and energy balance test on a steam generator

HEAT TRANSFER

1. Heat transfer through a composite wall
2. Thermal conductivity measurement by guarded plate method
3. Natural convection heat transfer from a vertical cylinder
4. Heat transfer from pin–fin (natural and forced convection modes)
5. Effectiveness of Parallel/counter flow heat exchanger
6. Determination of Stefan–Boltzmann constant
7. Determination of emissivity of a grey surface

TOTAL 45 PERIODS

18PBEME501 OPERATIONS RESEARCH SEMESTER – V
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To Formulate and solve engineering and managerial situations as LPP.
2. To understand the Engineering and Managerial situations in Transportation.
3. To Study and acquire knowledge on engineering and Managerial solutions in Assignment and scheduling problems.
4. To give exposure to inventory in industry.
5. To make the student acquire sound knowledge on sequences to perform operation among various alternatives.
6. To provide an overview of various tools in various sections of industries like marketing, material handling etc.

COURSE OUTCOME (CO's)

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

1. Formulate and solve engineering and managerial situations as LPP.
2. Solve Engineering and Managerial situations in Transportation.
3. Give Engineering and Managerial solutions in Assignment and scheduling problems.
4. Manage inventory in industry.
5. Select better sequence to perform operation among various alternatives.
6. Apply the various tools in various sections of industries like marketing, material handling etc.

UNIT I INTRODUCTION TO OPERATIONS RESEARCH 9

Operations research and decision–making – types of mathematical models and constructing the model – Role of computers in operations research –Linear Programming Techniques: Formulation of linear programming problem, applications and limitations, graphical method, simplex method – The Big –M method – the two–phase method.

UNIT II TRANSPORTATION PROBLEMS 9

Least cost method, North west corner rule, Vogel's approximation method, modified distribution method, optimization models, unbalance and degeneracy in transportation model.

UNIT III ASSIGNMENT MODELS AND SCHEDULING 9

Assignment models - Hungarian algorithm, unbalanced assignment problems - maximization case in assignment problems, traveling salesman problem. Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing two jobs through 'm' machines, processing n jobs through m machines.

UNIT IV INVENTORY CONTROL AND QUEUING THEORY 9

Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, multi item deterministic model.

Queuing Models: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.

UNIT V PROJECT MANAGEMENT, GAME THEORY, REPLACEMENT MODELS 9

Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing – Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Kanti Swarup, Gupta P.K and Manmohan (2012), Operations Research, Sultan Chand and Sons, New Delhi
2. Viswanathan N and Narahari Y (2000), Performance Modeling of Automated Manufacturing Systems, Prentice Hall Inc, Newyork
3. Prem kumar Gupta and Hira D.S (2015), Operation Research, S Chand and Company Limited, New Delhi
4. http://www.scienceofbetter.org/what/index.htm
5. http://www.informs.org/Pubs/OR
6. http://www.me.utexas.edu/~jensen/ORMM/models/unit/network/subunits/special_cases/transportation.html
7. http://www.projectmanagement.com/

18PBEME502 DESIGN OF MACHINE ELEMENTS SEMESTER – V
4H: 4C

Instruction Hours / Week: - L: 3 T: 1 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the various types of stresses induced in different machine members.
2. To Study and acquire knowledge on design shaft and couplings for effective transmission of power.
3. To study the features of welded joints and fasteners required for various industrial applications.
4. To give exposure to design springs and flywheels for various engineering applications.
5. To understand the importance design bearings and levers for engineering applications.
6. To make the students conversant to implement design procedure for designing a machine.

COURSE OUTCOMES

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

1. Determine various types of stresses induced in different machine members.
2. Design shaft and couplings for effective transmission of power.
3. Select the type of welded joints and fasteners required for various industrial applications.
4. Design springs and flywheels for various engineering applications.
5. Design bearings and levers for engineering applications.
6. Implement design procedure for designing a machine.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9 + 3

Introduction to the design process – factors influencing machine design, selection of materials based on mechanical properties – Factor of safety. Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame – theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9 + 3

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways – Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings – design of knuckle joints.

UNIT III DESIGN OF FASTENERS AND WELDED JOINTS 9 + 3

Threaded fasteners – Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures – theory of bonded joints.

UNIT IV DESIGN OF SPRINGS AND FLYWHEEL 9 + 3

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs – Belleville springs – Design of flywheels involving stresses in rim and arm.

UNIT V DESIGN OF BEARINGS AND LEVERS 9 + 3

Selection of bearings – sliding contact and rolling contact types – Cubic mean load – Selection of journal bearings – McKees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of Levers.

TOTAL 45 + 15 = 60 PERIODS

(Permitted to use PSG design data book in the examination)

SUGGESTED READINGS

1. Juvinall R.C and Marshek K.M (2015), Fundamentals of Machine Component Design Third Edition, John Wiley and Sons, New Delhi
2. Bhandari V.B (2016), Design of Machine Elements, Tata McGraw–Hill Book Co, New Delhi
3. Norton R.L (2011), Design of Machinery, Tata McGraw–Hill Book Co., New Delhi

4. Orthwein W (2004), Machine Component Design, Jaico Publishing Co., New Delhi
5. Ugural A.C (2004), Mechanical Design – An Integral Approach, McGraw–Hill Book Co., New York
6. Spotts M.F, Shoup T.E (2008), Design and Machine Elements, Pearson Education, New Delhi
7. www.roymech.co.uk
8. www.ncbi.nlm.nih.gov
9. www.engineersedge.com
10. www.bearings.machinedesign.com

18PBEME503 COMPUTER INTEGRATED MANUFACTURING SEMESTER – V 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the application of computers in various aspects of Manufacturing viz., Design, proper planning, Manufacturing cost, Layout & Material Handling system.
2. To know the application of principles of group technology in computer aided process planning.
3. To impart knowledge on working of the shop floor control
4. To Study and acquire knowledge on data collection system in FMS .
5. To familiarize the students to understand CIM architecture for practical application.
6. To expose students to generate database for computer integrated manufacturing processes.

COURSE OUTCOMES

Upon completion of this course, the student can able to

1. Implement computer integrated manufacturing concepts in industries.
2. Apply the principles of group technology in computer aided process planning.
3. Understand the working of the shop floor control
4. Implement automated data collection system in FMS .
5. Develop CIM architecture for practical application.
6. Generate database for computer integrated manufacturing processes.

UNIT I INTRODUCTION 9

The meaning and origin of CIM– the changing manufacturing and management scene – External communication – islands of automation and software–dedicated and open systems–manufacturing automation protocol – product related activities of a company– marketing engineering – production planning – plant operations – physical distribution– business and financial management.

UNIT II GROUP TECHNOLOGY 9

Group technology– – part families – Classification and coding – Approaches to computer aided process planning –variant approach and generative approaches

UNIT III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS 9

Shop floor control–phases –factory data collection system –automatic identification methods– Bar code technology– automated data collection system. FMS–components of FMS – types –FMS workstation –material handling and storage systems– FMS layout –computer control systems–application and benefits.

UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION 9

CIM and company strategy – system modeling tools –IDEF models – activity cycle diagram – CIM open system architecture (CIMOSA)– manufacturing enterprise wheel–CIM architecture – Product data management–CIM

implementation software. Communication fundamentals– local area networks –topology – LAN implementations – network management and installations –MRP, ERP concepts

UNIT V OPEN SYSTEM AND DATABASE FOR CIM 9

Open systems–open system inter connection – manufacturing automations protocol and technical office protocol (MAP /TOP).

Development of databases –database terminology– architecture of database systems–data modeling and data associations –relational data bases – database operators – advantages of data base and relational database.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Mikell.P.Groover (2016), Automation, Production Systems and computer integrated manufacturing, Pearson Education, Delhi
2. Yorem koren (2016), Computer Integrated Manufacturing system, McGraw-Hill, New York
3. Kant Vajpayee S (2017), Principles of computer integrated manufacturing, Prentice Hall India, New Delhi
4. Radhakrishnan P and Subramanyan S (2017), CAD/CAM/CIM, 2nd Edition, New Age International (P) Ltd, New Delhi
5. http://en.wikipedia.org/wiki/Computer-integrated_manufacturing
6. http://www.technologystudent.com/rmprp07/intman1.html
7. http://www.computerintegratedmanufacturing.com/

18PBEMEE-- PROFESSIONAL ELECTIVE - I SEMESTER – V
3H: 3C

18PBEME511 COMPUTER AIDED MANUFACTURING LABORATORY SEMESTER – V
3H: 2C

Instruction Hours / Week: - L: 0 T: 0 P: 3 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To perform simple structural analysis and thermal analysis using simulation software's.
2. To perform structural analysis of bars and trusses.
3. To perform structural analysis of beams and frames.
4. To perform 2D analysis of plate and shells
5. To perform modal analysis of simple systems
6. To perform thermal analysis of simple systems

COURSE OUTCOMES

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

1. Perform structural analysis of bars and trusses
2. Perform structural analysis of beams and frames
3. Perform 2d analysis of plate and shells
4. Perform modal analysis of simple systems
5. Perform thermal analysis of simple systems
6. Perform fluid and failure analysis of simple systems

COMPUTER AIDED MANUFACTURING (CAM)

1. MANUAL PART PROGRAMMING (Using G and M Codes) in CNC Machine.
2. Part programming for Linear, Circular interpolation, and Contour motions.
3. Part programming using standard canned cycles for Thread cutting, Drilling, Peck drilling, and Boring.
4. NC code generation using software's like Edge CAM, CREO, etc. CNC Controllers like FANUC, Siemens, and Hiedenhain etc.

TOTAL 45 PERIODS

18PBEME601 ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT SEMESTER – VI 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To enable students to understand the fundamental economic concepts applicable to engineering
2. To learn the techniques of incorporating inflation factor in economic decision making.
3. To Understand the measures of national income, the functions of banks and concepts of globalization
4. To Apply the concepts of financial management for project appraisal
5. To Understand accounting systems and analyze financial statements using ratio analysis
6. To Understand Financial planning, economic basis for replacement.

COURSE OUTCOMES

1. Evaluate the economic theories, cost concepts and pricing policies.
2. Understand the market structures and integration concepts
3. Understand the measures of national income, the functions of banks and concepts of globalization
4. Apply the concepts of financial management for project appraisal
5. Understand accounting systems and analyze financial statements using ratio analysis
6. Understand the impact of inflation, taxation, depreciation. Financial planning, economic basis for replacement, project scheduling, and legal and regulatory issues are introduced and applied to economic investment and project-management problems

UNIT 1 FUNDAMENTALS OF ENGINEERING ECONOMICS 9

Introduction to Engineering Economics – Definition, Scope and Significance – Demand and supply analysis – Definition – Law of Demand – Elasticity of Demand – Demand Forecasting – Supply – Law of supply – Elasticity of Supply.

UNIT II COMMERCIAL BANKING 9

Law of contracts, negotiable instruments, its types and regulations there on – New Industrial Policy – MSME sector – Development financial institutions and their relevance – Export Promotion - DICGC, ECGCI, EXIM Bank - Import and export concepts - Letter of credit, forward contracts / hedging.

UNIT III CAPITAL MARKET 9

Stock Exchanges – Functions – Listing of Companies – Role of SEBI – Capital Market Reforms. Money and banking - Money – Functions –Inflation and deflation – Commercial Bank and its functions – Central bank and its functions.

UNIT IV FINANCIAL CONCEPTS 9

Introduction, scope and objectives of basic financial concepts – time value of money – Interest - simple & compound interest, annuity and effective rate of interests. Appraisal of project for profitability, internal rate of return – payback period – net present value. NPV comparison – cost benefit analysis. Sources of finance – internal and external.

UNIT V COST ANALYSIS AND BREAK EVEN ANALYSIS 9

Cost analysis - Basic cost concepts – FC, VC, TC, MC – Cost output in the short and long run. Depreciation - meaning – Causes – Methods of computing Depreciation (simple problems in Straight Line Method, Written Down Vale Method). Meaning – Break Even Analysis - Managerial uses of BEA.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Ramachandra Aryasri V. V.Ramana Murthy (2016), Engineering Economics & Financial Accounting, Tata McGraw Hill,– ,New Delhi
2. Varshney R. L., and K.L Maheshwari (2015), Managerial Economics, Sultan Chand & Sons, New Delhi
3. M.L.Jhingan (2010), Principles of Economics, Konark Publications
4. Prasanna Chandra (2014), Fundamentals of Financial Management, Tata McGraw Hill, New Delhi
5. D.M.Mithani (2010), Money, Banking, International Trade & Public Finance, Himalaya Publishing House
6. http://economictimes.indiatimes.com
7. http://www.economist.com/
8. http://www.managementstudyguide.com/financial-management.htm

18PBEME602 SMART MANUFACTURING SEMESTER – VI
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand about industrial revolution
2. To understand the concept of Industry 4.0
3. To understand the benefit of IOT
4. To understand the concepts of automation
5. To understand about cloud computing
6. To understand the challenges in smart manufacturing

COURSE OUTCOMES:

At the end of the course the students

1. Can understand the concepts of industrial knowledge
2. Can apply the concept of Industry 4.0 in industries
3. Can able implement the IOT concept
4. Can able to evaluate the process of automation
5. Can able to apply the concepts of cloud computing
6. Can able to solve the challenges in industries

UNIT I INTRODUCTION 9

The Various Industrial Revolutions: First, Second, Third and Fourth. Industry 4.0 - Digitalization and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - The Journey so far: Developments in USA, Europe, China and other countries- Comparison of Industry 4.0 Factory and Today's Factory

UNIT II INDUSTRY 4.0 9

Definition and Development - Industry 4.0 environment – Exponential technologies – Characteristics of industry 4.0 - the basic Components of Industry 4.0 - the basic Principles of Industry 4.0 - Relations between principles and components of Industry 4.0

UNIT III ROAD TO INDUSTRY 4.0 9

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics - Technologies for enabling Industry 4.0 - Cyberphysical Systems - Robotic Automation and Collaborative Robots - Mobile Computing - Cyber Security

UNIT IV ROLE OF DATA, INFORMATION, KNOWLEDGE 9

Resource-based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0. Other Applications and Case Studies - Industry 4.0 laboratories, IIoT case studies

UNIT V BUSINESS ISSUES IN INDUSTRY 4.0 9

Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Kurt Gaubinger , Michael Rabl , Scott Swan, Thomas Werani (2015), Innovation and Product Management: A Holistic and Practical Approach to Uncertainty Reduction, Springer Texts in Business and Economics
2. Alan L. Porter, Scott W. unningham , Jerry Banks , A. Thomas Roper , Thomas W. Mason , Frederick A. Rossini (2011), Forecasting and Management of Technology, Wiley
3. https://www.aspeninstitute.it/system/files/private.../doc/INDUSTRY%204.0_finale.pdf
4. https://www.researchgate.net/...INDUSTRY.../56f1a41b08ae1cb29a3d1688.pdf?
5. https://www.cenit.com/fileadmin/dam/Corporate/.../2015_5_Expertenwissen_E.pdf
6. https://www.itu.int/en/ITU-D/Regional-Presence/.../Documents/.../S3_KITECH.pdf

7. https://www2.deloitte.com/.../Documents/.../ch-en-manufacturing-industry-4-0-2410201...

18PBEME603 ENTREPRENEURSHIP DEVELOPMENT SEMESTER – VI 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.
2. understanding basic concepts in the area of entrepreneurship,
3. understanding the role and importance of entrepreneurship for economic development
4. developing personal creativity and entrepreneurial initiative,
5. adopting of the key steps in the elaboration of business idea,
6. Understanding the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

COURSE OUTCOME

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

1. Have the ability to discern distinct entrepreneurial traits
2. Know the parameters to assess opportunities and constraints for new business ideas
3. Understand the systematic process to select and screen a business idea
4. design strategies for successful implementation of ideas
5. understand about financial management
6. understand about business support

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth. . EDP Institutions in India and their functions – DIC, SISI, TCOs.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting. Incentives to Small Scale Industry – Benefits to Industrial Units located in Backward Areas, Industrial Estates.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Khanka. S.S (2013), Entrepreneurial Development, S.Chand & Co. Ltd., New Delhi
2. Donald F Kuratko (2014), Entreprenuership – Theory, Process and Practice, Cengage Learning
3. Hisrich R D, Peters M (2013), Entrepreneurship, Tata McGraw-Hill
4. Mathew J Manimala (2005), Enterprenuership theory at cross roads: paradigms and praxis, Dream tech
5. Rajeev Roy (2011), Entrepreneurship, Oxford University Press

18PBEMEE-- PROFESSIONAL ELECTIVE - II SEMESTER – VI
3H: 3C

18PBEME611 COMPUTER AIDED ANALYSIS LABORATORY SEMESTER – VI
3H: 2C

Instruction Hours / Week: - L: 0 T: 0 P: 3 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To gain practical experience in handling 2D drafting and 3D modeling software systems.
2. To impart training on SOLID WORKS for modelling
3. To provide knowledge on assembly of components
4. To facilitate the understanding of manufacturing drawings from the model created
5. To understand the importance of MAT Lab for simulating different systems
6. To acquaint the student with the concepts of mat lab for performing various mathematical operations

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. use computer and CAD software's for modeling of mechanical components
2. use various options in Solid Works for modeling of given components
3. create assembly of components
4. prepare manufacturing drawings from the models created
5. Use MAT Lab for simulating different systems like hydraulic and pneumatic circuits
6. Use mat lab for performing various mathematical operations

Simple Analysis using ANSYS Tool

1. Stress analysis of rectangular L bracket
2. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
3. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
4. Harmonic analysis of a 2D component
5. Thermal stress analysis of a 2D component
6. Modeling a 3D component. (Single point cutting tool, I beams, etc.,)

TOTAL 45 PERIODS

18PBEME701 TOTAL QUALITY MANAGEMENT SEMESTER – VII
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To introduce the concepts of essentiality of quality.
2. To understand the importance of various TQM principles.
3. To introduce the concepts of the various TQM principles.
4. To Understand the techniques for quality management.
5. To introduce the standard quality systems in industries.
6. To familiarize the students to understand the various techniques to improve the quality in industries.

COURSE OUTCOMES

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

1. Understand the essentiality of quality.
2. Summarize various TQM principles.
3. Understand the various TQM principles.
4. Understand the techniques for quality management.
5. Implement standard quality systems in industries.
6. Apply various techniques to improve the quality in industries.

UNIT I ESSENTIALS OF TQM 9

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III TQM TOOLS 9

The new seven management tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma – APQP.

UNIT IV TQM TECHNIQUES 9

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V QUALITY AND ENVIRONMENT SYSTEMS 9

Need for ISO 9000 and Other Quality Systems, ISO 9000:2002 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 and ISO 18001 – Concept, Requirements and Benefits.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Dale H.Besterfiled (2017), Total Quality Management, Pearson Education, Delhi
2. Feigenbaum.A.V (2008), Total Quality Control, McGraw Hill, New Delhi
3. Oakland.J.S (2014), Total Quality Management, Butterworth – Hcinemann Ltd., Oxford
4. Narayana V. and Sreenivasan N.S (2016), Quality Management – Concepts and Tasks, New Age International Ltd., New Delhi
5. Zairi (1996), Total Quality Management for Engineers, WoodHead Publishers, New Delhi
6. http://auciello.tripod.com/14tqm.html
7. http://www.fkm.utm.my/~shari/download/toc%20paper%20hilma%20tqm%20dis06.pdf
8. http://www.businessgyan.com/node/5409

9. http://www.accelper.com/pdfs/SS_Measurements_Concepts.pdf
10. http://tutor2u.net/business/strategy/benchmarking.htm
11. http://www.trst.com/iso2a.htm

18PBEMEE--	**PROFESSIONAL ELECTIVE - III**	**SEMESTER – VII 3H: 3C**

18PBEMEE--	**PROFESSIONAL ELECTIVE - IV**	**SEMESTER – VII 3H: 3C**

18PBEME791	**PROJECT WORK AND VIVA – VOCE**	**SEMESTER – VII 9H: 6C**

Instruction Hours / Week: - L: 0 T: 0 P: 9 Marks: - Internal: 40 External: 60 Total: 100

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL 135 PERIODS

PROFESSIONAL ELECTIVES

DESIGN ENGINEERING

18PBEMEED01	**DESIGN OF TRANSMISSION SYSTEMS**	**3H: 3C**

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To Study and acquire knowledge on design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. To Study and acquire knowledge on design spurs and parallel axis helical gears.
3. To give exposure to dimensions for bevel and worm gears.
4. To provide an overview of design procedures of gear boxes for industrial applications.
5. To provide an overview of clutches and brakes for engineering applications.
6. To make the student acquire sound knowledge of mechanical system

COURSE OUTCOMES

Upon completion of this course, the students will able to

1. Design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. Design spurs and parallel axis helical gears.
3. Estimate the dimensions for bevel and worm gears.
4. Practice the design procedures of gear boxes for industrial applications.
5. Design clutches and brakes for engineering applications.
6. Design a mechanical system

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 9

Design of V belts and pulleys – Selection of Flat belts and pulleys – Wire ropes and pulleys – Selection of Transmission chains and Sprockets – Design of sprockets.

UNIT II DESIGN OF SPUR AND HELICAL GEARS 9

Gear Terminology – Speed ratios and number of teeth–Force analysis – Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Module and Face width–power rating calculations based on strength and wear considerations – Parallel axis Helical Gears – Pressure angle in the normal and transverse plane– Equivalent number of teeth–forces and stresses – Estimating the size of the helical gears.

UNIT III DESIGN OF BEVEL AND WORM GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits– terminology – Thermal capacity, materials–forces and stresses, efficiency, estimating the size of the worm gear pair – Cross helical: Terminology–helix angles–Estimating the size of the pair of cross helical gears.

UNIT IV DESIGN OF GEAR BOXES 9

Geometric progression – Standard step ratio – Ray diagram, kinematics layout –Design of sliding mesh gear box – Constant mesh gear box. – Design of multi speed gear box.

UNIT V DESIGN OF CLUTCHES AND BRAKES 9

Design of plate clutches –axial clutches–cone clutches–internal expanding rim clutches–internal and external shoe brakes.

TOTAL 45 PERIODS

(Permitted to use PSG design data book in the examination)

SUGGESTED READINGS

1. Juvinall R. C, Marshek K.M (2017), Fundamentals of Machine component Design, John Wiley and Sons., London
2. Bhandari, V.B (2016), Design of Machine Elements, Tata McGraw–Hill Publishing Company Ltd, New York
3. Maitra G.M., Prasad L.V (2009), Hand book of Mechanical Design, Tata McGraw–Hill, New Delhi
4. Shigley J.E, Mischke C.R (2015), Mechanical Engineering Design, McGraw–Hill International Editions, New Delhi
5. Prabhu. T.J (2002), Design of Transmission Elements, Mani Offset, Chennai
6. http://en.wikipedia.org/wiki/Gear
7. http://www.physicsforums.com/showthread.php?t=292163
8. http://www.seminarprojects.com/Thread–design–and–fabrication–of–gearbox–full–report

18PBEMEED02 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge on the principles of locating and clamping devices in machining process.
2. To familiarize the students to understand design of jigs for a given component.
3. To Study and acquire knowledge on design fixtures for a given component.
4. To make the student acquire sound knowledge on appropriate type of press tool for a given component.
5. To expose students to drawing die for a given component.
6. To give exposure to the use computer aids for sheet metal forming analysis

COURSE OUTCOMES

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

1. Summarize the principles of locating and clamping devices in machining process.
2. Design jigs for a given component.
3. Design fixtures for a given component.
4. Design an appropriate type of press tool for a given component.
5. Develop a drawing die for a given component.
6. Use computer aids for sheet metal forming analysis

UNIT I PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES 9

Tool design objective – Production devices – Inspection devices – Materials used in Jigs and Fixtures – Types of Jigs – Types of Fixtures–Mechanical actuation–pneumatic and hydraulic actuation–Analysis of clamping force–Tolerance and error analysis.

UNIT II JIGS 9

Drill bushes –different types of jigs–plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs–Automatic drill jigs–Rack and pinion operated. Air operated Jigs components. Design and development of Jigs for given components.

UNIT III FIXTURES 9

General principles of boring, lathe, milling and broaching fixtures– Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures– Modular fixtures. Design and development of fixtures for given component.

UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT 9

Press working terminology–Presses and press accessories–Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies:Die block–die shoe. Bolster plate–punch plate–punch holder–guide pins and bushes – strippers – knockouts–stops –pilots–Selection of standard die sets strip lay out–strip lay out calculations

UNIT V DESIGN AND DEVELOPMENT OF DIES 9

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies–forming and drawing dies–Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Edward G Hoffman (2016), Jigs and Fixture Design, Thomson – Delmar Learning, Singapore
2. Donaldson C (2015), Tool Design, Tata McGraw–Hill, New Delhi
3. Kempster (2004), Jigs and Fixtures Design, Tata McGraw–Hill Publishing, New Delhi
4. Joshi P.H (2016), Jigs and Fixtures Second Edition, Tata McGraw–Hill Publishing Company Limited, New Delhi
5. Hiram E Grant (2003), Jigs and Fixture, Tata McGraw–Hill, New Delhi
6. www.wisetool.com
7. www.invert–a–bolt.com
8. www.diemech.com
9. www.schaefertools.com
10. www.steelsmith.com

18PBEMEED03 DESIGN FOR MANUFACTURE AND ASSEMBLY 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the importance of the DFM approach and guidelines
2. To enrich the understanding of the selective assembly and Datum systems
3. To introduce the concepts of demonstrate true Position tolerancing theory.
4. To develop an understanding of the standard techniques and redesigning cast members using weldments and plastic component manufacturing.
5. To equip them with skills on Tolerance Charting Technique.
6. To Study and acquire knowledge of the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

COURSE OUTCOMES

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

1. Understand the DFM approach and guidelines
2. Understand the selective assembly and Datum systems
3. Demonstrate true Position tolerancing theory.
4. Understand redesigning cast members using weldments and plastic component manufacturing.
5. Demonstrate the Tolerance Charting Technique.
6. Know the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

UNIT I DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY 9

DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka – Yoke principle; 6σ concept; Tolerance Analysis: Process capability, process capability metrics, Cp, Cpk , cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law.

UNIT II SELECTIVE ASSEMBLY 9

Interchangeable and selective assembly, deciding the number of groups, Model–I: group tolerances of mating parts equal; Model–II: total and group tolerances of shaft, control of axial play.

Datum Systems: Grouped datum systems–different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, and tongue–slot pair, computation of translational and rotational accuracy.

UNIT III TRUE POSITION TOLERANCING THEORY 9

Comparison between co–ordinate and convention method of feature location tolerancing and true position tolerancing, zero true position tolerance, virtual size concept, floating and fixed fasteners, projected tolerance zone, functional gauges, paper layout gauging, compound assembly, examples.

UNIT IV FORM DESIGN OF CASTINGS AND WELDMENTS 9

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – design considerations for plastic component manufacturing.

UNIT V TOLERANCE CHARTING 9

Tolerance Charting Technique: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining. Datum features – functional and manufacturing, component design–machining considerations, redesign for manufacture, examples.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Harry Peck (1983), Designing for Manufacture, Pitman Publications, London

2. Gerhard Pahl, Wolfgang Beitz (2013), Engineering Design – A Systematic Approach, Springer Science & Business Media
3. Spotts M F (1983), Dimensioning and Tolerance for Quantity Production, Prentice Hall Inc., New Jersey, USA
4. Oliver R Wade (1967), Tolerance Control in Design and Manufacturing, Industrial press Inc., New York
5. James G Bralla (1986), Hand Book of Product Design for Manufacturing, McGraw Hill Publications, New Delhi
6. www.dfma.com
7. www.design4manufacturability.com

18PBEMEED04 HYDRAULICS AND PNEUMATICS POWER CONTROL 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To recognize symbols and fundamentals in fluid power generation and distribution.
2. To identify power source for hydraulic systems.
3. To select appropriate components used in various hydraulic systems.
4. To design hydraulic circuits for given applications
5. To distinguish the components used in pneumatic circuits.
6. To create the logic circuits for controlling electro-hydraulic/ pneumatic systems.

COURSE OUTCOMES

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

1. Recognize symbols and fundamentals in fluid power generation and distribution.
2. Identify power source for hydraulic systems.
3. Select appropriate components used in various hydraulic systems.
4. Design hydraulic circuits for given applications
5. Distinguish the components used in pneumatic circuits.
6. Create the logic circuits for controlling electro-hydraulic/ pneumatic systems.

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics–Applications of Pascals Law– Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, Pressure boosting pumps, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Construction of Control Components : Direction control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS 9

Pneumatic Components: Properties of air – Compressors – Filter, Regulator and Lubricator UNIT Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Anthony Esposito (2013), Fluid Power with Applications, Pearson Education, New Delhi
2. Majumdar S.R (2016), Oil Hydraulics, Tata McGraw–Hill, New Delhi
3. Majumdar S.R (2015), Pneumatic systems – Principles and maintenance, Tata McGraw Hill, New Delhi
4. Anthony Lal (2015), Oil hydraulics in the service of industry, Allied publishers, New Delhi
5. http://www.g–w.com/PDF/SampChap/60525_0816_Ch02.pdf
6. http://www.engineeringtoolbox.com/classification–pumps–d_55.html
7. http://www.omega.com/auto/pdf/SimpValvesguide.pdf

18PBEMEED05 DESIGN AND ANALYSIS OF EXPERIMENTS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 **Marks: - Internal: 40 External: 60 Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To provide foundations on design of experiments and statistical analysis of experimental data obtained from laboratory and/or industrial processes.
2. To understand the important concepts of single factorial designs
3. To Study and acquire knowledge on various methodologies involved in single factorial designs
4. To know the application of testing of factorial experiment
5. To enrich the understanding of special experimental designs
6. To impart knowledge on basic concepts of Taguchi method in parameter design

COURSE OUTCOMES

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

1. Understand the knowledge of various techniques for experimental planning
2. Understand the concepts of single factorial designs
3. List the various methodologies involved in single factorial designs
4. Apply the concept of testing of factorial experiment
5. Solve the partial and ordinary differential equations special experimental designs
6. Apply the basic concepts of Taguchi method in parameter design

UNIT I INTRODUCTION 9

Planning of experiments – Steps – Need - Terminology: Factors, levels, variables, experimental error, replication, Randomization, Blocking, Confounding.

UNIT II SINGLE FACTOR EXPERIMENTS 9

ANOVA rationale - Sum of squares – Completely randomized design, Randomized block design, effect of coding, Comparison of treatment means – Newman Kuel‘s test, Duncan‘s Multiple Range test, Latin Square Design, Graeco-Latin Square Design, Balanced incomplete design.

UNIT III FACTORIAL EXPERIMENTS 9

Main and interaction effects –Two and three Factor full factorial Designs, 2 k deigns with Two and Three factors-Unreplicated design- Yate‘s Algorithm

UNIT IV SPECIAL EXPERIMENTAL DESIGNS 9

Blocking in factorial design, Confounding of 2k design, nested design-Response Surface Methods.

UNIT V TAGUCHI TECHNIQUES 9

Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Montgomery, D.C (2012), Design and Analysis of Experiments, John Wiley and Sons
2. Hicks. C.R (2000), Fundamental concepts in the Design of Experiments, Holt, Rinehort and Winston
3. Bagchi. T.P (2002), Taguchi Methods explained, Prentice Hall
4. Ross. P.J (2000), Taguchi Techniques for quality Engineering, Prentice Hall
5. http://cran.r-project.org
6. http://www.itl.nist.gov/div898/handbook/
7. http://home.ubalt.edu/ntsbarsh/stat-data/Topics.htm

18PBEMEED06 ADVANCED STRENGTH OF MATERIALS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To analyze the stresses and deformations through advanced mathematical models.
2. To estimate the design strength of various industrial equipment.
3. To understand the mechanism of rotating dics
4. To understand the mechanism of elastic foundation
5. To understand about stresses distribution
6. To understand the applications to rolling contact elements

COURSE OUTCOME (CO's)

. On successful completion of this course students will be able to:

1 Explain the theory, concepts, principles and governing equations of solid mechanics;
2 Demonstrate the abiltity to deconstruct complex problems to produce effective outcomes;
3 Use analytical, experimental and computational tools needed to solve the idealized problem;
4 Demonstrate the independent judgment required to interpret the results of these solutions;
5 Use these solutions to guide a corresponding design, manufacture, or failure analysis;
6 Explain the selection, design and stress analysis

UNIT I ANALYSIS OF PLATES 9

Mathematical modeling of plates with normal loads – Point and Distributed Loads – Support conditions – Rectangular plates - Stresses along coordinate axes – Plate deformations – Axi-symmetric plates – Radial and tangential stresses – plate deflections.

UNIT II THICK CYLINDERS AND SPHERES 9

Equilibrium and compatibility conditions - Lame's Theorem – Boundary conditions – distribution of radial and tangential stresses – compound cylinders – Interference fits - Stresses due to temperature distributions.

UNIT III ROTATING DISCS 9

Lame-Clayperon Theorem – radial and tangential stresses in discs due to centrifugal effects – boundary conditions – solid and hollow discs – Interference fit on shafts –Strengthening of the hub – residual stresses – Autofrettege – Discs of variable thickness – Disc profile for uniform strength.

UNIT IV BEAMS ON ELASTIC FOUNDATION 9

Infinite beam subjected to concentrated load – Boundary Conditions – Infinite beam subjected to a distributed load segment – Triangular load – Semi infinite beam subjected to loads at the ends and concentrated load near the ends – Short beams.

UNIT V CURVED BEAMS AND CONTACT STRESSES 9

Analysis of stresses in beams with large curvature – Stress distribution in curved beams – Stresses in crane hooks and C clamps – Contact Stresses – Hertz equation for contact stresses – applications to rolling contact elements.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Boresi A.P, R.J Schmidt (2003), Advanced Mechanics of Materials, John Wiley and Sons, London
2. Dally J.W and W.F.Riley (2003), Experimental Stress Analysis, John Wiley and Sons, London
3. A.H Burr , CheathAm J.B (2001), Mechanical Analysis and Design, Prentice Hall of India, New Delhi
4. J.P Den-Hartog (2001), Strength of Materials, John Wiley and Sons, London
5. http://www.rwc.uc.edu/koehler/biophys/2f.html
6. http://wiki.answers.com/Q/What_is_torsion
7. www.engin.umich.edu/students/ELRC/me211/beamdef.htmlhttp://www.mech.uwa.edu.au/DANotes/cylinders/thin/thin.html
8. http://en.wikipedia.org/wiki/shear_stress

18PBEMEED07 FINITE ELEMENT METHODS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To explain the steps involved in FEA and also the types of weight residual methods
2. To impart knowledge to formulate and solve problems in one dimensional structures including trusses, beams and frames.
3. To enrich the understanding of two dimensional thermal and torsion problems.
4. To enrich the understanding of axisymmetric bodies, plate and shell.
5. To develop an understanding of the standard techniques on matrix solution techniques to dynamic problems.
6. To impart knowledge on FE equation for structural, heat transfer and vibration problems.

COURSE OUTCOMES

1. Explain the steps involved in FEA and also the types of weight residual methods
2. Formulate and solve problems in one dimensional structures including trusses, beams and frames.
3. Predict finite element equations for two dimensional thermal and torsion problems.
4. Predict finite element equations for axisymmetric bodies, plate and shell.
5. Apply matrix solution techniques to dynamic problems.

Formulate FE equation for structural, heat transfer and vibration problems

UNIT I INTRODUCTION 9

Historical background – Matrix approach – Application to the continuum – Discretization – Matrix algebra – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method

UNIT II ONE DIMENSIONAL PROBLEMS 9

Finite element modeling – Coordinates and shape functions– Potential energy approach – Galerkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses

UNIT III TWO DIMENSIONAL CONTINUUM 9

Introduction – Finite element modeling – Scalar valued problem – Poisson equation –Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galerkin approach – Stress calculation – Temperature effects

UNIT IV AXISYMMETRIC CONTINUUM 9

Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures

UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM 9

The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration – Stiffness integration – Stress calculations – Four node quadrilateral element.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Rao S.S (2017), The Finite Element Method in Engineering, Butter worth Heinemann imprint, USA
2. Khanka S.S (2010), A First course in the Finite Element Method, Cengage Learning, Stamford, USA
3. Chandrupatla T.R., and Belegundu A.D (2017), Introduction to Finite Elements in Engineering, Pearson Education, Delhi
4. David V Hutton (2015), Fundamentals of Finite Element Analysis, McGraw–Hill Education
5. http://nptel.iitm.ac.in/courses/Webcourse–contents/IIT–KANPUR/mathematics–2/node18.html
6. http://www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf

7. http://www.rose–hulman.edu/~fine/FE2004/Class2/Notes2.pdf
8. http://www.asiri.net/courses/meng412/m412sm04ex1sol.pdf
9. http://hyperphysics.phy–astr.gsu.edu/hbase/electric/laplace.html

18PBEMEED08 MACHINE TOOL DESIGN 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To gain knowledge in design and material selection of various machine tools.
2. To provide an overview of regulation of speeds and feeds
3. To study the features of machine tool structures
4. To understand the importance of constructional features of machine tool structures
5. To expose students to design in machine tool structures, guide ways, power screws and spindles
6. To expose students to design spindles and spindle supports

COURSE OUTCOMES:

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

1. Discuss the basics machine tool drives and mechanisms
2. Get knowledge on regulation of speeds and feeds
3. Understand the importance of machine tool structures
4. Explain the constructional features of machine tool structures
5. Design in machine tool structures, guide ways, power screws and spindles
6. Design spindles and spindle supports

UNIT I INTRODUCTION TO MACHINE TOOL DRIVES AND MECHANISMS 9

Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNIT II REGULATION OF SPEEDS AND FEEDS 9

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 III DESIGN OF MACHINE TOOL STRUCTURES 9

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 IV DESIGN OF GUIDEWAYS, POWER SCREWS AND SPINDLES 9

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

UNIT V DESIGN OF SPINDLES AND SPINDLE SUPPORTS 9

Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings. Dynamics of Machine Tools - Machine Tool Elastic System, Static and Dynamic Stiffness

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Sen, G.C. and Bhattacharya, A (2006), Principles of machine tools, New Central Book Agency, Calcutta
2. Chernov N (2010), Machine Tools, Mir publishers Moscow
3. N.K. Mehta (2017), Machine Tool Design and Numerical Control, 3e, TMH, New Delhi
4. D. K Pal, S. K. Basu (2016), Design of Machine Tools, Oxford IBH

5. N. S. Acherkhan (2010), Machine Tool Design, MIR publications

18PBEMEED09 DESIGN OF MECHATRONIC SYSTEMS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
2. To understand the concepts of sensors and transducers.
3. To provide an overview of actuation systems.
4. To expose students to controller model for electrical, mechanical and thermal systems.
5. To provide knowledge about various types of controllers
6. To facilitate the understanding of PLC program using ladder logic.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Implement the concepts of sensors and transducers.
2. Design the actuation systems.
3. Develop the controller model for electrical, mechanical and thermal systems.
4. Explain about various types of controllers
5. Create the PLC program using ladder logic.
6. Design Mechatronics system

UNIT I MECHATRONICS SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics – Systems – Measurement Systems – Control Systems –Traditional design – Microprocessor based Controllers. Introduction to sensors – Performance Terminology – Static and Dynamic characteristics – Displacement – Position and Proximity – Velocity and Motion – Fluid Pressure – Temperature Sensors – Light Sensors – Selection of Sensors – Signal processing – Servo systems.

UNIT II ACTUATORS AND SYSTEM MODELS 9

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors.
Introduction to system models– Building block of Mechanical, Electrical, Fluid and Thermal Systems.

UNIT III MICROPROCESSORS IN MECHATRONICS 9

Introduction – Architecture – pin configuration Instruction set – Programming of Microprocessors using 8085 instructions – Interfacing. Input and output devices – interfacing D/A converters and A/D converters – Application – Temperature control – Stepper motor control.

UNIT IV CONTROLLERS 9

Introduction –Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers –Digital Controllers – Adaptive Control – Digital Logic Control – Micro Processors Control. Introduction to PLC – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Data Handling – Analog Input / Output – Selection of a PLC.

UNIT V DESIGN OF MECHATRONIC SYSTEMS 9

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design – Possible Design Solutions – Case Studies of Mechatronics Systems, Pick and place robot – automatic Car Park Systems – Engine Management Systems – Introduction to MEMS.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Bolton W (2015), Mechatronics (Anna University): A Multidisciplinary, Pearson Education, Delhi

2. Michael B. Histand David G. Alciatore (2011), Introduction to Mechatronics and Measurement Systems, McGraw–Hill International Editions, New York
3. Nitaigour Premchand Mahalik (2003), Mechatronics : Principles, Concepts and Applications, McGraw–HillEducation, New Delhi
4. Ghosh P.K and Sridhar P.R (2009), Introduction to Microprocessors for Engineers and Scientist, Prentice Hall of India, New Delhi

18PBEMEED10 TRIBOLOGY 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To impart knowledge in the friction , wear and lubrication aspects of machine components
2. To understand the material properties which influence the tribological characteristics of surfaces.
3. To understand the analytical behavior of different types bearings and design of bearings based on analytical /theoretical approach
4. Tomake the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
5. To expose the students to the factors influencing the selection of bearing materials fordifferent sliding applications.
6. To introduce the concepts of surface engineering and its importance in tribology

COURSE OUTCOME (CO's)

After studying this course, students will be able to:

1. Understand the fundamentals of tribology and associated parameters.
2. Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.
3. Analyze the requirements and design hydrodynamic journal and plane slider bearings for a given application.
4. Select proper bearing materials and lubricants for a given tribological application.
5. Select suitable surface treatment methods to enhance tribological properties
6. Apply the principles of surface engineering for different applications of tribology.

UNIT I SURFACE INTERACTION AND FRICTION 9

Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact

UNIT II WEAR AND SURFACE TREATMENT 9

Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear modelsWear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements – Laser methods – instrumentation - International standards in friction and wear measurements.

UNIT III LUBRICANTS AND LUBRICATION REGIMES 9

Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants-Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary LubricationHydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION 9

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds EquationReynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearingPressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION 9

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication TheorySoft and hard EHL-Reynolds equation for elasto

hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Rabinowicz.E (1995), Friction and Wear of materials, John Willey &Sons ,UK
2. Cameron, A (1981), Basic Lubrication Theory, Ellis Herward Ltd., UK
3. Halling, J. (1984), Principles of Tribology, Macmillian
4. Williams J.A (1994), Engineering Tribology, Oxford Univ. Press
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja (2005), Fundamentals of Tribology, Prentice – Hall of India Pvt Ltd , New Delhi
6. G.W.Stachowiak & A.W .Batchelor (2005), Engineering Tribology, Butterworth-Heinemann,UK

PRODUCTION ENGINEERING

18PBEMEEP01 ADVANCED MANUFACTURING PROCESSES 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To provide knowledge on different aspects of powder metallurgy parameters.
2. To understand the importance of principle of advanced welding processes and its application.
3. To understand the importance of advanced forming processes and its application.
4. To familiarize the students to advanced manufacturing process for processing of different materials.
5. To acquaint the student to apply the suitable rapid prototyping mechanism for industry need.
6. To provide knowledge on optimum parametric for advanced manufacturing process.

COURSE OUTCOMES

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

1. Understand different aspects of powder metallurgy parameters.
2. Understand basic principle of advanced welding processes and its application.
3. Understand basic principle of advanced forming processes and its application.
4. Select the best suitable advanced manufacturing process for processing of different materials.
5. Apply the suitable rapid prototyping mechanism for industry need.
6. Select the optimum parametric for advanced manufacturing process.

UNIT I POWDER METALLURGY PROCESS 9

Introduction to powder metallurgy process – preparation of powders – types and functions of binders – green compaction – sintering process and its effect on the product.

UNIT II ADVANCED WELDING PROCESSES 9

Percussion Welding– Electro Slag Welding, Plasma Arc Welding – Thermit Welding – Electron Beam Welding – Friction and Inertia Welding – Friction Stir Welding – Under Water Welding Process.

UNIT III SHEET METAL AND FORMING PROCESS 9

Working principle and application of special forming process – Hydro Forming– Rubber Pad Forming– Explosive Forming – Magnetic Pulse Forming– Peen Forming – Super Plastic Forming – Deep Drawing Process.

UNIT IV ADVANCED MACHINING PROCESS 9

Modern machining process: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Electro chemical Machining, Electro chemical Grinding, Electro Discharge Machining, wire cut EDM, Electron Beam Machining, plasma arc machining, Laser Beam Machining. Ultrasonic Machining, High speed machining process – deep hole drilling process

UNIT V RAPID PROTOTYPING 9

Introduction to Rapid Prototyping – Need for RPT– Stereo–lithography – Selective Laser Sintering, Fused Deposition Modeling, Laminated Object Manufacturing, Solid Ground Curing, Ballistic Particle Manufacturing

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Serope kalpakjian and Steven.R. Schmid (2016), Manufacturing process for engineering materials, Pearson Education, Inc
2. O.P.Khanna (2017), A Textbook Of WWelding Technology, Dhanpat Rai Publications Pvt Ltd
3. P.N. Rao (2013), Manufacturing technology Volume I, TMH Ltd
4. Singh, M.K (2016), Unconventional Manufacturing Process, New age international
5. Vijay.K Jain (2010), Advanced Machining Processes, Allied Publishers Pvt. Ltd
6. http://mfg.eng.rpi.edu/gmp/WebChapters/ch39.pdf
7. http://web.iitd.ac.in/~pmpandey/MEL120_html/RP_document.pdf
8. http://www.me.psu.edu/lamancusa/rapidpro/rpintro2.pdf
9. http://file.guiacnc.com.br/data/PDF/PrototypeeBook2.pdf

18PBEMEEP02 MICROPROCESSOR IN AUTOMATION 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge about the elements and techniques involved in microprocessors
2. To understand the concepts of connected Factory.
3. To provide an overview of shipment systems.
4. To expose students to product lifecycle
5. To provide knowledge about various types of sensors and controllers
6. To facilitate the understanding Sensor Data Management.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Implement the concepts of microprocessors.
2. Design the of connected Factory.
3. Develop the controller model for shipment thermal systems.
4. Explain about various types product lifecycle
5. Understand the applications of sensors and controllers.
6. Design automation system.

UNIT I INTRODUCTION 9

General definitions of mini computers, microprocessors, micro controllers and digital signal processors - Overview of 8085 microprocessor - Overview of 8086 microprocessor - Signals and pins of 8086 microprocessor - Description of Instructions - Assembly directives - Algorithms with assembly software programs

UNIT II CONNECTED FACTORY 9

What is a Connected Factory? - Digitization and the Manufacturing Enterprise - Criteria for Connected Factories - Leveraging Sensors on the Factory Floor - Customer Order Management - Managing Component Inventory - Materials Management - Sensors at the Dock Door

UNIT III MANUFACTURING ACROSS MULTIPLE FACILITIES 9

Inter-facility Shipment Tracking, advanced shipment notifications and customs documentation - Managing Capital Assets, balance sheet and digital asset management - Managing Indirect Materials, Tracking inventory location and maintenance status of tooling, transport jigs and specialized materials - Final Assembly Processes

UNIT IV MANAGING THE PRODUCT LIFECYCLE 9

Sensor-enabled Supplier Networks, Collecting sensor data, suppliers and service partners - Sensors in Aftermarket Services, quality of service and reverse logistics , digital twins - minimize downtime

UNIT V BEST PRACTICES 9

Integrating with Enterprise Systems of Record - Adding Sensors to Existing Machinery - Connected Factories in the Cloud - Sensor Data Management - Making the Business Case for a Connected Factory

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Sunil Mathur (2016), Microprocessors and Microcontrollers**,** Prentice-Hall Of India
2. Ramesh Gaonkar (2011), Microprocessor Architecture, Programming, and Applications with the 8085, CBS Publishers
3. www.experfy.com/training/courses/smart-manufacturing-the-connected-factory
4. https://onlinecourses.nptel.ac.in/noc18_ec03

18PBEMEEP03 AUTOMATION IN MANUFACTURING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the importance of automation in the of field machine tool based manufacturing
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
3. To understand the basics of product design and the role of manufacturing automation
4. To provide an overview of importance of group technology and FMS

5. To provide knowledge on various inspection technologies to enhance the quality of the system
6. To enrich the understanding of various manufacturing support systems

COURSE OUTCOMES

Upon completion of this course, the students will

1. Understand the basics and need for automation in manufacturing
2. Describe the essential requirement of the computers in design
3. Explain the importance of group technology and FMS
4. Understand the essentiality of quality control.
5. Apply various inspection technologies to enhance the quality of the system.
6. Explain various manufacturing support systems.

UNIT I MANUFACTURING OPERATIONS 9

Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, Costs of manufacturing operations.

UNIT II CONTROL TECHNOLOGIES 9

Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.

UNIT III NUMERICAL CONTROL AND ROBOTICS 9

NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications – End effectors – Industrial applications

UNIT IV AUTOMATED HANDLING AND STORAGE 9

Automated guided vehicle systems – AS/RS – carousel storage, Automatic data capture- Bar coding technology.

UNIT V COMPUTER-AIDED DESIGN 9

Fundamentals of CAD – design process, manufacturing database – Computer graphics – functions, constructing the geometry, transformation, wire frame Vs solid modeling.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Mikell P.Groover (2003), Automation, Production Systems and Computer Integrated Manufacturing, PHI
2. Mikell P.Groover Emory W. Zimmers, Jr (2007), CAD/CAM: Computer - Aided Design and Manufacturing, PHI

18PBEMEEP04 QUALITY CONTROL AND RELIABILITY ENGINEERING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To Understand the concept of SQC.
- To enrich the understanding of control charts to analyze for improving the process quality.
- To familiarize the students to understand different sampling plans
- To Understand the importance of need and types of life testing.
- To introduce the reliability of a system.
- To introduce the concepts of quality control and reliability techniques in industries.

COURSE OUTCOMES

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

- Understand the concept of SQC.
- Use control charts to analyze for improving the process quality.
- Describe different sampling plans
- Understand the need and types of life testing.
- Improve the reliability of a system.
- Implement quality control and reliability techniques in industries.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost–Variation in process– factors – process capability – process capability studies and simple problems – Theory of control chart– uses of control chart – Control chart for variables – X chart, R chart and σ chart.

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for proportion or fraction defectives – P chart and NP chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling – Types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts–standard sampling plans for AQL and LTPD– uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – objective: – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY 9

Reliability improvements – techniques– use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles – Maintenance.

TOTAL 45 PERIODS

Note: Permitted to use approved statistical table in the examination.

SUGGESTED READINGS

1. Grant. Eugene .L (2017), Statistical Quality Control, McGraw–Hill, New Delhi
2. Srinath L.S (2016), Reliability Engineering, Affiliated East west press New Delhi
3. Manohar Mahajan (2016), Statistical Quality Control, Dhanpat Rai and Sons, New Delhi
4. Besterfield D.H (1993), Quality Control, Prentice Hall, New Delhi
5. Danny Samson (2010), Manufacturing and Operations Strategy, Prentice Hall, New Delhi

6. http://www.statsoft.com/textbook/stquacon.html
7. http://www.isixsigma.com/library/content/c010806a.asp
8. http://www.statgraphics.com/control_charts.htm
9. http://www.sqconline.com/sampling–plans.html
10. http://reliability.sandia.gov/Maintenance/Data_Failure_Analysis/data_failure_analysis.html
11. http://www.designinindia.net/everywhere/disciplines/product–design/index.html

18PBEMEEP05 COMPOSITE MATERIALS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the fundamentals of composite material strength and its mechanical behavior
2. Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
3. Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
4. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.
5. To introduce the concepts of carbon-carbon composite for different industrial application
6. To impart knowledge on various advances in composites

COURSE OUTCOMES

Learners should be able to

1. Select the various types of composite matrix required for an application.
2. Choose appropriate manufacturing process for polymer matrix composite.
3. Opt appropriate manufacturing process for metal matrix composite.
4. Use the concepts of ceramic composites and its production techniques.
5. Identify the type of carbon-carbon composite for different industrial application.
6. Explain the various advances in composites

UNIT I INTRODUCTION TO COMPOSITES 9

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

UNIT II POLYMER MATRIX COMPOSITES 9

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

UNIT III METAL MATRIX COMPOSITES 9

Characteristics of MMC, Various types of Metal matrix composites Alloys - MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting.

UNIT IV CERAMIC MATRIX COMPOSITES 9

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon

nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

UNIT V ADVANCES IN COMPOSITES 9

Carbon /carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Mathews F.L and Rawlings R.D (2010), Composite materials Engineering and Science, Wood head publishing Ltd, England
2. Chawla K.K (2017), Composite materials, Springer – Verlag, , New York
3. Clyne T.W and Withers P.J (1995), Introduction to Metal Matrix Composites, Cambridge University Press, New York
4. Strong A.B (2008), Fundamentals of Composite Manufacturing, Society of Manufacturing Engineering
5. Sharma S.C (2010), Composite materials, Narosa Publications, New Delhi
6. http://www.metu.edu.tr/~ckaynak/METE%20470.htm
7. http://www.springerlink.com/content/978–1–4020–8771–4
8. http://www.virginia.edu/bohr/mse209/chapter17.htm
9. http://www.virginia.edu/bohr/mse209/chapter10.htm

18PBEMEEP06 NON DESTRUCTIVE TESTING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To provide in-depth knowledge on various techniques of non-destructive testing
2. To provide an overview of destructive and non destructive tests and state their applications
3. To study the features of NDT techniques for various products.
4. To expose students to skills needed for selection of appropriate NDT technique(s) for new inspection jobs
5. To understand the established NDE techniques and basic familiarity of emerging NDE techniques.
6. To facilitate the understanding of standard application area of NDET

COURSE OUTCOMES

Student will be able to

1. Understand the codes, standards and specifications related to NDT
2. Classify the destructive and non destructive tests and state their applications
3. Develop NDT techniques for various products.
4. Acquire skills needed for selection of appropriate NDT technique(s) fornew inspection jobs
5. Acquire sound knowledge of established NDE techniques and basicfamiliarity of emerging NDE techniques.
6. Make use of standards application area of NDET

UNIT I BASIC CONCEPTS AND VISUAL INSPECTION 9

Concepts of Non-Destructive Testing - Relative merits and limitations - NDT versus mechanical testing, Unaided and aided visual inspection testing.

UNIT II LIQUID PENETRANT INSPECTION 9

Principle, applications, advantages and limitations, dyes, developers and cleaners, fluorescent, penetrant test.

UNIT III MAGNETIC PARTICLE INSPECTION 9

Principles, applications, magnetisation methods, magnetic particles, dry technique and wet technique, demagnetization, advantages and limitations.

UNIT IV EDDY CURRENT AND ULTRASONIC TESTING 9

Principle, applications and instrumentation of eddy current testing. Types of ultrasonic waves, principles of wave propagation, characteristics of ultrasonic waves, Attenuation, couplants. Inspection methods - pulse echo, Transmission and resonance techniques, thickness measurement. Types of scanning, test block, IIW - reference blocks.

UNIT V RADIOGRAPHY TESTING 9

X-rays and Gamma rays, properties of X-rays relevant to NDE, absorption of rays, scattering, types and use of filters and screens, characteristics of films - graininess, density, speed, contrast, characteristic curves, penetrameters, exposure charts, radiographic equivalence. Fluoroscopy- Xero-Demerits of Radiography.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Louis Cartz (1995), Nondestructive Testing, ASM International, Almere, Netherland
2. Paul E. Mix (2005), Introduction to Nondestructive Testing, John Wiley & Sons,Newyork
3. Baldev Raj, T. and Jayakumar, M. (2007), Practical Non-destructive Testing, Woodhead Publishing, Cambridge
4. J. Blitz, G. Simpson (1996), Ultrasonic Methods of Non-destructive Testing, Springer Science & Business Media
5. https://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT
6. https://www.asnt.org/
7. www.bindt.org/
8. www.ndt.net/
9. www.aindt.com.au/

18PBEMEEP07 PRODUCTION PLANNING AND CONTROL 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To impart knowledge of need for planning and control in various aspects.
- To develop an understanding of the standard techniques in various work study methodologies.
- To familiarize the students to understand the product and process plan.
- To introduce the concepts of a production schedule based on different facets.
- To enrich the understanding of the level of inventory
- To understand the importance the recent advancements in production planning and control.

COURSE OUTCOMES

Student will be able to

- Indicate the need for planning and control in various aspects.
- Understand various work study methodologies.
- Construct product and process plan.
- Prepare a production schedule based on different facets.
- Estimate the level of inventory
- Understand the recent advancements in production planning and control.

UNIT I INTRODUCTION 9

Objectives: and benefits of planning and control–Functions of production control–Types of production–job– batch and continuous–Product development and design–Marketing aspect – Functional aspects–Operational aspect–Durability and dependability aspect–aesthetic aspect. Profit consideration–Standardization, Simplification and specialization–Break even analysis–Economics of a new design.

UNIT II WORK STUDY 9

Method study, basic procedure–Selection–Recording of process – Critical analysis, Development – Implementation – Micro motion and memo motion study – work measurement – Techniques of work measurement – Time study – Production study – Work sampling – Synthesis from standard data – Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning–Extending the original product information–Value analysis–Problems in lack of product planning–Process planning and routing–Pre requisite information needed for process planning–Steps in process planning–Quantity determination in batch production–Machine capacity, balancing–Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems–Loading and scheduling–Master Scheduling–Scheduling rules–Gantt charts–Perpetual loading–Basic scheduling problems – Line of balance – Flow production scheduling–Batch production scheduling–Product sequencing – Production Control systems–Periodic batch control–Material requirement planning Kanban – Dispatching–Progress reporting and expediting–Manufacturing lead time–Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control–Purpose of holding stock–Effect of demand on inventories–Ordering procedures.
Two bin system –Ordering cycle system–Determination of Economic order quantity and economic lot size–ABC analysis–Recorder procedure–Introduction to computer integrated production planning systems–elements of JIT Systems–Fundamentals of MRP and ERP.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Martand Telsang (2016), Industrial Engineering and Production Management, S.Chand and Company, New Delhi
2. Samson Eilon (1981), Elements of production planning and control, Macmillan, India
3. Elwood S.Buffa, and Rakesh K.Sarin (2017), Modern Production Operations Management, John Wiley and Sons, New Delhi
4. Jain C.K and Aggarwal L.N (2010), Production Planning Control and Industrial Management, Khanna Publishers, New Delhi
5. http:// envfor.nic.in/divisions/iwsu/iwsu.html
6. http://src.edu/work–study

18PBEMEEP08 INDUSTRIAL ROBOTICS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the anatomy, basic concepts and applications of robot.
2. To learn the drives and end effectors used in robot.
3. To study the various types of sensors used in robot.
4. To familiarize robot kinematics and robot programming
5. To provide knowledge on simple offline robot program
6. To impart knowledge on economic analysis of robots

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Identify the various types of robots.
2. Select appropriate drive systems and end effectors for industrial application.
3. Decide the types of sensors required according to the applications of robot.
4. To identify the different types of machine vision technologies
5. Develop simple offline robot program for different applications.

Calculate the economic analysis of robots

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co–ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Their Functions – Need for Robots – Different Applications

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives

End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT III SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors – Position sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors

Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems.

Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method, Process application of Robots and Collaborative robots.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Groover M.P (2017), Industrial Robotics – Technology Programming and Applications, McGraw–Hill, New Delhi
2. Fu.K.S., Gonzalz.R.C. and Lee C.S.G (2010), Robotics Control, Sensing, Vision and Intelligence, McGraw–Hill Book Co., New Delhi
3. Yoram Koren (2017), Robotics for Engineers, McGraw–Hill Book Co., New Delhi
4. Janakiraman. P.A (1995), Robotics and Image Processing: An Introduction, Tata McGraw–Hill, New Delhi

18PBEMEEP09 ADVANCED WELDING TECHNOLOGY 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To enable the students to gain competence in various Welding Technologies and to have in depth understanding of the weldability of metals.
2. To expose students to Identify suitable reinforcement and matrix materials for preparation of composites using frictionstir processing.
3. To understand the basic principle of electron beam and laser beam processes and its application.
4. To understand the weldability of cast iron and high carbon steel.
5. To provide knowledge on welding power sources.
6. To facilitate the understanding of grain growth mechanism and related properties.

COURSE OUTCOMES

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

1. Understand solid state welding processes and applications.
2. Identify suitable reinforcement and matrix materials for preparation of composites using frictionstir processing.
3. Understand basic principle of electron beam and laser beam processes and its application.
4. Understand weldability of cast iron and high carbon steel.
5. Select welding power sources.
6. Understand the importance of grain growth mechanism and related properties.

UNIT I GAS AND ARC WELDING PROCESSES 9

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electro slag welding processes – advantages, limitations and applications.

UNIT II RESISTANCE WELDING PROCESSES 9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes – advantages, limitations and applications

UNIT III SOLID STATE WELDING PROCESSES 9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes – advantages, limitations and applications

UNIT IV OTHER WELDING PROCESSES 9

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

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

Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Parmer R.S (2008), Welding Engineering and Technology, Khanna Publishers, New Delhi
2. Little R.L (2008), Welding and welding Technology, Tata McGraw Hill Publishing Co., Ltd., New Delhi
3. Davis A.C (1993), The Science and Practice of Welding, Cambridge University Press, Cambridge
4. Schwartz M.M (1979), Metals Joining Manual, McGraw Hill Books
5. Tylecote R.F (1968), The Solid Phase Welding of Metals, Edward Arnold Publishers Ltd. London
6. Nadkarni S.V (2005), Modern Arc Welding Technology, Oxford IBH Publishers

THERMAL ENGINEERING

18PBEMEET01 GAS DYNAMICS AND JET PROPULSION 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the basic difference between incompressible and compressible flow.
2. To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
3. To introduce the concepts of various conditions of compressible fluid flows
4. To Study and acquire knowledge on performance analysis of subsonic and supersonic inlets, combustors, afterburners and exhaust nozzles
5. To understand the concept of working of various types of rocket engines
6. To study the features of thrust equation for rocket propulsion system

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Analyze various conditions of compressible fluid flows.
2. Calculate mass flow rate in flow through variable area ducts.
3. Carryout simple performance analysis of subsonic and supersonic inlets.
4. Perform performance analysis of combustors, afterburners and exhaust nozzles.
5. Understand the working of various types of rocket engines
6. Use thrust equation for rocket propulsion system.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone –Effect of Mach number on compressibility – Isentropic flow through variable area ducts – Nozzle and Diffusers –area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles. Use of Gas tables.

UNIT II FLOW THROUGH DUCTS 9

Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties – Isothermal flow with friction in constant area ducts –Use of tables and charts – Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

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

UNIT IV JET PROPULSION 9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors.

UNIT V ROCKET PROPULSION 9

Types of rocket engines – Propellants – Ignition and combustion – Theory of rocket propulsion – solid and liquid propellants, comparison of different propulsion systems .Performance study – Staging – Terminal and characteristic velocity – Applications – Space flights.

TOTAL 45 PERIODS

(Permitted to use standard Gas Tables in the examination)

SUGGESTED READINGS

1. Yahya.S.M (2016), Fundamentals of Compressible flow, New Age International (P) Ltd., New Delhi
2. Rathakrishnan.E (2017), Gas Dynamics, Prentice Hall of India, New Delhi
3. Patrich.H.Oosthvizen, Willam E.Carscallen (2016), Compressible fluid flow, McGraw–Hill
4. Zucker,R.D. and Biblarz,O (2016), Fundamentals of Gas Dynamics, John Willey
5. Ganesan .V (2016), Gas Turbines, Tata McGraw–Hill, New Delhi
6. P.Hill and C. Peterson (2009), Mechanics and Thermodynamics of Propulsion, Addison –Wesley Publishing Company
7. http://www.adl.gatech.edu/classes/ae3021/ae3021_f06_6.pdf
8. http://www.grc.nasa.gov/WWW/k–12/airplane/isndrv.html
9. http://panoramix.ift.uni.wroc.pl/~maq/papers/PM_Correct_Matyka.pdf
10. http://soliton.ae.gatech.edu/people/jseitzma/classes/ae3450/StudyProblems.pdf
11. http://www.sil.si.edu/smithsoniancontributions/AnnalsofFlight/pdf_lo/SAOF–0001.4.pdf

18PBEMEET02 POWER PLANT ENGINEERING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To give exposure to accessories and layout required for a steam power plant depending upon the requirements.
2. To study performance of steam power plant.
3. To make the student acquire sound knowledge of working of nuclear and hydel power plant.
4. To study the features of gas turbine power plant.
5. To make the student acquire sound knowledge of economics of the power plant.
6. To make the student acquire sound knowledge on renewable energy technologies and availability.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Select the accessories and layout required for a steam power plant depending upon the requirements.
2. Compute performance of steam power plant.
3. Explain the working of nuclear and hydel power plant.
4. Compute performance of gas turbine power plant.
5. Calculate the economics of the power plant.
6. Apply appropriate type of renewable energy technologies depending upon the application and availability.

UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS 9

Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants – Combined Power Cycles – Comparison and Selection, Load Duration Curves.
Steam Boilers and Cycles – High Pressure and Super Critical Boilers – Fluidised Bed Boilers – Industrial Standards.

UNIT II STEAM POWER PLANT 9

Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught – different types, Surface Condenser Types, Cooling Towers

UNIT III NUCLEAR AND HYDEL POWER PLANTS 9

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, pressurized water reactor, Boiling Water Reactor, Waste Disposal and safety.

Hydel Power Plant – Essential Elements, Selection of Turbines, Governing of Turbines– Micro Hydel developments.

UNIT IV DIESEL AND GAS TURBINE POWER PLANT 9

Types of Diesel Plants, Components, Selection of Engine Type, Applications Gas Turbine Power Plant – Fuels – Gas Turbine Material – Open and Closed Cycles – Reheating – Regeneration and Intercooling – Combined Cycle.

UNIT V OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS 9

Geo thermal –OTEC – Tidel – Pumped storage – Solar thermal central receiver system.

Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, comparison of economics of various power plants.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Arora S.C and Domkundwar S (2017), A course in Power Plant Engineering, Dhanpatrai Publishers, New Delhi
2. Nag P.K (2017), Power plant Engineering, Tata McGraw Hill, New Delhi
3. Rajput R.K (2016), Power Plant Engineering, Laxmi Publications, Chennai
4. Morse Frederick T (1998), Power Plant Engineering, Prentice Hall of India, New Delhi
5. www.solarpaces.org
6. www.igcar.gov.in
7. ga.water.usgs.gov
8. www.mapsofindia.com

18PBEMEET03 POWER PLANT ENGINEERING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To give exposure to accessories and layout required for a steam power plant depending upon the requirements.
2. To study performance of steam power plant.
3. To make the student acquire sound knowledge of working of nuclear and hydel power plant.
4. To study the features of gas turbine power plant.
5. To make the student acquire sound knowledge of economics of the power plant.
6. To make the student acquire sound knowledge on renewable energy technologies and availability.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Select the accessories and layout required for a steam power plant depending upon the requirements.
2. Compute performance of steam power plant.
3. Explain the working of nuclear and hydel power plant.
4. Compute performance of gas turbine power plant.

5. Calculate the economics of the power plant.
6. Apply appropriate type of renewable energy technologies depending upon the application and availability.

UNIT I ENERGY AND ENVIRONMENT 9

Primary energy sources – world energy resources–Indian energy scenario–energy cycle of the earth –environmental aspects of energy utilisation, CO_2 emissions and Global warming–renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy resources.

UNIT II SOLAR ENERGY 9

Principles of solar energy collection – solar radiation – measurements – instruments – data and estimation– types of collectors – characteristics and design principles of different type of collectors – performance of collectors – testing of collectors. Solar thermal applications – water heaters and air heaters – performance and applications – simple calculations – solar cooling – solar drying – solar ponds – solar tower concept – solar furnace.

UNIT III WIND, TIDAL AND GEO THERMAL ENERGY 9

Energy from the wind – general theory of windmills – types of windmills – design aspects of horizontal axis windmills – applications. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants – power from geothermal energy – principle of working of geothermal power plants.

UNIT IV BIO ENERGY 9

Energy from bio mass and bio gas plants –various types – design principles of biogas plants – applications. Energy from wastes – waste burning power plants – utilization of industrial and municipal wastes – energy from the agricultural wastes.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) – thermoelectric generators – thermionic generators – fuel cells – solar cells – types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Rai G.D (2015), An Non conventional Energy sources, Khanna Publishers, New Delhi
2. Khan.B.H (2009), Non-Conventional Energy Resources, The McGraw Hills, Second edition
3. Rao.S. & Parulekar (2017), Energy Technology, Khanna publishers, Fourth edition
4. Godfrey Boyl (2012), Renewable Energy: Power sustainable future, Oxford University Press, Third edition
5. John W Twidell and Anthony D Weir (2015), Renewable Energy Resources, Taylor and Francis
6. http://www.apricus.com/html/solar_typesofsolar.htm
7. http://www.solarserver.de/wissen/sonnenkollektoren–e.html
8. http://earthsci.org/mineral/energy/wind/wind.html
9. http://www.biomassgasification.com/

18PBEMEET04 REFRIGERATION AND AIR CONDITIONING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.

2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems
3. To introduce the concepts on use of unconventional refrigerant system for industrial application
4. To expose students to properties of air using psychrometric chart
5. To provide knowledge on cooling load for a given system
6. To know the application of air conditioning system for industrial and domestic purpose

COURSE OUTCOMES

Learners should be able to

1. Calculate COP of various refrigeration cycles.
2. Choose appropriate refrigerants for various applications.
3. Identify the use of unconventional refrigerant system for industrial application.
4. Calculate the properties of air using psychrometric chart.
5. Calculate cooling load for a given system
6. Select the appropriate air conditioning system for industrial and domestic applications.

UNIT I REFRIGERATION CYCLE 9

Review of thermodynamic principles of refrigeration. Concept of refrigeration system. Vapour compression refrigeration cycle – use of P–H charts – multistage and multiple evaporator systems – cascade system – COP comparison. Vapor absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steam jet refrigeration system

UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING 9

Compressors – reciprocating and rotary (elementary treatment.) – Condensers – evaporators – cooling towers. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Refrigeration plant controls – testing and charging of refrigeration units. Balancing of system components. Applications to refrigeration systems – ice plant – food storage plants – milk –chilling plants – refrigerated cargo ships.

UNIT III PSYCHROMETRY 9

Psychrometric processes– use of psychrometric charts – – Grand and Room Sensible Heat Factors – bypass factor – requirements of comfort air conditioning – comfort charts – factors governing optimum effective temperature, recommended design conditions and ventilation standards

UNIT IV COOLING LOAD CALCULATIONS 9

Types of load – design of space cooling load – heat transmission through building. Solar radiation – infiltration – internal heat sources (sensible and latent) – outside air and fresh air load – estimation of total load – Domestic, commercial and industrial systems – central air conditioning systems.

UNIT V AIRCONDITIONING 9

Air conditioning equipments – air cleaning and air filters – humidifiers – dehumidifiers – air washers – condenser – cooling tower and spray ponds – elementary treatment of duct design – air distribution system. Thermal insulation of air conditioning systems. – Applications: car, industry, stores, and public buildings

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Manohar Prasad (2011), Refrigeration and Air Conditioning, New Age International Ltd, New Delhi
2. Arora. C.P (2010), Refrigeration and Air Conditioning, Tata McGraw–Hill, New Delhi
3. Roy.J Dossat (2002), Principles of Refrigeration, Pearson Education, New Delhi
4. Jordon and Prister (1981), Refrigeration and Air Conditioning, Prentice Hall of India PVT Ltd., New Delhi
5. Stoecker N.F and Jerold W.Jones (1986), Refrigeration and Air Conditioning, McGraw Hill, New Delhi
6. http://nptel.iitg.ernet.in/Mech_Engg/IIT%20Kharagpur/Refrigeration%20and%20Air%20Conditioning.htm
7. http://www.ashrae.org/
8. http://en.wikipedia.org/wiki/Thermal_comfort

18PBEMEET05 COGENERATION AND WASTE HEAT RECOVERY SYSTEMS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To study the significance of waste heat recovery systems and carry out its economic analysis
2. To know the concepts of cogeneration, its types and probable areas of applications
3. To enrich the understanding of thermodynamics, heat transfer, and fluid Mechanics principles to design and analysis of this emerging technology.
4. To impart knowledge on operational issues and challenges cogeneration technologies.
5. To Understand the impact of this technology in waste heat recovery systems
6. To introduce the concepts of various systems involved in waste heat recovery process

COURSE OUTCOMES

The student will be able to

1. Understand the various methods of cogeneration.
2. Apply knowledge of thermodynamics, heat transfer, and fluid Mechanics principles to design and analysis of this emerging technology.
3. Have thorough understanding, operational issues and challenges cogeneration technologies.
4. Understand the impact of this technology in waste heat recovery systems
5. Get the knowledge over various systems involved in waste heat recovery process
6. Begin a career as an engineer in an organization economic analysis

UNIT I INTRODUCTION 9

Introduction – principles of thermodynamics – cycles – topping - bottoming – combined cycle - organic rankine cycles – performance indices of cogeneration systems – waste heat recovery – sources and types – concept of tri generation.

UNIT II COGENERATION TECHNOLOGIES 9

Configuration and thermodynamic performance – steam turbine cogeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems – combined cycles cogeneration systems – advanced cogeneration systems: fuel cell, Stirling engines etc.,

UNIT III ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES 9

Cogeneration plants electrical interconnection issues – utility and cogeneration plant interconnection issues – applications of cogeneration in utility sector – industrial sector – building sector – rural sector – impacts of cogeneration plants – fuel, electricity and environment

UNIT IV WASTE HEAT RECOVERY SYSTEMS 9

Election criteria for waste heat recovery technologies - recuperators - Regenerators - Economizers - plate heat exchangers - thermic fluid heaters - Waste heat boilers classification, location, service conditions, design Considerations - fluidized bed heat exchangers - heat pipe exchangers - heat pumps – sorption systems.

UNIT V ECONOMIC ANALYSIS 9

Investment cost – economic concepts – measures of economic performance – procedure for economic analysis – examples – procedure for optimized system selection and design – load curves - sensitivity analysis – regulatory and financial frame work for cogeneration and waste heat recovery systems.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. R.Kehlhofer, B. Rukes, F. Stirnimann (2009), Combined-cycle gas & steam turbine power plants, PennWell Books
2. Steve Doty, Wayne C. Turner (2009), Energy management handbook, The Fairmont Press, Inc
3. A.Thumann, D. Paul Mehta (2014), Handbook of energy engineering, The Fairmont Press Inc
4. B.F.Kolanowski (2013), Small-scale cogeneration handbook, Fairmont Press
5. M.P. Boyce (2010), Handbook for cogeneration and combined cycle power plants, ASME Press
6. Educogen (2001), The European Educational tool for cogeneration, Fairmont Press

18PBEMEET06 COMPUTATIONAL FLUID DYNAMICS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To introduce Governing Equations of viscous fluid flows
2. To introduce numerical modeling and its role in the field of fluid flow and heat transfer
3. To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
4. To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.
5. To equip them with skills to solve convection and diffusion problems
6. To understand the importance continuity and momentum equations for different types of fluid flow

COURSE OUTCOMES

Upon completion of this course, the students can able

1. Identify, solve engineering problems by computational fluid dynamics.
2. Understand the importance of governing equations involved in CFD
3. Formulate and solve problems in the field of fluid flow and heat transfer.
4. Solve the heat conduction problems using finite difference method.
5. Analyze and provide solutions for convection and diffusion problems.
6. Develop continuity and momentum equations for different types of fluid flow.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time–averaged equations for Turbulent flow – Turbulence –Kinetic –Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

UNIT II DISCRETIZATION AND SOLUTION METHODOLOGIES 9

Methods of Deriving the Discretization Equations – Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method.

Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNIT III HEAT CONDUCTION 9

Finite difference and finite volume formulation of steady/transient one–dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

UNIT IV CONVECTION AND DIFFUSION 9

Finite volume formulation of steady one–dimensional convection and Diffusion problems, Central, upwind, hybrid and power–law schemes – Discretization equations for two dimensional convection and diffusion.

UNIT V CALCULATION OF FLOW FIELD 9

Representation of the pressure – Gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and velocity corrections – Pressure – Correction equation, SIMPLE algorithm and its variants. Turbulence models: mixing length model, two equation (k–ε) models.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Versteeg H.K and Malalasekera.W (2016), An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson education
2. Ghoshdastidar P.S (2010), Computer Simulation of flow and heat transfer, Tata McGraw–Hill Publishing Company Ltd., New Delhi
3. Patankar S.V (1980), Numerical Heat Transfer and Fluid Flow, CRC press, Taylor & Francis Group
4. Muralidhar K and Sundarajan T (2017), Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi
5. BoseT.K. Jain (2010), Numerical Fluid Dynamics, Narosa publishing House, New Delhi
6. http://www.ams.org/mcom//.pdf
7. http://www.cham.co.uk/website/new/cfdintro.htm
8. http://www.mechartes.com/
9. http://www.technologystudent.com
10. http://web.njit.edu/topics/Prog_Lang_Docs/html/FLUENT/fluent/fluent5/ug/html/node594.htm

18PBEMEET07 DESIGN OF HEAT EXCHANGERS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To learn the thermal and stress analysis on various parts of the heat exchangers
2. To analyze the sizing and rating of the heat exchangers for various applications
3. Students will come to know about different techniques of heat exchanger analysis.
4. Student will be able to learn construction and thermal design methodology of shell and tube, Plate and compact heat exchanger
5. To understand about Stress in tubes
6. To understand about evaporative condensers

COURSE OUTCOME (CO's)

1. Understand the physics and the mathematical treatment of typical heat exchangers.
2. Employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach.
3. Examine the performance of double-pipe counter flow (hair-pin) heat exchangers
4. Design and analyze the shell and tube heat exchanger.
5. Understand the fundamental, physical and mathematical aspects of boiling and condensation.
6. Classify cooling towers and explain their technical features.

UNIT I INTRODUCTION 9

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

UNIT IIPROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III STRESS ANALYSIS 9

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT IV COMPACT AND PLATE HEAT EXCHANGER 9

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT V CONDENSERS AND COOLING TOWERS 9

Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. SadikKakac and Hongtan Liu (2002), Heat Exchangers Selection, Rating and Thermal Design, CRC Press
2. Shah,R. K., Dušan P. Sekulić (2003), Fundamentals of heat exchanger design, John Wiley & Sons
3. Robert W. Serth (2007), Process heat transfer principles and applications, Academic press, Elesevier
4. Kuppan. T. (2000), Heat exchanger design hand book, New York : Marcel Dekker
5. Eric M. Smith (1999), Advances in thermal design of heat exchangers: a numerical approach: direct- sizing, step-wise rating, and transients, John Wiley & Sons

18PBEMEET08 CRYOGENIC ENGINEERING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To study the basics of cryogenics
2. To understand Cryogenic Refrigerators
3. To know the ways to handle cryogens.
4. To make the students understand the various methods to create cryogenic temperatures and to maintain it
5. To make the students aware of the wide technological applications of cryogenics in various fields.

6. To recognize the engineering problems solvable by applying cryogenic techniques.

COURSE OUTCOME (CO's)

At the end of the course students will be able to

1. Synthesise and apply the basic concepts of cryogenic engineering
2. Describe various applications of cryogenics in Engineering and Technology
3. Acquire knowledge in various cryogenic liquefaction and refrigeration systems
4. Identify the various avenues of the subject, to help the students choose a specific area of interest
5. Find applications of cryogenics
6. Demonstrate the knowledge of cryogenic instrumentation

UNIT I INTRODUCTION 8

Insight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of Cryogenics in Space Programs, Superconductivity, Cryo Metallurgy, Medical applications.

UNIT II LIQUEFACTION CYCLES 10

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve - Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle Dual Cycle, Ortho- Para hydrogen conversion, Eollins cycle, Simpson cycle, Critical Components in Liquefaction Systems.

UNIT III SEPARATION OF CRYOGENIC GASES 9

Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification, Rectification Column Analysis - McCabe Thiele Method. Adsorption Systems for purification.

UNIT IV CRYOGENIC REFRIGERATORS 8

J.T.Cryocoolers, Stirling Cycle Refrigerators, G.M.Cryocoolers, Pulse Tube Refrigerators Regenerators used in Cryogenic Refrigerators, Dilution refrigerators, Magnetic Refrigerators

UNIT V HANDLING OF CRYOGENS 10

Cryogenic Dewar, Cryogenic Transfer Lines. Insulations used in Cryogenic Systems, Instrumentation to measure Flow, Level and Temperature

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Klaus D. Timmerhaus and Thomas M. Flynn (1989), Cryogenic Process Engineering, Plenum Press, New York
2. Randall F. Barron (1985), Cryogenic Systems, McGraw-Hill
3. Scott R.B (1962), Cryogenic Engineering, Van Nostrand and Co
4. www.nasa.gov
5. www.cryogenicsociety.org/
6. www.iifiir.org/
7. www.linde.com
8. www.airliquide.com/
9. www.cern.ch
10. www.nist.gov

18PBEMEET09 ADVANCED THERMODYNAMICS 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand Availability concept and the behavior of real gas
2. To study Statistical and Irreversible thermodynamics
3. To understand the concepts on laws of thermodynamics
4. To understand the concepts of degeneracy of energy levels
5. To understand the concepts of entropy
6. To understand the concepts irreversible thermodynamics

COURSE OUTCOME (CO's)

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

1. apply the concept of real gas equations
2. apply the concepts of thermodynamics
3. Identify applications of thermodynamics in real time problems.
4. Establish the basic thermodynamic relations in degeneracy of energy levels.
5. Calculate the properties entropy.
6. Explain the basic principles irreversible thermodynamics

UNIT I AVAILABILITY ANALYSIS AND THERMODYNAMIC PROPERTY RELATIONS 9

Reversible work - availability - irreversibility and second – law efficiency for a closed system and steady – state control volume. Availability analysis of simple cycles. Thermodynamic potentials. Maxwell relations. Generalized relations for changes in entropy - internal energy and enthalpy - generalized relations for Cp and CV Clausius Clayperon equation, Joule – Thomson coefficient.Bridgeman tables for thermodynamic relations

UNIT II REAL GAS BEHAVIOUR AND MULTI – COMPONENT SYSTEMS 9

Different equations of state – fugacity – compressibility - principle of corresponding States - Use of generalized charts for enthalpy and entropy departure - fugacity coefficient,Lee – Kesler generalized three parameter tables. Fundamental property relations for systems of variable composition.Partial molar properties.Real gas mixtures - Ideal solution of real gases and liquid - activity - equilibrium in multi phase systems - Gibbs phase rule for non – reactive components.

UNIT III CHEMICAL THERMODYNAMICS AND EQUILIBRIUM 9

Thermochemistry - First law analysis of reacting systems - Adiabatic flame temperature - entropy change of reacting systems - Second law analysis of reacting systems - Criterion for reaction equilibrium.Equilibrium constant for gaseous mixtures - evaluation of equilibrium composition.

UNIT IV STATISTICAL THERMODYNAMICS 9

Microstates and Macrostates - thermodynamic probability - degeneracy of energy levels - Maxwell – Boltzman, Fermi – Diarc and Bose – Einstein statistics - microscopic interpretation of heat and work, evaluation of entropy, partion function, calculation of the Macroscopic properties from partition functions.

UNIT V IRREVERSIBLE THERMODYNAMICS 9

Conjugate fluxes and forces - entropy production Onsager's reciprocity relations - thermo – electric phenomena, formulations

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Kenneth Wark Jt.m (1995), Advanced Thermodynamics for Engineers, McGrew – Hill Inc
2. Bejan, A (1988), Advanced Engineering Thermodynamics, John Wiley and Cons
3. Holman, J.P (1988), Thermodynamics, McGraw – Hill Inc
4. Smith, J.M. and Van Ness., H.C (1987), Introduction to Chemical Engineering Thermodynamics, McGraw – Hill Inc
5. Sonntag, R.E., and Van Wylen, G (1991), Introduction to Thermodynamics, Classical and Statistical Thermodynamics, John Wiley and Sons

AUTOMOTIVE ENGINEERING

18PBEMEEA01 AUTOMOBILE ENGINEERING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge on the constructional details and principle of operation of various automobile components.
2. To learn the function and working of various components in transmission and drive lines.
3. To study the concept and working of steering and suspension systems in an automobile.
4. To give knowledge on the wheels, tyres and brakes of automobiles.
5. To provide information on the current and future trends in automobiles.
6. Identify and explain the types of steering system..

COURSE OUTCOMES

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

1. Demonstrate the operating principles and constructional details of various automobile components.
2. Explain the function and working of components in transmission and drive lines.
3. Identify and explain the types of steering system.
4. Identify and explain the types of suspension system.
5. Classify and describe the types of wheels, tyres and brakes of automobiles.
6. Discuss the current and future trends in the automobiles

UNIT I AUTOMOBILE ARCHITECTURE AND PERFORMANCE 9

Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance.

UNIT II TYPES OF ENGINE 9

Types of engine, multi valve engine, in-line engine, vee-engine, Petrol engine-direct, single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging, alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles.

UNIT III TRANSMISSION SYSTEMS 9

Clutch : Types-coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box : Types-constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling.

UNIT IV WHEEL AND TYRES AND SUSPENSION SYSTEM 9

Types of wheels, construction, wired wheels, Tyres- construction, Radial, bias & belted bias, slip angle, Tread patterns, Tyre retreading cold & hot, Tubeless tyres

Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems.

UNIT V STEERING SYSTEM AND BRAKING SYSTEM 9

Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.

Breaking System - Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc & Drum brakes, Engine brakes anti lock braking system.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. R.B. Gupta (1993), Automobile Engineering, Laxmi Publications, Chennai
2. Kirpal Singh (1997), Automobile Engineering Vol-I & II, Standard Publishers, Delhi.
3. Julian Happian Smith (2002), An introduction to modern vehicle design, Butterworth Heinemann, New Delhi
4. Crouse W H (1976), Automotive transmissions and power trains, Mc-Graw Hill Book Co., NewDelhi

18PBEMEEA02 TWO AND THREE WHEELER TECHNOLOGY 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. The objective of this course is to make the students to know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.
2. Construct the frames of two and three wheelers of different layouts.
3. Demonstrate the constructional details and principle of operation of various engine components.
4. Identify and explain the types of transmission systems.
5. Identify and explain the types of steering and suspension systems.
6. Classify and describe the types of wheels, tyres and brakes for two and three wheelers.

COURSE OUTCOMES

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

1. Construct the frames of two and three wheelers of different layouts.
2. Demonstrate the constructional details and principle of operation of various engine components.
3. Identify and explain the types of transmission systems.
4. Identify and explain the types of steering and suspension systems.
5. Classify and describe the types of wheels, tyres and brakes for two and three wheelers.
6. Explain the servicing of two and three wheelers.

UNIT I INTRODUCTION 8

Classifications- design considerations –weight and dimension limitations – requirements stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS 9

2 stroke and 4 stroke SI engines and CI engines design criteria– design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburetor types and design. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical system.

UNIT III CLUTCHES AND TRANSMISSION 9

Types of clutches for 2 and 3 wheelers. Design of clutch system. Gears for two and three wheelers. Design of gear box and gear change mechanism. Belt, chain and shaft drive. Freewheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES 10

Types of frames used for two wheelers and three wheelers. Wheel frames- construction design of frames for fatigue strength torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, Types of wheels - construction. Function of tyres - Solid and pneumatic Tyres. Constructional details of pneumatic tyres.

UNIT V THREE WHEELERS 9

Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission for 3 wheelers wheel types, wheel attachment tyre types. Brakes and their operating mechanism.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Irving P.E. (1992), Motor Cycle Engineering, Temple Press Book, London
2. Srinivasan.S. (1988), Motor cycle, Scooter, Mobeds, New century book house
3. Griffin.M.M (1978), Motor cycles from inside and outside, Prentice Hall Inc, New Jersey
4. Bruce A. Johns, David D.Edmundson and Robert Scharff (1999), Motorcycles: Fundamentals, Service, Repair, Goodheart-Willcox

18PBEMEEA03 INTELLIGENT VEHICLE TECHNOLOGY 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To impart knowledge on trends in the vehicle power plants.
2. To learn the various advanced driver assistance systems.
3. To study the working of advanced suspension and braking systems in an automobile.
4. To give information about motor vehicle emission and noise pollution control.
5. To provide knowledge of the vehicle telematics.
6. To give information about the noise control techniques.

COURSE OUTCOMES

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

1. Distinguish and describe the various modern vehicle power plant systems.
2. List and explain the various driver assistant mechanisms.
3. Identify and describe the working of advanced suspension and braking systems.
4. Apply the knowledge of motor vehicle emission and noise pollution control.
5. Describe the noise control techniques
6. Describe the vehicle telematics and its applications

UNIT I DRIVER ASSISTANCE SYSTEMS 9

Introduction, driver support systems – driver information, driver perception, driver convenience, driver monitoring. Vehicle support systems – general vehicle control, collision avoidance, vehicle status monitoring-Night vision system

UNIT II TELEMATICS 9

Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems.

UNIT III SAFETY AND SECURITY SYSTEMS 9

Airbags, seat belt tightening system, collision warning systems, child lock, anti lock braking systems. Anti theft technologies, smart card system, number plate coding.

UNIT IV COMFORT SYSTEMS 9

Active suspension systems, requirement and characteristics, different types, power steering, collapsible and tiltable steering column, power windows-Adaptive lighting system

UNIT V ADAPTIVE CONTROL SYSTEMS 9

Adaptive cruise control, adaptive noise control, anti spin regulation, traction control systems, cylinder cut- off technology.-Autonomous vehicles

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Ljubo Vlacic, Michael Saren and Fumio Harashima (2001), Intelligent Vehicle Technologies, Butterworth- Heinemann publications, Oxford
2. Ronald K.Jurgen (1998), Navigation and Intelligent Transportation Systems –Progress in Technology, Automotive Electronics Series,SAE, USA
3. William B Riddens (1998), Understanding Automotive Electronics, Butterworth Heinemann Woburn
4. Bechhold (1998), Understanding Automotive Electronics, SAE
5. Robert Bosch (2000), Automotive HandBook, SAE

18PBEMEEA04 OFFROAD VEHICLES 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To familiarize the students with off-road vehicles like land clearing machines, earth moving Vehicles
2. Classification and requirements of off road vehicles
3. To understand about. earth moving machines
4. . To understand about elevating graders
5. To understand about shovels and ditchers
6. To understand about Capacity of shovels

COURSE OUTCOMES

1. To gain knowledge about off-road vehicles like land clearing machines
2. To gain knowledge about earth moving Vehicles
3. To gain knowledge about requirements of off road vehicles
4. To gain knowledge about elevating graders
5. To gain knowledge about shovels and ditchers
6. To gain knowledge about Capacity of shovels

UNIT I CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES 9

Power plants, chassis and transmission, Multi axle vehicles.

UNIT II LAND CLEARING MACHINES 8

Bush cutter, Stampers, Tree dozer, Rippers.

UNIT III EARTH MOVING MACHINES 11

Bulldozers, cable and hydraulic dozers. Crawler track, running and steering gears, scrapers, drag and self powered types - Dump trucks and dumpers - Loaders, single bucket, multi bucket and rotary types - Power and capacity of earth moving machines.

UNIT IV SCRAPERS AND GRADERS 8

Scrapers, elevating graders, self powered scrapers and graders.

UNIT V SHOVELS AND DITCHERS 9

Power shovel, revolving and stripper shovels - drag lines - ditchers - Capacity of shovels.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Abrosimov.K, Bryan berg.A and Katayer.K (1971), Road making Machinary, MIR Publishers, Moscow
2. Wong.J.Y (2008), Theory of Ground vehicles, John Wiley & Sons, New York

18PBEMEEA05 VEHICLE TROUBLESHOOTING AND MAINTENANCE 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To be able to have a complete knowledge of the vehicle maintenance procedures and acquire skills in handling situations where the vehicle is likely to fail.
2. to understand the concepts of schedule, records
3. To understand about of power plant and its components
4. To understand about the maintenance, servicing
5. To understand the concepts of radiator boiling
6. To understand the concepts of

COURSE OUTCOMES

1. Understand the different features and procedures of vehicle evaluation process.
2. Understand the various forms and procedures used to maintain the functioning of vehicle and engines.
3. Know the Chassis and suspension maintenance.
4. Maintain the Electrical equipments and trouble shooting.
5. Trouble shoots the fuel block, Radiator boiling and lubrication system.
6. Trouble shoots shooting of shooting of battery

UNIT I MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS 10

Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

UNIT II POWER PLANT REPAIR AND OVERHAULING 10

Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Power plant trouble shooting chart.

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS 9

Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY 8

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS 8

Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Judge.A.W (1969), Motor Vehicle Servicing, Pitman Paperpack, London
2. W.Crouse (1986), Everyday Automobile repair, Intl.student edition, TMH, New Delhi
3. Ernest Venk., Edward spicer (1963), Automotive maintenance and trouble shooting, D.B. Taraporevala Sons, Bombay
4. Stator Abbey (1971), Automotive steering, braking and suspension overhaul, Pitman publishing, London
5. Frazee, fledell, Spicer (1953), Automobile collision Work, American technical publications, Chicago
6. John Dolce (1984), Fleet maintenance, Mcgraw Hill, Newyork
7. A,W.Judge (1956), Maintenance of high speed diesel engines, Chapman Hall Ltd., London
8. V.L.Maleev (1995), Diesel Engine operation and maintenance, McGraw Hill Book Co., Newyork

18PBEMEEA06 ELECTRIC VEHICLE TECHNOLOGY 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles.
2. To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.
3. To impart knowledge on various energy source
4. To provide knowledge on concepts of electric propulsion systems
5. To expose students to various drive trains for hybrid electric vehicles
6. To facilitate the understanding of the concepts of electronic converters

COURSE OUTCOMES

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

1. Understand the concepts of electric and hybrid electric vehicles
2. Describe about the various energy source available for the hybrid electric vehicles.
3. Explain the concepts of electric propulsion systems
4. Design series drive train for hybrid electric vehicles
5. Design parallel drive train for hybrid electric vehicles
6. Understand the concepts of electronic converters for battery charging of electric hybrid vehicles.

UNIT I INTRODUCTION 9

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II HYBRID ELECTRIC DRIVE-TRAINS 9

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III ELECTRIC PROPULSION UNIT 9

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV ENERGY STORAGE 9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT V ENERGY MANAGEMENT STRATEGIES 9

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

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Iqbal Hussein (2010), Electric and Hybrid Vehicles: Design Fundamentals, CRC Press – 2nd edition
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Standardsmedia – 2nd edition

3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley – 2nd edition

MANAGEMENT SYSTEMS

18PBEMEEM01 PRINCIPLES OF MANAGEMENT 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To understand objectives, Strategies, Policies and Plan.
2. To introduce pans by directing and controlling.
3. To Understand the need of Engineering Ethics.
4. To Understand the forces that shape culture.
5. To develop the entrepreneurial skills.
6. To make the students conversant to execute an engineering plan with ethics.

COURSE OUTCOMES

1. Prepare objectives, Strategies, Policies and Plan.
2. Execute plans by directing and controlling.
3. Understand the need of Engineering Ethics.
4. Understand the forces that shape culture.
5. Show the entrepreneurial skills.
6. Execute an engineering plan with ethics.

UNIT I OVERVIEW OF MANAGEMENT 9

Definition - Management - Role of managers - Evolution of Management thought -Organization and the environmental factors – Trends and Challenges of Management in Global Scenario

UNIT II PLANNING 9

Nature and purpose of planning - Planning process - Types of plans – Objectives - Managing by objective (MBO) Strategies - Types of strategies - Policies – Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions.

UNIT III ORGANIZING 9

Nature and purpose of organizing - Organization structure - Formal and informal groups/organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal.

UNIT IV DIRECTING 9

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication - Organization Culture - Elements and types of culture – Managing cultural diversity

UNIT IV CONTROLLING 9

Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control – Maintenance Control - Quality Control - Planning operations.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Stephen P. Robbins and Mary Coulter (2006), Management, Prentice Hall of India
2. Charles W L Hill, Steven L McShane (2007), Principles of Management, Mcgraw Hill Education
3. Hellriegel, Slocum & Jackson (2007), Management - A Competency Based Approach, Thomson South Western
4. Harold Koontz, Heinz Weihrich and Mark V Cannice (2007), Management - A global & Entrepreneurial Perspective, Tata Mcgraw Hill
5. Andrew J. Dubrin (2007), Essentials of Management, Thomson Southwestern

18PBEMEEM02 PROJECT MANAGEMENT 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To learn the concepts of managing project
2. To develop an understanding of the need, concept, objectives and characteristics of project management approach in the industrial context.
3. To develop working knowledge of the technical and financial aspects of project management decisions.
4. To explore the basic concepts in appraisal criteria and learn to handle the problems in appraisal risk analysis.
5. To acquire working knowledge of the tools and techniques for project planning and control.
6. To acquire working knowledge project organizations

COURSE OUTCOMES

The students will be able to:

1. Develop an understanding of the importance and main features of project management approach in the industry context.
2. Obtain knowledge about the technical and financial aspects of project management decisions.
3. Explore the basic concepts in appraisal criteria and shall learn to handle the problems in appraisal risk analysis.
4. Use the tools and techniques for project planning and control.
5. Apply project planning methods in industries
6. Manage team projects

UNIT I INTRODUCTION TO PROJECT MANAGEMENT 9

Project Management – Definition –Goal - Lifecycles. Project Selection Methods. Project Portfolio Process – Project Formulation. Project Manager – Roles- Responsibilities and Selection – Project Teams.

UNIT II PLANNING AND BUDGETING 9

The Planning Process – Work Break down Structure – Role of Multidisciplinary teams. Budget the Project – Methods. Cost Estimating and Improvement. Budget uncertainty and risk management.

UNIT III SCHEDULING & RESOURCE ALLOCATION 9

PERT & CPM Networks - Crashing – Project Uncertainty and Risk Management – Simulation – Gantt Charts – Expediting a project – Resource loading and leveling. Allocating scarce resources – Goldratt‟s Critical Chain.

UNIT IV CONTROL AND COMPLETION 9

The Plan-Monitor-Control cycle – Data Collecting and reporting – Project Control – Designing the control system. Project Evaluation, Auditing and Termination.

UNIT V PROJECT ORGANISATION & CONFLICT MANAGEMENT 9

Formal Organisation Structure – Organisation Design – Types of project organizations. Conflict – Origin & Consequences. Managing conflict – Team methods for resolving conflict.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Clifford Gray and Erik Larson (2005), Project Management, Tata McGraw Hill Edition
2. John M. Nicholas (2006), Project Management for Business and Technology - Principles and Practice, Pearson Education
3. Gido and Clements (2003), Successful Project Management, Thomson Learning
4. Harvey Maylor (2006), Project Management, Pearson Education

18PBEMEEM03 MANUFACTURING SYSTEMS MANAGEMENT 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the basics of Plant Engineering.
2. To study the process planning and various forecasting techniques.
3. To get an overview of Project Management
4. To understand about Break even analysis
5. To understand about scheduling
6. to understand about principles of management

COURSE OUTCOME (CO's)

The students will be able to:

1. Apply the concepts of of Plant Engineering
2. Analysis the process planning and various forecasting techniques
3. Gain knowledge on Project Management
4. Gain knowledge on break even analysis
5. Preform scheduling on various activities
6. Gain knowledge on principles of management

UNIT I PLANT ENGINEERING 9

Plant location – Factors affecting plant location – Techniques – Plant layout - principles - Types – Comparison of layouts – Materials handling – Principles – Factors affecting selection of Materials handling system – Types of materials handling systems – Techniques.

UNIT II WORK STUDY 9

Method study – Principles of motion economy – steps in method study – Tool and Techniques – Work measurement – Purpose – stop watch time study – Production studies – work sampling – Ergonomics – Value analysis

UNIT III PROCESS PLANNING AND FORECASTING 9

Process planning – Aims of process planning – steps to prepare the detailed work sheets for manufacturing a given component – Break even analysis – Forecasting – Purpose of forecasting – Methods of forecasting – Time series – Regression and Correlation – Exponential smoothing.

UNIT IV SCHEDULING AND PROJECT MANAGEMENT 9

Scheduling – Priority rules for scheduling – sequencing – Johnson‘s algorithm for job sequencing – n job M machine problems – Project Network analysis – PERT/CPM – Critical path –Floats – Resource leveling – Queuing analysis.

UNIT V PERSONNEL AND MARKETING MANAGEMENT 9

Principles of Management – Functions of personnel management – Recruitment – Traiing – Motivation – Communication – conflicts – Industrial relations – Trade Union – Functions of marketing – Sales promotion methods – Advertising – Product packaging – Distribution channels – Market research and techniques.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Dr. R. Kesavan, C.Elanchezian and B.Vijayaramnath (2008), Production Planning and Control, Anuratha Publications, Chennai
2. Martand T. Telsang (2007), Production Management, S.Chand & Co
3. Dr. R. Kesavan,C. Elanchezian and T.Sundar Selwyn (2005), Engineering Management, Eswar Press, Chenna

18PBEMEEM04 MARKETING MANAGEMENT 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To understand the various processes involved in Marketing and its Philosophy
2. To learn the Psychology of consumers
3. To formulate strategies for advertising, pricing and selling
4. To understand the concepts of marketing management
5. To learn about marketing process for different types of products and services
6. To understand the tools used by marketing managers in decision situations

COURSE OUTCOME

1. Students will demonstrate strong conceptual knowledge in the functional area of marketing management.
2. Students will demonstrate effective understanding of relevant functional areas of marketing management and its application.
3. Students will demonstrate analytical skills in identification and resolution of problems pertaining to marketing management.
4. students will demonstrate market segmentation
5. students will demonstrate strategy formulation
6. students will demonstrate sales promotion

UNIT I MARKETING PROCESS 9

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy

UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION 9

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic -Psycho graphic and geographic segmentation, process, patterns.

UNIT III PRODUCT PRICING AND MARKETING RESEARCH 9

Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION 9

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION 9

Characteristics, impact, goals, types, and sales promotions- point of purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Govindarajan. M (2007), Marketing management – concepts, cases, challenges and trends, Prentice hall of India
2. Philip Kolter,Koshy Jha (2007), Marketing Management, Pearson Education ,Indian adapted edition
3. Czinkota&Kotabe (2007), Marketing management, Thomson learning, Indian edition
4. Adrain palmer (2004), Introduction to marketing theory and practice, Oxford university press IE
5. Donald S. Tull and Hawkins (1997), Marketing Research, Prentice Hall of India
6. Philip Kotler and Gary Armstrong (2000), Principles of Marketing, Prentice Hall of India

18PBEMEEM05 INDUSTRIAL SAFETY MANAGEMENT 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To recognize and evaluate occupational safety and health hazards in the workplace.
2. To determine appropriate hazard controls following the hierarchy of controls.
3. To analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. To prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. To teach student the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. To prevent or mitigate harm or damage to people, property, or the environment.

COURSE OUTCOMES

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

1. Recognize and evaluate occupational safety and health hazards in the workplace.
2. Determine appropriate hazard controls following the hierarchy of controls.
3. Analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. Understand the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. Prevent or mitigate harm or damage to people, property, or the environment.

UNIT I SAFETY MANAGEMENT 9

Evaluation of modern safety concepts - Safety management functions - safety organization, safety department - safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

UNIT II OPERATIONAL SAFETY 9

Hot metal Operation - Boiler, pressure vessels - heat treatment shop - gas furnace operation - electroplating-hot bending pipes - Safety in welding and cutting. Cold-metal Operation - Safety in Machine shop - Cold bending and chamfering of pipes - metal cutting - shot blasting, grinding, painting - power press and other machines.

UNIT III SAFETY MEASURES 9

Layout design and material handling - Use of electricity - Management of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries - planning, security and risk assessments, on- site and off site. Control of major industrial hazards.

UNIT IV ACCIDENT PREVENTION 9

Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP - Training and development of employees - First Aid- Fire fighting devices - Accident reporting, investigation.

UNIT V SAFETY, HEALTH, WELFARE & LAWS 9

Safety and health standards - Industrial hygiene - occupational diseases prevention - Welfare facilities - History of legislations related to Safety-pressure vessel act-Indian boiler act - The environmental protection act - Electricity act - Explosive act.

TOTAL 45 PERIODS

SUGGESTED READINGS

1. John V. Grimaldi and Rollin H. Simonds (1989), Safety Management, All India Travellers bookseller, New Delhi
2. Krishnan N.V (1996), Safety in Industry, Jaico Publisher House
3. U.K. Singh & J.M. Dewan (1996), Safety security and risk management, A.P.H Publishing company, New Delhi

18PBEMEEM06 LEAN MANUFACTURING 3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES

1. To know the various tools and methodologies of lean manufacturing
2. To know the cost of wastes in manufacturing systems
3. To study the requirements of customer satisfaction in terms of quality
4. To understand the concepts of process mapping
5. To understand the concepts of Six sigma measurements
6. To know about value stream mapping

COURSE OUTCOME (CO's)

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

1. To understand issues & challenges in implementing & developing lean manufacturing techniques
2. Apply lean techniques to improving organization performance
3. Analyze how lean techniques can be applied to manufacturing & service industry
4. Developing lean management strategy for process mapping
5. Able to apply lean six sigma concepts
6. Understand about value stream mapping

UNIT I INTRODUCTION 9

Objectives of lean manufacturing–key principles and implications of lean manufacturing– Traditional Vs lean manufacturing – Lean benefits – Case studies

UNIT II LEAN MANUFACTURING CONCEPTS 9

Value creation and waste elimination– Major kinds of waste– pull production–different models of pull production– continuous flow–continuous improvement / Kaizen– Worker involvement. .

UNIT III MANUFACTURING FLOW ELEMENT 9

Product/quantity analysis – process mapping – routing analysis – takt time calculations, line balancing and one–piece flow – Various types of layouts – Process – Product and cellular layouts – Manufacturing cell design criteria.

UNIT IV PROCESS CONTROL ELEMENT 9

Single minute exchange of dies (SMED) – total productive maintenance (TPM) – Poka–yoke – 5S – visual controls – graphic work instructions – Lean Sixsigma Concepts and tools – Sixsigma measurements – Case studies.

UNIT V VALUE STREAM MAPPING 9

The as–is diagram–the current state and future state map–application to the factory simulation scenario – overall equipment effectiveness(OEE)– measurements and case studies.
Just in Time manufacturing: Introduction – elements of JIT – Kanban system – Kanban sizing – Case studies
IMPLEMENTING LEAN: Road map–senior management Involvement – best practices.
INTEGRATING LEAN WITH OTHER SYSTEMS: Toyota production system–lean six sigma–lean and ERP–lean with ISO9001: 2000)

TOTAL 45 PERIODS

SUGGESTED READINGS

1. Askin R.G. and Goldberg J.B (2003), Design and Analysis of Lean Production Systems, John Wiley and Sons Inc.,New Jercy
2. Micheal Wader (2002), Lean Tools: A Pocket guide to Implementing Lean Practices, Productivity and Quality Publishing Pvt Ltd., New Delhi
3. Joseph A.D Feo , William W Bearnard (2004), Juran Institute's Six Sigma Break Through and Beyond, Tata McGraw–Hill Edition, New Delhi
4. Richard B Chase, Robert Jacobs F and Nicholas J Aquilano (2003), Operations Management for Competitive Advantage Tenth Edition, McGraw– Hill, Newyork
5. Alan Robinson (1991), Continuous Improvement in Operations, Productivity Press, Portland, Oregon
6. www.leanmanufacturingconcepts.com
7. www.learnleanblog.com