SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM-REGULATIONS 2014

BRANCH: ME –Engineering Design

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 1		**THEORY**							
1	14PSM102	Computational Methods	3	1	0	4	40	60	100
2	14PGK101/ 14PAK101	Computer Graphics and Applications	3	1	0	4	40	60	100
3	14PGK102/ 14PAK102	Finite Element Methods in Mechanical Design	3	1	0	4	40	60	100
4	14PGK103/ 14PAE304	Tribology in Design	3	1	0	4	40	60	100
5	14PGK104	Theory of Elasticity and Plasticity	3	0	0	3	40	60	100
6	14PGK105/ 14PAE311	Design For Manufacturing and Assembly	3	1	0	4	40	60	100
		PRACTICAL							
1	14PGK106	Integrated Design and Analysis Lab	0	0	3	2	40	60	100
2	-	Industrial Visit	0	0	0	-	-	-	-
		TOTAL	18	5	3	25	280	420	700

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 2		**THEORY**							
1	14PGK201/ 14PAK201	Vibration Analysis of Mechanical Systems	3	1	0	4	40	60	100
2	14PGK202	Mechanical Behaviour of Materials	3	0	0	3	40	60	100
3	14PGK203	Mechanisms Design and Simulation	3	1	0	4	40	60	100
4	14PGK204	Quality Engineering	3	0	0	3	40	60	100
5		Elective – I	3	0	0	3	40	60	100
6		Elective – II	3	0	0	3	40	60	100
		PRACTICAL							
1	14PGK205	Simulation and Design Engineering Lab	0	0	3	2	40	60	100
2	14PGK206	Technical Seminar	0	0	3	1	100	---	100
3	-	Industrial Visit	0	0	0	-	-	-	-
		TOTAL	18	2	6	23	380	420	800

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 3		**THEORY**							
1		Elective – III	3	0	0	3	40	60	100
2		Elective – IV	3	0	0	3	40	60	100
3		Elective – V	3	0	0	3	40	60	100
		PRACTICAL							
1	14PGK301	Project Work Phase – I	0	0	12	6	40	60	100
2	-	Industrial Visit	0	0	0	-	-	-	-
		TOTAL	9	0	12	15	160	240	400

S.NO	CODE	COURSE	HOURS/WEEK			CREDITS	MAXIMUM MARKS		
			L	T	P		CA	FE	TOTAL
SEMESTER - 4		**PROJECT WORK**							
1	14PGK401	Project Work Phase – II	0	0	24	12	40	60	100
		TOTAL	0	0	24	12	40	60	100

TOTAL: 75 CREDITS

L – Lecture T – Tutorial P – Practical C - Credit

CA – Continuous Assessment FE- Final Exam

LIST OF ELECTIVES

II Semester

14PGE201/ 14PAE201 Advanced Tool Design
14PGE202/14PAE202 Mechatronic System Design
14PGE203/14PAE203 Composite Materials Analysis and Applications
14PGE204/14PAE307 Advanced Metrology and Non Destructive Testing
14PGE205/14PAE205 Computational Fluid Dynamics
14PGE206/14PAE206 Productivity Management and Re-Engineering
14PGE207/14PAE207 Modern trends in Casting, Welding and Forming Techniques
14PGE208/14PAE208 Facilities Planning and Layout Design
14 PGE209/14PAE209 Product Design and Development
14PGE210 Industrial Robotics and Expert Systems
14PGE211/12PAE212 Manufacture of Automobile Components

III Semester

14PGE301/14PAK105 Rapid Manufacturing and Tooling
14PGE302 Research Methodology
14PGE303/14PAE303 Enterprise Resource Planning
14PGE304 Mechanics of Fracture in Engineering
14PGE305/14PAE305 Quality Control and Reliability Engineering
14PGE306/14PAE306 Robust Design of Product/Process
14PGE307/14PAE204 Engineering Economics and Cash Flow Analysis
14PGE308 Reverse Engineering
14PGE309 Bearing Design and Rotor Dynamics
14PGE310 Reliability and Maintenance Engineering
14PGE311 Advanced strength of materials
14PGE312/14PAE312 Advanced Optimization Techniques
14PGE313 Design of Material Handling Equipments
14PGE314 Plasticity and Metal Forming
14PGE315 Design of Pressure Vessels and Piping Layout
14PGE316 Automotive Design
14PGE317/14PAE314 Field Work
Interdisciplinary Subject

14PSM102 COMPUTATIONAL METHODS

L	T	P	C
3	1	0	4

Course objectives

- *To acquire the knowledge in functions, functional dependent on derivatives and functional dependent on functions of several independent variables.*
- *To solve simultaneous equations using different methods.*
- *To solve differential equations using different methods.*
- *To solve Partial differential equations using different methods.*
- *Solving integrals using numerical techniques.*

UNIT I CURVE FITTING AND SOLUTION OF SYSTEM OF EQUATIONS 9

Curve fitting –method of group averages –principle of least squares –method of moments - fitting a straight line and non linear curve fitting-Data fitting with cubic splines. Solutions of linear systems –Direct methods -Gauss elimination and Gauss Jordan methods–Indirect method –Gauss Seidel method.

UNIT II CALCULUS OF VARIATION 9

Variation and its properties –Euler's equation – Functional dependent on first and higher order derivatives –Functional dependent on functions of several independent variables – problems with moving boundaries.

UNIT III NUMERICAL INTEGRATION 9

Newton-Cotes integration formulas –Trapezoidal rule, Simpson's rules and Weddle's rule – Gaussian Quadrature –Double integrals using Trapezoidal and Simpson's rules.

UNIT IV BOUNDARY VALUE AND CHARACTERISTIC VALUE PROBLEMS 9

Solving initial value problems using Taylor's series method and R-K method of fourth order–Boundary value problems –Solution through a set of equations with derivative boundary conditions. Characteristic value problems–Power method and Jacobi method– Inverse power method.

UNIT V NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS 9

Boundary value problems for ODE –Finite difference methods–Numerical solution of PDE – Solution of Laplace's and Poisson equation–Liebmann's iteration process –Solution of heat conduction equation by Schmidt explicit formula and Crank-Nicolson implicit scheme – Solution of one dimensional wave equation.

STATE OF ART (Not for Exam)

Finite element method, finite difference method, finite volume method.

Note: Assignments using MATLAB to solve design problems

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Curtis F Gerald and Patrick O Wheatley, "Applied Numerical Analysis", Pearson Education, 2002.
2. Venkataraman, M. K., “Higher Mathematics for Engineering and Science”, National Publishing Company,1992.
3. Grewal, B.S., Numerical methods in Engineering and Science, 7th edition, Khanna Publishers, 2005.

REFERENCES:

1. Douglas J Faires and Riched Burden, "Numerical Methods", Brooks/Cole Publishing Company, 1998, Second Edition.
2. Steven C Chapra and Raymond P Canale, “Numerical Methods for Engineers with Software and Programming Applications”, Tata McGraw Hill Edition, 2004. John H Mathews and Kurtis D Fink, “Numerical Methods using MATLAB”, Prentice Hall, 1998.
3. Rajasekaran S, “Numerical Methods in Science and Engineering –A Practical Approach”, Wheeler Publishing, 1999, Second edition.
4. Gupta, A.S., Calculus of variations with applications, Prentice-Hall of India, New Delhi, 1997.

14PGK101 / 14PAK101 COMPUTER GRAPHICS AND APPLICATIONS

L	T	P	C
3	1	0	4

Course objective

- *To understand the applications of computers in engineering design, tooling and data management.*

UNIT I PRINCIPLES OF COMPUTER GRAPHICS **9**

Transformation and mapping of geometric models – inversion transformations and mappings – projection of geometric models – design and engineering applications – model clean up – hidden line, surface and solid removal .

UNIT II GEOMETRIC MODELLING **9**

Wire frame models – parametric representation of analytic and synthetic curves – curve manipulators– surface models – parametric representation of analytic and synthetic surfaces – surface manipulations — design and engineering applications in wireframe, surface and solid modeling.

UNIT III SOLID MODELLING **9**

Solid models – boundary representation (B-Rep) – constructive solid geometry (CSG) – sweep representation – analytical solid modeling - shading and coloring.

UNIT IV CAD/CAM DATA EXCHANGE **9**

Evolution of data exchange format – shape and product data based formats – ISO standard IGES description, data representation, file structure and format – processors – PDES description and data representation.

UNIT V PRODUCT DATA MANAGEMENT **9**

Version control – library creation – catalog making – standardization for design – collaborative design among groups – design optimization for geometry – Design check, approval and validation. Introduction to Product Data Management (PDM), PDM systems and importance, reason for implementing a PDM system, barriers to PDM implementation.

STATE OF ART (Not for Exam)

CAD Software packages and languages like Auto LISP/C.

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS

1. Ibrahim Zeid, “CAD/CAM – Theory and Practice” - McGraw Hill, International Edition, 1998.
2. Donald Hearn and M Pauline Baker, “Computer Graphics”, Prentice Hall, 1992.

REFERENCES

1. William M. Neumann and Robert Sproul, “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore 1989.
2. P.Radhakrishnan, S.Subramanyan and V.Raju, “CAD/CAM/CIM”, New age International (P).Ltd. Publishers, New Delhi.

14PGK102 / 14PAK102 FINITE ELEMENT METHODS IN MECHANICAL DESIGN

L	T	P	C
3	1	0	4

Course objectives:

- *To understand the concept of isoparametric elements and their usefulness*
- *To have an insight of the applications of heat transfer and structural dynamics problem with solution procedure.*
- *To have study of magnitude and types of errors that can kept in a FE solution and their remedies.*

UNIT I 2-D ISOPARAMETRIC ELEMENTS 9

Introduction- Four node quadrilateral – shape function-element stiffness matrix – element force vectors- Numerical integration: 2-D integrals – stiffness integration-stress calculations-higher order elements- 4 node quadrilaterals for axisymmetric problems.

UNIT II AXISYMMETRIC SOLIDS, PLATE BENDING AND SHELLS 9

Axisymmtric formulation- modeling with triangular elements- potential energy & Galerkin approach-problem modeling and boundary conditions – Kirchoff and Mindlin plate elements – Analytical problems- General shells – 3 & 4 node elements - curved isoparametric elements- Axisymmetric shell applications

UNIT III HEAT TRANSFER AND SELECTED FLUID PROBLEMS 9

Introduction-steady state heat transfer- 2D steady state heat conduction- 2D fins-Radiation.Non-linear heat transfer problems- Potential flow, seepage & fluid flow in ducts, 1-D & 2-D acoustics, boundary conditions - problems

UNIT IV STRUCTURAL DYNAMICS AND VIBRATIONS 9

Dynamic equations – Mass and damping matrices – Natural frequencies and modes – evaluation of eigen values and vectors - Guyan reduction– Modal methods – Explicit and implicit direct integration methods – Harmonic response - Analysis by response spectra.

UNIT V NON-LINEARITY & ERROR ESTIMATES 9

Introduction – Material non – Geometric non – linearity – modeling considerations – sources of error – diagonal decay test- discretization error - convergence rates – Posterior error estimate – adaptive meshing.

STATE OF ART (Not for Exam)

FEA software packages with applications modeling consideration and software use.

Theory: 45; Tutorial: 15; Total Hours: 60

NOTE

As for the examination, modeling considerations, choice of elements, boundary conditions, loading conditions, and basic procedures only need to be emphasized without expecting a complete numerical solution to practical problems.

TEXT BOOKS:

1. Cook, Robert Davis et al, “Concepts and Applications of Finite Element Analysis”, Wiley, John & Sons, 2002
2. T.R. Chandrupatla and A.D. Belegundu, “Introduction to the finite elements in Engineering”, PHI Learning Private Limited, New Delhi, 2009.

REFERENCES:

1. Logan D.L, “A First Course in the Finite Element Method”, Third Edition, Thomson Learning, 2004.
2. Reddy J.N, “An introduction to the finite element method”, McGraw Hill, International Edition, 2003.
3. Sienkiewicz, O.C and Taylor, R.L., “ The Finite Element Method”, Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics services, 1991

14PGK103 / 14PAE304 TRIBOLOGY IN DESIGN

L	T	P	C
3	1	0	4

Course Objectives:

- *To provide greater insight into the science and technology of interacting surfaces in relative motion.*
- *To give detailed study of surfaces, friction and wear surface coatings and their effect.*
- *To apply the concepts to the design of hydro dynamic and hydro static and rolling element bearings.*

UNIT – I INTRODUCTION **9**

Nature of surfaces and contact, surface topography, friction and wear mechanisms and effect of lubricants, methods of fluid film formation.

Selection of Rolling Element Bearings

Nominal life, static and dynamic capacity, equivalent load, probabilities of survival, cubic mean load, bearing mounting details, preloading of bearings, condition monitoring using shock pulse method.

UNIT – II HYDRODYNAMIC BEARINGS **9**

Fundamentals of fluid film formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfeld number -performance parameters – optimum bearing with maximum load capacity – friction – heat generated and heat dissipated. Hydrodynamic thrust bearings: Raimondi and Boyd solution for hydrodynamic thrust bearings – fixed and tilting pads, single and multiple pad bearings – optimum condition with largest minimum film thickness.

UNIT – III HYDROSTATIC BEARINGS **9**

Thrust bearings – pad coefficients – restriction – optimum film thickness – Journal bearings – design procedures. Aerostatic bearings: thrust bearings and journal bearings, design procedure.

Dry Rubbing bearings: Porous metal bearings and oscillatory journal bearings, qualitative approach only.

UNIT – IV LUBRICATION: **9**

Choice of lubricant type, oil, grease and solid lubricants, additives, lubrication systems and their selection, selection of pump, filters, piping design, oil changing and oil conservation.

Seals : Different types, mechanical seals, lip seals, packed glands, soft piston seals, mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves, selection of mechanical seals.

UNIT – V TRIBOLOGY IN INDUSTRIES & TRIBO MEASURMENTS **9**

Tribology in Metal working industries – effects of friction, wear and lubrication in metal working – classification of plastic deformation processes – rolling – drawing – extrusion – forging – sheet metal working – metal removal. Paper and pulp industries – paper making processes – tribological considerations and applications. Glass fiber industries – making of glass fiber – tribological considerations. Measurement techniques – contact and non-contact type.

STATE OF ART (Not for Exam)

Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using SOAP and Ferrography, Green tribology - introduction, feature and its latest applications

Theory: 45; Tutorial: 15; Total Hours: 60

TEXT BOOKS:

1. S.K.Basu, S.N.Sengupta, B.B.Ahuja "Fundamentals of Tribology" PHI Learning Pvt Limited.
2. Prasanta Sahoo, "Engineering Tribology", PHI Learning Pvt Limited, New Delhi.

REFERENCES:

1. Sushilkumarsrivastava "Tribology in Industries" S.Chand&Company Ltd, New Delhi, 2001.
2. Neale M J, "Tribology Handbook", Neumann Butterworths, 1975.
3. Hydrostatic and Hybrid Bearing Design – Rowe W W & O' Dionoghue – Butterworths & Co. Publishers Ltd.

14PGK104 THEORY OF ELASTICITY AND PLASTICITY

L	T	P	C
3	0	0	3

Course Objectives:

- *To write the full set of equations for an elastic and an elasto-plastic analysis of a body with an arbitrary shape in two- or three-dimensional space*
- *To interpret the states of stress and deformation.*
- *To make an analysis of a solid mechanics problem with an elastic material and simple geometry in two- or three-dimensional space, and with an elasto-plastic material in one- or two-dimensional space.*

UNIT I ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS 9

Stress at a point – components of stress; Principal stresses; Stress ellipsoid and stress director surface; Determination of principal stresses; Stress invariants; Determination of maximum shear stresses; Octahedral shear stress; strain at a point – Components of strain; Differential equations of equilibrium ; Conditions of compatibility; Generalized Hooke's law

UNIT II TWO-DIMENSIONAL PROBLEMS IN RECTANGULAR COORDINATES 9

Plane stress; Plane strain; Differential equations of equilibrium; Boundary conditions; Compatibility equations; Stress function; Governing differential equation; Solution b y polynomials; End effects – Saint-Venant's Principle; Determination of displacements; Bending of a cantilever loaded at the end; Bending of a beam by uniform load

UNIT III TWO-DIMENSIONAL PROBLEMS IN POLAR COORDINATES 9

General equations in polar coordinates; Stress distribution symmetrical about an axis; Effect of circular holes on stress distribution in plates; Concentrated force at a point of a straight boundary; Concentrated force acting on a beam; Stresses in a circular disc

UNIT IV TORSION 9

Torsion of straight bars – Saint Venant's theory; Elliptic cross section; Membrane analogy; Torsion of a bar of narrow rectangular cross-section; Torsion of rolled profile sections; Torsion of thin tubes

UNIT V PLASTICITY 9

Introduction, Flow curve, True stress and true strain, Yielding criteria for ductile materials, The Tresca yield criterion, The von Mises yield criterion; Stress-Strain relations – Introduction, Plastic potential and Plastic flow, Levy-Mises equations, Prandtl-Reuss equations, torsion of a bar of oval section (Sokoloskey's method), problems of spherical and axial symmetry, slip lines and plastic flow, strain hardening and FEM applications.

STATE OF ART (Not for Exam)

Applications of Finite Element Analysis, Analysis of plasticity problems using finite element analysis.

Total Hours: 45

TEXT BOOKS:

1. S.P. Timoshenko & J.N. Goodier, "Theory of Elasticity", McGraw-Hill.
2. L.S. Srinath, "Advanced mechanics of solids", Tata McGraw-Hill.

REFERENCES:

1. George E. Dieter, " Mechanical Metallurgy", SI metric edition, McGraw Hill Book Company, 2001.
2. G .K Lal and N V Reddy, "Introduction to Engineering plasticity", Narosa Publishing House.
3 Johnson & Miller – Van Nostrand, "Plasticity for Mechanical Engineers".

14PGK105 / 14PAE311 DESIGN FOR MANUFACTURING AND ASSEMBLY

L	T	P	C
3	1	0	4

Course Objectives

- *To understand the concept of tolerance analysis.*
- *To enable the students to understand and appreciate better design and manufacturingmethodologies that facilitates easier assembly of complex equipment.*

UNIT I SELECTION OF MATERIALS AND PROCESSES 9

Phases of design – General requirements for material and process selection, effect of material properties and manufacturing process on design – DFM approach - DFM Guidelines – Product design for manual assembly, automatic assembly and robotic assembly – Computer aided DFMA.

UNIT II TOLERANCE ANALYSIS 9

Process capability – metrics – costs aspects – Feature tolerance – geometric tolerance – surface finish, review of relationship between attainable tolerance grades and difference machining process – Cumulative effect of tolerances; sure fit law , normal law and truncated normal law. Tolerance charting technique**:** Tolerance worksheets and centrality analysis, examples – Computer aided tolerance charting.

UNIT III SELECTIVE ASSEMBLY AND DATUM SYSTEMS 9

Interchangeable selective assembly – Control and axial play; introducing secondary machining operations, laminated shims, examples. Datum systems : Degrees of freedom, grouped datum systems different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess pair and tongue – slot pair – computation of translational and rotational accuracy, geometric analyses and applications.

UNIT IV TRUE POSITION THEORY 9

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

UNIT V DESIGN FOR MACHINING 9

Design features to facilitate machining – Functional and manufacturing datum features, component design, machining considerations, redesign for manufacture, examples. Form design**:** Form design of castings and weldments – Redesign of castings based on parting line considerations, minimizing core requirements – redesigning case members using weldments.

STATE OF ART (Not for Exam)

Case studies- Tolerance Technique, Design For Machining

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Boothroyd, G, 1980 Design for Assembly Automation and Product Design. New York,
   Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGraw hill, 1999.

REFERENCES:

1. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
2. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.

14PGK106 INTEGRATED DESIGN AND ANALYSIS LAB

L	T	P	C
0	0	3	2

- CAD Introduction.
- Sketcher
- Solid modeling –Extrude, Revolve, Sweep, etc and Variational sweep, Loft ,etc
- Surface modeling –Extrude, Sweep, Trim, etc and Mesh of curves, Free form etc
- Feature manipulation – Copy, Edit, Pattern, Suppress, History operations etc.
- Assembly-Constraints, Exploded Views, Interference check
- Drafting-Layouts, Standard & Sectional Views, Detailing & Plotting.

Exercises in Modeling and drafting of Mechanical Components - Assembly using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA etc

Analysis of Mechanical Components – Using packages like ANSYS/ NASTRAN, MATLAB etc.,
Exercises shall include analysis of

i) Machine elements under Static loads
ii) Thermal Analysis of mechanical systems
iii) Aerodynamic analysis
iv) Modal Analysis

Total Hours: 45

INDUSTRIAL VISIT

- All ME students are expected to visit at least 3 industries every semester either by means of regular industrial visits organized by the department or through self interest.
- These visits could be a formal visit to learn the practices followed in the industries.
- In-plant trainings and internships will also be considered as industrial visits.
- Every student should submit an ‘Industrial Visit’ report at the end of each visit to the Year In-charge/Advisor of that branch. The report should explain the practices and methodologies adopted in the visited industry in an understandable manner.
- The student should also make a presentation about the experiences gained in the industry in front of the panel of faculty experts, including the Head of the Department.

14PGK201/14PAK201 VIBRATION ANALYSIS OF MECHANICAL SYSTEMS

L	T	P	C
3	1	0	4

Course objectives

- *To understand the Fundamentals of Vibration and its practical applications*
- *To understand the various Vibration control strategies*

UNIT-I UNDAMPED AND DAMPED FREE VIBRATIONS 9

Importance and scope definition and terminology, representation of harmonic motions, introduction to various types of vibrations and types of excitation,

Undamped Free Vibrations: Single Degrees of Freedom Systems - D Alemberts Principle, Energy method, Rayleigh method, simple applications of these methods, equivalent spring stiffness.

Damped Free Vibrations: Introduction to different types of damping, Viscous damping, sub-critical, critical and over damping, logarithmic decrement, frequency of damped oscillations.

UNIT-II FORCED VIBRATIONS 9

Single Degree of Freedom System - Solution for simple harmonic excitation, steady state vibrations, Rotating and reciprocating unbalance, base excitation, vibration isolation and transmissibility, whirling of shaft without friction.

UNIT-III TWO DEGREE OF FREEDOM SYSTEMS 9

Free vibration of spring coupled systems, Two degrees of freedom mass coupled systems,

Forced vibration of an undamped two degrees of freedom system, Undamped vibration absorbers, Vibration isolation. Torsional vibrations of two rotor systems.

Applications: Dynamic vibration absorber, centrifugal pendulum absorber, torsional vibration absorber.

UNIT-IV MULTI-DEGREE OF FREEDOM SYSTEMS 9

Lagrange's equation, dunker ley's approximation method, rayleigh method, matrix method, matrix iteration, orthogonality principle, modal analysis, stodola method, holzer method, galerkin method, rayleigh- ritz method.

UNIT-V CONTINUOUS SYSTEMS 9

Longitudinal vibrations of bar, transverse vibration of beam, torsion of vibrations of circular shaft with various end conditions, vibration instruments, vibration exciters, transducers and measurement devices, Analysis of SHM, Fourier theorem and simple problems.

STATE OF ART (Not for Exam)

Application of Computer software in vibration Analysis

Theory: 45; Tutorial: 15; Total Hours: 60

TEXT BOOKS:

1. Mechanical Vibrations: V.P. Singh, DhanpatRai& Company Pvt. Ltd., 3rd edition, 2006.
2. Theory of Vibration with Applications: W.T. Thomson and Marie Dillon Dahleh, Pearson Education 5th edition, 2007
3. Mechanical Vibrations : GopalKrishan Grover , Nem Chand, 1977.

REFERENCES:

1. Mechanical Vibrations: S.S. Rao, Pearson Education Inc, 4th Edition, 2003.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007.
3. Theory & Practice of Mechanical vibrations: J.S. Rao& K. Gupta, New Age International Publications, New Delhi, 2001.

14PGK202 MECHANICAL BEHAVIOUR OF MATERIALS

L	T	P	C
3	0	0	3

Course objectives

- *To understand the basics of mechanical behaviour of materials*
- *To understand the strengthening mechanism and fracture mechanics*
- *To understand the fatigue phenomenon and high temperature deformation*

UNIT I – PROPERTIES AND BEHAVIOUR OF MATERIALS 9

Elastic and Plastic behaviour of the materials- stress-strain curve for different materials – elastic and plastic properties of the materials- state of stress in two and three dimensions – Mohr's circle - elements of plastic deformation of metallic materials-flow curves- true stress strain curve- theories of strength

UNIT II -DISLOCATION MECHANICS 9

Introduction to Plastic deformation – slip and twin – dislocation – nature of dislocation – burger vector- forces on dislocation – stacking faults - dislocation mechanics – frank read sources- dislocation pile ups- cross slip – dislocation interaction-climb

UNIT III - HARDENING MECHANISM IN METALS 9

Work hardening – Taylor's, Seeger's and Kuhlmann-Wilsdorf theories- grain boundary strengthening – Hall-Petch and Cottrell theories – solid solution strengthening – precipitate hardening - strengthening due to point defects – martensite strengthening

UNIT IV - FRACTURE MECHANICS AND TESTING 9

Fracture-types of fracture- stress concentration and Griffith criterion of fracture – fracture toughness- fracture toughness parameters – fracture testing – impact test – significance of DBTT - fracture toughness test- crack opening test- J integral test

UNIT V - FATIGUE AND CREEP 9

Introduction to fatigue failure – theories of fatigue failure- factors affecting fatigue strength – fatigue test- S-N curve – creep – creep curve – creep mechanism – creep test

STATE OF ART (Not for Exam)

High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications

Total Hours: 45

TEXT BOOKS:

1. Marc André Meyers, Krishan Kumar Chawla, "Mechanical Behavior of Materials", Cambridge University Press, 2009.
2. William F. Hosford, "Mechanical Behavior of Materials", Cambridge University Press, 2005

REFERENCES:

1. George Ellwood Dieter, "Mechanical Metallurgy", McGraw-Hill, 1988
2. Forrest, P.G., "Fatigue of Metals", PregamanPross, 1961.
3. Knott, J.F., "Fundamentals of fracture mechanics ", Worths, 1979.

14PGK203 MECHANISMS DESIGN AND SIMULATION

L	T	P	C
3	1	0	4

Course objective

- *To develop a thorough understanding of the various mechanisms and its design and simulation with ability to effectively use the various mechanisms in real life problems.*

UNIT I INTRODUCTION 9

Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms – mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms-Equivalent mechanisms.

UNIT II KINEMATIC ANALYSIS 9

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism-Denavit-Hartenberg Parameters – Forward and inverse kinematics of robot manipulators.

UNIT III PATH CURVATURE THEORY, COUPLER CURVE 9

Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp-crunode- coupler driven six-bar mechanisms-straight line mechanisms

UNIT IV SYNTHESIS OF FOUR BAR MECHANISMS 9

Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique-inversion technique-point position reduction-two, three and four position synthesis of four-bar mechanisms. Analytical methods- Freudenstein‟s Equation-Bloch„s Synthesis.

UNIT V SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS 9

Cognate Lingages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms-determination of optimum size of cams. Mechanism defects. Study and use of Mechanism using Simulation Soft-ware packages. Students should design and fabricate a mechanism model as term project.

STATE OF ART (Not for Exam)

Synthesis of mechanism – Graphical Method- Bloch's Synthesis

Theory: 45; Tutorial: 15; Total Hours: 60

TEXTBOOKS:

1. Uicker, J.J, Pennock G.R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, NY, 2003.
2. AmitabhaGhosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 1999.

REFERENCES:

1. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis",
   Prentice Hall, 1984.
2. Nortron R.L., "Design of Machinery", McGraw Hill, 1999.
3. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery" John Wiley-sons, 1999.
4. Ramamurti, V., "Mechanics of Machines", Narosa, 2005.

14PGK204 QUALITY ENGINEERING

L	T	P	C
3	0	0	3

Course objective

- *To study about robust design, embodiment principles, various methods in design of experiments, reliability charts and histograms and six sigma techniques.*

UNIT I DESIGN FOR QUALITY **9**

Quality Function Deployment-House of Quality-Objectives and functions-Targets-Stakeholders- Measures and Matrices. Robust Design –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan-experimental design–testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT II DESIGN OF EXPERIMENTS **9**

Design of experiments-Basic methods- Two factorial experiments-Extended method-reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design-Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual t-test, ANOVA-ratio test, other indicators-residual plots, Advanced DOE method for product testing-Product applications of physical modeling and DOE, Blender panel display evaluation, coffee grinder experimental optimization-Taguchi method.

UNIT III FAILURE MODE EFFECT ANALYSIS **9**

Basic methods: Refining geometry and layout, general process of product embodiment-Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method - linking fault states to systems modeling-Case study- computer monitor stand for a docking station.

UNIT IV STATISTICAL CONSIDERATION AND RELIABILITY **9**

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter
diagrams –Multivariable charts –Matrix plots and 3-D plots.-Reliability-Survival and Failure- Series and parallel systems-Mean time between failure-Weibull distribution

UNIT V DESIGN FOR SIX SIGMA **9**

Basis of Six Sigma –Project selection for Six Sigma- Six Sigma problem solving- Six Sigma in service and small organizations - Six Sigma and lean production –Lean Six Sigma and services

STATE OF ART (Not for Exam)

Case studies – FMEA, DFMEA, DOE- Taguchi method, SIX SIGMA in industries

Total Hours: 45

TEXTBOOKS:

1. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN Otto & Kristin Wood, Pearson Education (LPE), 2001.
2. Product Design And Development, karl t. Ulrich, steven d. Eppinger, tata McGRAW-HILL- 3rd Edition, 2003.

REFERENCES:

1. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay Pub:on south-western(www.swlearning.com)
2. Fundamentals of Quality control and improvement 2nd edition, Amitava Mitra, PearsonEducation Asia, 2002.

14PGK205 SIMULATION AND DESIGN ENGINEERING LAB

L	T	P	C
0	0	3	2

- Design of experiments and analysis of data using analysis of mean and ANOVA.
- Measurement of linear displacement using linear variable differential transducer and strain in a member using strain gauge and virtual instrumentation software.
- Determining the natural frequency and amplitude for given vibrating member using virtual instrumentation software.
- Simulation of pneumatic system using FLUID SIM and Automation studio software.
- Design and testing of pneumatic system using KV map method and cascade method.
- Modeling and Analysis of real time systems (Eg. Roll cage/Chassis of Vehicles/Trusses, etc.)
- Simulation of mechanical linkages using kinematics and dynamics simulation software like ADAMS/ MATLAB.

Hardware requirements

1. Pentium core 2 Duo, 250 GB Hard disk, 2GB RAM
2. Pneumatic and hydraulic kits
3. LVDT, Strain-gauge

Software requirements

1. ANSYS/MATLAB/ADAMS
2. Automation Studio
3. FLUID SIM
4. LAB VIEW
5. MacAnova/Minitab

Total Hours: 45

14PGK206 TECHNICAL SEMINAR

L	T	P	C
0	0	3	1

1. It is mandatory that each student will give individually two seminars in the third semester.
2. During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of not less than 45 minutes.
3. Also, the student has to submit a hard copy of the technical topic, in the form of a report consisting of a title page, Introduction, body chapters and a conclusion with references, running to not less than 20 pages; this will be evaluated by the faculty coordinator/guide.
4. In a session of three periods per week, 3 students are expected to present the seminar.
5. For each student, a faculty guide will be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
6. Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models.
7. This will enable them to gain confidence in technical presentation skills and to face the placement interviews.

14PGK301 PROJECT PHASE – I

L	T	P	C
0	0	12	6

1. Each student is expected to do an individual project. and separately one design project
2. Every student shall have a guide who is the member of the faculty of the institution.

   Identification of faculty guide has to be completed within a week from the day of beginning of third semester.
3. The student has to identify and select the problem to be addressed as his/her project works; make through literature survey and finalize a comprehensive aim and scope of his/her work to be done.
4. 25% of the total project work and 100 % design project have to be completed by the end of third semester.
5. A mini project report (of the phase-I) to this effect has to be submitted by each student. Also the complete design project report has to be submitted by each student.
6. One mid semester review and another end semester review of the progress of the project work have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member of the faculty team.
7. At the end of semester exam, one internal examiner and one external examiner, appointed by the COE will examine the project phase I done by the students. Design project report will be considered for awarding internal marks.

14PGK401 PROJECT WORK PHASE – II

L	T	P	C
0	0	24	12

8. The entire semester shall be utilized by the students to receive the directions from the guide, for library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.
9. The progress of the project is to be evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.
10. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines issued by the COE.
14. The project work is evaluated jointly by external and internal examiners constituted by the COE based on oral presentation and the project report.

14PGE201/ 14PAE201 ADVANCED TOOL DESIGN

L	T	P	C
3	0	0	3

Course objectives

- *To understand the types of tooling materials and heat treatment*
- *To understand the principles involved in the design of jigs, fixtures and dies*
- *To understand the tool design for Numerically Controlled machine tools*

UNIT I TOOL-DESIGN METHODS 9

Introduction – The Design Procedure – Statement of the problem – The Needs Analysis – Research and Ideation – Tentative Design Solutions – The Finished Design – Drafting and Design Techniques in Tooling drawings – Screws and Dowels – Hole location – Jig-boring practice – Installation of Drill Bushings – Punch and Die Manufacture – Electro-discharge machining for cavity.

UNIT II TOOLING MATERIALS AND HEAT TREATMENT 9

Introduction – Properties of Materials – Ferrous Tooling Materials – Tool steels – Cast Iron – Mild, or low-carbon Steel – Nonmetallic Tooling Materials – Nonferrous Tooling Materials – Metal cutting Tools – Single-point cutting tools – Milling cutters – Drills and Drilling – Reamer classification – Taps – Tap classification- the selection of carbide cutting tools – Determining the insert thickness for carbide tools

UNIT III DESIGN OF DRILL JIGS 9

Introduction – Fixed Gages – Gage Tolerances – The selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Drill jigs and modern manufacturing

UNIT IV DESIGN OF FIXTURES AND DIES 9

Introduction – Fixtures and economics – Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Types of Die construction – Die-design fundamentals – Blanking and Piercing die construction – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing operations.

UNIT V TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS 9

Introduction – Fixture design for numerically controlled machine tools – Cutting tools for numerical control machines– Tool holding methods for numerical control – Automatic tool changers and tool positioners – Tool presetting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines

STATE OF ART (Not for Exam)

Recent Advances in tool design-Advanced materials for tool-automated jigs and fixtures-Application-Advances in Die design for cutting and forming operation

Total Hours: 45

TEXT BOOKS:

1. Edward G.Hofffman, "Jigs and fixtures Design" Delmar Publishers, Singapore, Fourth Edition.
2. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.

REFERENCES:

1. J.R.Paquin, R.E.Crowley, "Die Design fundamentals", Second Edition, Industrial Press Inc.
2. V.Korsakov, "Fundamentals of fixture design", Mir Publishers, Mascow.
3. Prakash Hiralal Joshi, "Tooling data", Wheeler Publishing, 2000.

14PGE202 / 14PAE202 MECHATRONIC SYSTEM DESIGN

L	T	P	C
3	0	0	3

Course Objective

- *To understand the concept of sensors, actuators, real time interfacing and their applications.*

UNIT – I MODELING AND SIMULATION **9**

Definition, Key elements, Mechatronics approach for Design process, analogy approach of modeling, block diagram approach of modeling, simulation, software and hardware in loop simulation.

UNIT – II SENSORS AND TRANSDUCERS **9**

Sensors for motion and position measurement, force, torque, tactile, temperature sensors, ultrasonic sensors, magneto strictive sensors.

UNIT – III ACTUATORS FOR MECHATRONICS SYSTEM **9**

Types of actuators and their working principles, control valves, direction, pressure and flow, comparison of hydraulic, pneumatic and electrical actuators, proportional pressure and flow valves. Automation system Design- Pneumatic elements, proportional pressure and flow control valves, electro pneumatic system, circuit design, examples, hydraulic elements, electro hydraulic system, circuit design, examples, casecade and Karnaugh Veitch map methods.

UNIT – IV REAL TIME INTERFACING **9**

Introduction of data acquisition and control system, Overview of I/O process, interfacing of various sensors, stepper Motor with PC, virtual Instrumentation.

UNIT – V ADVANCED APPLICATIONS **9**

Sensor for condition monitoring, mechatronic control in automated manufacturing, microsensors, case studies. Traditional Vs Mechatronics approach, integrated product design, mechanisms, load conditions, design, flexibility, modeling and simulation. Structures – load conditions, environmental isolation, and modeling. Man-machine interface, industrial design and ergonomics, information transfer, safety. Bond Graph Technique, Case studies of Mechatronics systems.

STATE OF ART (Not for Exam)

Control systems-Sequence control and programmable controllers, logic control and sequencing elements, ladder diagram, PLC, Programming the PLC.

Total Hours: 45

TEXT BOOKS:

1. Bradley. D.A, Dawson.D., Buru.N.C. and Loader.A.J., “Mechatronics”, Chapman and Hall,1993.
2. Devdas Shetty and Richard A.Kolk., “Mechatronics System Design”, PWS Publishing company, USA,1997

REFERENCES:

1. Sanjay Gupta and Joseoh John,”Virtual Instrumentation using Lab VIEW” Tata McGraw Hill Publications, 2005.
2. Sabrie soloman, “Sensors and control system in Manufacturing” McGraw Hill, Inc, 1994.

14PGE203 / 14PAE203 COMPOSITE MATERIALS ANALYSIS AND APPLICATIONS

L	T	P	C
3	0	0	3

Course Objectives:

- *To impart on types, physical properties and processing of polymer matrix and composites, metal matrix composites and ceramics matrix composites.*
- *To study matrix material, particulates and fibers of polymer matrix composites, MMC and ceramic matrix composites.*
- *To develop knowledge on processing, interfacial properties and application of computers.*

UNIT – I INTRODUCTION TO FIBERS AND COMPOSITE MATERIALS 9

Fibres – Fabrication, Structure, properties and applications - Glass, Boron, carbon, organic, ceramic and metallic fibers whiskers– Matrix materials structure – polymers, – metals and ceramics – Physical and chemical properties

UNIT – II PROCESSING OF POLYMER MATRIX COMPOSITES 9

Open mould process, bag moulding, compression moulding with BMC and SMC filament winding – pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC's – Carbon Matrix Composites - Interfaces – Properties – recycling of PMC.

UNIT – III PROCESSING OF METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES 9

Solid state fabrication techniques – diffusion bonding – powder metallurgy techniques plasma spray, chemical and physical vapour deposition of matrix on fibers Chemical vapour infiltration – Sol gel – liquid state fabrication methods – infiltration – squeeze, casting – rheo casting – compo casting - interfaces properties– application of MMC and ceramic matrix composites.

UNIT – IV MECHANICS 9

Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi-Empirical model-Longitudinal Young's modulus transverse Young's modulus–major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina–laminates– lamination theory, Inter laminar stresses

UNIT – V PERFORMANCE AND DESIGN 9

Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Long term properties, Fracture Behavior and Damage Tolerance, Failure Predictions, Laminate Design Consideration-design criteria-design allowable design guidelines, Joint design-Bolted and Bonded Joints, Design Examples-Design of a tension member – design of a compression member – design of a beam-design of a torsional member, Application of FEM for design and analysis of laminated composites.

STATE OF ART (Not for Exam)

Application of PMC, MMC and CMC in automotive industries and space applications. ASTM standards for composite materials.

Total Hours: 45

TEXT BOOKS:

1. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Marcel Dekker Inc, 1993.
2. Krishnan K Chawla, Composite Materials Science and Engineering, International Edition, Springer, 2006

REFERENCES:

1. Autar K. Kaw, "Mechanics of Composite Materials" CRC Press, 2006
2. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
3. Ronald Gibson, "Principles of Composite Material Mechanics", Tata McGraw Hill, 1994.

14PGE204/ 14PAE307 ADVANCED METROLOGY AND NON DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

Course Objective

- *To provide exposure to the students on various advanced measuring methods and non-destructive testing techniques.*

ADVANCED MEASURING MACHINES **9**

LASER based measurement– laser interferometer – laser alignment telescope – Laser viewers for production profile checks - Co-ordinate measuring machines - Use of computers - Machine vision technology - Microprocessors in metrology.

VISUAL METHODS AND RADIO GRAPHY **9**

Optical aids, optical holographic methods, dynamic inspection. Principles of radiography-sources of radiation, ionising radiation -x-ray and gamma ray production - properties of x rays and gamma rays - Recording of radiation-film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment -applications.

LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS **9**

Characteristics of liquid penetrants - different washable systems - Developers -applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test – Magnetography- field sensitive probes-Applications - Advantages and limitations.

ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES **9**

Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications.

ELECTRICAL METHODS AND OTHER TECHNIQUES **9**

Eddy current methods- potential-drop methods, applications. Basics of Electromagnetic testing and thermal inspection.

STATE OF ART (Not for Exam)

Application of NDT in automotive and space applications, multi axis inspection by laser and CMM.

Total Hours: 45

TEXT BOOKS:

1. Jain, R.K. “Engineering Metrology ", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.

REFERENCES:

1. American Society for Metals, "Metals Hand Book ", Vol.II, 1976.
2. Progress in Acoustic Emission, "Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.
3. Halmshaw, R., “Non-destructive testing**”**, 2nd edition, Edward Arnold, 1991.

14PGE205/ 14PAE205 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

Course Objectives:

- *To introduce Governing Equations of viscous fluid flows.*
- *To introduce numerical modeling and its role in the field of fluid flow and heat transfer.*
- *To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.*
- *To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.*

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

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

UNIT II FINITE DIFFERENCE METHOD 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION 9

Finite volume formulation for steady state One, Two and Three - dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes- properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT V CALCULATION FLOW FIELD BY FVM 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-Є) models – High and low Reynolds number models.

STATE OF ART (Not for Exam)

Application of CFD in a single heat transfer and fluid flow systems, Eg: heat transfer in water tube boiler, typical heat exchanger, evaporator and condenser of air conditioner, etc.,

Validation of the above using fluent, openfoam or equivalent softwares.

Total Hours: 45

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Longman, 1998.
2. Ghoshdastidar , P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., "Computations Fluid Flow and Heat Transfer", Narosa Publishing House, NewDelhi, 1995.
3. T.J. Chung, "Computational Fluid Dynamics", Cambridge University, Press, 2002.

14PGE206/ 14PAE206 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives

- *To study the different types of productivity models*
- *To understand the various re-engineering process improvement models*
- *To understand the tools and techniques in Business Process Re-engineering*

UNIT I PRODUCTIVITY 9

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organization level - Productivity measurement models

UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT 9

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

UNIT III ORGANIZATIONAL TRANSFORMATION 9

Elements of Organizational Transformation and Reengineering – Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology and guidelines.

UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS 9

PMI models, PASIM Model , Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model.

UNITV RE-ENGINEERING TOOLS AND IMPLEMENTATION 9

Analytical and process tools and techniques – information and Communication Technology – implementation of Reengineering Projects –success Factors and common implementation Problem –cases.

STATE OF ART (Not for Exam)

Modern Engineering Tools Drive Productivity In Manufacturing
Business Drivers for Manufacturers, Evolution and Vision of Engineering Tools, Total Integrated Automation Portal Integrates in Engineering Tools.

Total Hours: 45

TEXT BOOKS:

1. Sumanth, D.J., “Productivity Engineering and management ", TMH, New Delhi, 1990.
2. Edosomwan, J.A., “Organizational transformation and process re-engineering", British Library cataloging in pub. data, 1996.

REFERENCES:

1. Rastogi, P.N. “Re-Engineering and Re-inventing the enterprise ", Wheeler pub. New Delhi, 1995.
2. Premvrat, Sardana, G.D. and Sahay, B.S, “Productivity Management - A systems, Narosa Publishing House, 01-Jan-1998.

14PGE207 / 14PAE207 MODERN TRENDS IN CASTING, WELDING AND FORMING TECHNIQUES

L	T	P	C
3	0	0	3

Course Objective

- The course is designed to provide students with the metallurgical and engineering principles of casting, welding and forming techniques. The influence of process variables on casting, weld and forming quality is emphasized.

UNIT I CASTING METALLURGY AND DESIGN 9

Principles of melting practice-fluxing- Degasification and inoculation - Principles of gating and risering - Heat transfer between metal and mould-Solidification of pure metal and alloys- Shrinkage in cast metals -progressive and directional solidification- Designing for directional and mono crystal solidification and minimum stresses- casting defects.

UNIT II MODERN CASTING PROCESSES 9

Shell moulding, Precision investment casting, CO_2 moulding, centrifugal casting, vacuum casting, Die casting, Continuous casting, squeeze casting, semisolid metal casting and forging - pollution control techniques. Modeling of temperature distribution - Design for casting, application of finite element method in casting - modeling of flow in molds, modeling of heat transfer in castings – case studies -Goals of research.

UNIT III WELDING METALLURGY AND DESIGN 9

Classification of welding and allied process overview – process modeling – welding procedure – welding terms and characteristics - joint design - heat flow in welding – welding metallurgy – welding of specific alloys – residual stress and distortion – design of weldments.

UNIT IV MODERN WELDING PROCESS 9

Gas welding, arc welding, shielded metal arc welding, submerged arc welding, gas tungsten arc welding, gas metal arc welding, plasma arc welding, stud welding, resistance welding, electro slag welding – electron beam welding – ultrasonic welding – friction stir welding - laser welding. Design of weldment, application of finite element method in welding – determination of temperature distribution and distortion in weldments for an modern material- case studies - Goals of research.

UNIT V SPECIAL FORMING PROCESS 9

Forming – theory of plastic deformation – coordinates – conventional process HERF techniques – Explosive forming – Electro Hydraulic Forming – Magnetic pulse forming – Perforation of sheet metals – overview of FEA applications in metal forming analysis. Metal forming Survey of applications - case studies -Goals of research.

STATE OF ART (Not for Exam)

Analysis and Optimization of process parameters in casting, welding and forming techniques.

Total Hours: 45

FIELD STUDY & MINI PROJECT WORK:

Field Study: (for internal assessment – 10 marks)

The students are expected to submit a report at the end of the semester covering the various aspects of his/her observation in (any casted / welded / forming) industry visits.

Mini Project work: (for internal assessment – 10 marks)

Cast or weld or form any one of the modern materials / alloys/composites and test their properties. OR Design/ analysis / optimization of casted / welded / forming samples.

TEXT BOOKS:

1. Jain, "Principles of Foundry Technology ", Tata McGraw Hill, 3rd Edition, 2000.
2. Parmar, "Welding processes and technology" Khanna Publishers, 2nd Edition, 2007.

REFERENCES:

1. Heine, Loper & Rosenthal," Principles of Metal Casting ", Tata McGraw Hill, 1976, 38th reprint 2014.
2. Srinivasan, "Welding Technology", Khanna Publishers, 2nd Edition, 2005.
3. Ravi B, "Metal Casting: Computer Aided Design and Analysis", Prentice Hall, 2005.
4. Larry Jeffus, "Welding: Principles and Applications", Delmar Publishers, 2004.

14PGE208/ 14PAE208 FACILITIES PLANNING AND LAYOUT DESIGN

L	T	P	C
3	0	0	3

Course Objectives

- *To analyze the factors involved in facility location*
- *To understand the principles of layout design*
- *To understand the principles of materials handling and warehousing*

UNIT I FACILITY LOCATION AND ANALYSIS 9

Location decisions - Qualitative and Quantitative factors, Simple models in single facility and multi facility problems

UNIT II LAYOUT DESIGN 9

Facilities requirement, need for layout study – types of layout; Design cycle – SLP procedure – Algorithms – ALDEP, CORELAP, CRAFT

UNIT III CELLULAR LAYOUT 9

Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Assembly Line balancing

UNIT IV INTRODUCTION TO MATERIAL HANDLING 9

Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging.

UNIT V WAREHOUSE DESIGN 9

Introduction – Measuring & Benchmarking warehouse performance – Warehouse operations, Receiving and put away principles, Pallet Storage and Retrieval system - Case Picking systems – Warehouse layout – Computerizing warehouse operations.

STATE OF ART (Not for Exam)

Software in Facilities layout and design

Introduction to Factory CAD, Layout planning models and design algorithms for different operations, designing an integrated System for material handling.

Total Hours: 45

TEXT BOOKS:

1. Sundaresh Heragu, "Facilities Design", PWS Publishing Company, Boston, 1997
2. James Apple, M. "Plant layout and Material Handling", John Wiley, 1977

REFERENCES:

1. Tompkins, J.A. and J.A.White, "Facilities planning", John Wiley, 2003
2. Richard Francis.L. and John A.White, "Facilities Layout and location - An analytical approach, Prentice Hall of India Pvt. Ltd. 2006.
3. Edward Frazelle, "World-Class Warehousing and Material Handling", McGraw Hill Publishers, 2002

14PGE209 /14PAE209 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

Course objective:

- *To study about engineering design fundamentals, product development process, design method, material selection, team behavior and tools, Human factors in design, various design methods, design for different fabrication techniques and failures and probability concepts in design to ensure reliability.*

UNIT I DESIGN FUNDAMENTALS 9

Importance of engineering design process-consideration of good design –Total life cycle-conceptual design – Computer Aided Engineering – Designing to codes and-redesign –societal consideration in engineering design -simplified iteration model – Concurrent Engineering Market Identification – Competition Bench marking.

UNIT II PRODUCT DEVELOPMENT PROCESS 9

Identification of customer needs- customer requirements- Product and Process Cycle-Organization for design and product development-market and marketing-technological innovations-types of technological innovation, invention, innovation and diffusion, Business strategies related to innovation and product development

UNIT III DESIGN METHODS 9

Creativity and Problem Solving – Creativity thinking methods-Theory of Inventive Problem Solving (TRIZ) –Creative methods for design- refinement and evaluation of ideas, generating design concepts, Systematic methods for designing -Axiomatic Design-axiomatic design introduction ,the axioms, using axiomatic design to generate a concept, using axiomatic design to improve existing concept-industrial design-human factor in design-design for environment

UNIT IV MATERIAL SELECTION PROCESSING AND DESIGN 9

Performance characteristics of materials-Classification of materials, properties of materials, specification of materials, Ashby chart-Economics of materials-recycling and material selection-Pugh selection method and weighted property index- design for fatigue failure-design for corrosion resistance-design against wear-mistake proofing-residual stress in design

UNIT V INDUSTRIAL DESIGN 9

Need for industrial design – Impact of Industrial design – Industrial design process – Management of Industrial Design process – Assessing the quality of Industrial design.

STATE OF ART (Not for Exam)

Team roles-team dynamics-effective team-time management-planning and scheduling - Contracts-types of contracts.

Total Hours: 45

TEXT BOOKS:

1. A.K. Chitale and R.C. Gupta, “Product Design and Development”, McGraw Hill International Edtition, 1999.
2. Karl T. Ulrich and Steven D. Eppinger “Product Design and Development” McGraw Hill Edition, 2000.

REFERENCES:

1. Pahl, G, and Beitz, W.," Engineering Design", Springer – Verlag, NY. 1984.
2. Ray, M.S., "Elements of Engg. Design", Prentice Hall Inc. 1985.
3. Suh, N.P., "The principles of Design", Oxford University Press, NY.1990.
4. Web sites: http://en.wikipedia.org/wiki/Sustainable_design
   http://gdi.ce.cmu.edu/gd/education/gdedintro.pdf

14PGE210 INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the principles of robot kinematics*
- *To understand the various drives and control for robot*
- *To learn the types of sensors and programming for robots*

UNIT I INTRODUCTION AND ROBOT KINEMATICS 10

Definition need and scope of Industrial robots – Robot anatomy – Work volume –Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT II ROBOT DRIVES AND CONTROL 9

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT III ROBOT SENSORS 9

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing – Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT IV ROBOT CELL DESIGN AND APPLICATION 9

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 8

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

STATE OF ART (Not for Exam)

Design of robot, applications of robots in automobile, aerospace and marine industries.

Total Hours: 45

TEXT BOOKS:

1. .S.Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987.
2. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.

REFERENCES:

1. Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.
2. Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.

14PGE211 / 14PAE212 MANUFACTURE OF AUTOMOBILE COMPONENTS

L	T	P	C
3	0	0	3

Course Objective

- *To impart knowledge at an all the manufacturing process steps and their level in automobile engineering components/ parts.*

UNIT I MANUFACTURE OF ENGINE & ENGINE COMPONENTS 9

Introduction to basic production process - welding - casting - plastic moulding - powder metallurgy - manufacture of composite materials. Introduction - Casting of engine block - drilling of cylinder holes - water cooling passages - Preparation of casting for cylinder heads - design of cores. Forging of crankshafts and connecting rod, casting piston and drilling of oil holes - Upset forging of valves. Heat treatment of crankshafts and connecting rod. Drilling of oil holes and grinding of crank shafts. Forging and heat treatment of camshafts.

UNIT II MANUFACTURE OF CLUTCH, GEAR BOX AND PROPELLER SHAFT COMPONENTS 9

Manufacturing friction plates - manufacture of composite friction lining - Composite moulding of phenol formaldehyde lining.

Casting of gear box casing - Introduction to gear milling - hobbling - manufacturing and inspection of gears.

Casting of propeller shaft. Extrusion of propeller shaft - extrusion dies - heat treatment and surface hardening of propeller shaft.

UNIT III MANUFACTURE OF AXLES, SPRINGS & BODY PANELS 9

Forging of axles, Casting of front and rear axles - Provision of KPI. Wrap forming of coil springs. Introduction - Thermoforming and hydro forming – Press forming. Welding of body panels - resistance welding and other welding processes.

UNIT IV MANUFACTURE OF AUTOMOTIVE PLASTIC COMPONENTS 9

Introduction - Principle of injection moulding- injection moulding of instrument panel- moulding of bumpers - tooling and tooling requirements - hand lay-up process for making composite panels - Filament winding of automotive spring and propeller shaft. Manufacture of metal/Polymer/Metal panels.

UNIT V MANUFACTURE OF ENGINE COMPONENTS USING CERAMIC MATRIX COMPOSITES AND ADVANCED MACHINING PROCESS 9

Introduction, Ceramic matrix piston rings, Chemical vapour deposition, Cryogenic grinding of powders, Sol-gel processing.

Machining concepts using NC, generation of numerical control codes using Pro-E and IDEAS package, interfacing the CNC machine and manufacturing package. Introduction to rapid prototyping - rapid prototyping of using resins.

Total Hours: 45

STATE OF ART (Not for Exam)

Design and manufacturing of automotive components by using hybrid composite materials with the help of modern machineries.

FIELD STUDY & MINI PROJECT WORK

Field Work: (for internal assessment – 10 marks)

The students are expected to submit a report at the end of the semester covering the various aspects of his/her observation in automobile component manufacturing industry visits.

Project Work: (for internal assessment – 10 marks)

Manufacture of automobile components using modern materials and techniques and provide an innovative for improving their performance.

TEXT BOOK:

1. Kalpakjian," Manufacturing Engineering and Technology", Addison-Wesley Publishing Company, inc., Third Edition, 1995.
2. Anil Chhikare, Automobile Engineering Volume 1 &2, Satya Prakashan, New Delhi.

14PGE301 / 14PAK105 RAPID MANUFACTURING AND TOOLING

L	T	P	C
3	0	0	3

Course Objective:

- *Generating a good understanding of RP history, its development and applications. Expose the students to different types of Rapid prototyping processes, materials used in RP systems and Tooling.*

UNIT – I INTRODUCTION 5

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development – history of RP systems - Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits- Survey of Applications - growth of RP industry, classification of RP systems.

UNIT – II ENGINEERING & CAD MODELING 11

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – Software for RP: STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools. Data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation. Rapid Manufacturing Process Optimization: Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.

UNIT – III LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 9

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and Survey of applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and Survey of applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing(LOM): Working Principles, details of processes, products, materials, advantages, limitations and Survey of applications - Case studies - Goals of research.

UNIT – IV POWDER BASED RAPID PROTOTYPING SYSTEMS 9

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Survey of applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and Survey of applications– Case Studies. Goals of research.

UNIT – V RAPID TOOLING 11

Concept Modelers: Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, object quadra system. Rapid Tooling: Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, cast Kirksite. direct rapid tooling - direct AIM, quick cast process, copper polyamide, rapid tool, DMILS, prometal, sand casting tooling, laminate tooling, soft tooling Vs hard tooling. Allied Processes: 3DP, SDM, SLM,EBM, Vacuum casting, surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models.

Total Hours: 45

STATE OF ART (Not for Exam)
RPT techniques to model the prototype for automotive and aerospace applications.

FIELD STUDY & MINI PROJECT WORK:

Field Study: (for internal assessment – 10 marks)

The students are expected to submit a report at the end of the semester covering the various aspects of his/her observation in RP training centers / industry visits.

Mini project work: (for internal assessment – 10 marks)
Modeling of Proto Model/ Physical Model Built up by using RP Techniques.

TEXT BOOKS:

1. Pham. D. T. and Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2001.
2. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim**, "**Rapid prototyping: principles and applications" 2001.

REFERENCES:

1. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
2. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2001
3. Rapid Prototyping: Theory and practice, Ali K. Kamrani, EmadAbouel Nasr, Springer, 2006

14PGE302 RESEARCH METHODOLOGY

L	T	P	C
3	0	0	3

Course *Objectives*

- *To understand the fundamentals and data collection for research*
- *To understand the different types of scales, hypothesis testing and sampling testing*
- *To understand the analysis techniques and report writing of research work*

UNIT I FUNDAMENTALS AND DATA COLLECTION 9

Research methodology – definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modeling research, algorithmic research, Research process- steps.

Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data – internal sources of data, external sources of data.

UNIT II MEASUREMENT SCALES AND SAMPLING 9

Scales – measurement, Types of scale – Thurstone's Case V scale model, Osgood's Semantic Differential scale, Likert scale, Q- sort scale. sampling methods- Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement, stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling.

UNIT III HYPOTHESES TESTING 9

Hypotheses testing – Testing of hypotheses concerning means (one mean and difference between two means -one tailed and two tailed tests), Concerning variance – one tailed Chi-square test.

UNIT IV SAMPLING TEST 9

Nonparametric tests- One sample tests – one sample sign test, Kolmogorov- Smirnov test, run test for randomness, Two sample tests – Two sample sign test, Mann- Whitney U test, K-sample test – Kruskal Wallis test (H-Test)

UNIT V ANALYSIS AND REPORT WRITING 9

Introduction to Disciminant analysis, Factor analysis, cluster analysis, multidimensional scaling, conjoint analysis. Report writing- Types of report, guidelines to review report, typing instructions, oral presentation

STATE OF ART (Not for Exam)

Factorial Design principles, Two factor Factorial Design, General Factorial Design, Fitting response Curves and Surfaces, Blocking, Taguchi Approach to Parameter Design, Robust Design.

Total Hours: 45

TEXT BOOK:

1. Kothari, C.R., Research Methodology –Methods and techniques, New Age Publications, New Delhi, 2009.

REFERENCE:

1. Panneerselvam, R., Research Methodology, Prentice-Hall of India, New Delhi, 2004.

14PGE303 / 14PAE303 ENTERPRISE RESOURCE PLANNING

L	T	P	C
3	0	0	3

Course objectives

- *To know the basics of ERP*
- *To understand the key implementation issues of ERP*
- *To know the business modules of ERP*
- *To be aware of some popular products in the area of ERP*

UNIT I ERP – AN OVERVIEW **9**

Business functions and processes – Integrated management information – business modeling – Introduction to ERP – Advantages of ERP – roadmap for successful implementation of ERP – Risk factors of ERP implementation.

UNIT II ERP AND RELATED TECHNOLOGIES **9**

Business process Re-engineering (BPR) – Data warehousing – Data mining – On Line Analytical Processing (OLAP) – Supply chain management – Customer relationship management – Geographical Information Systems (GIS) – ERP security.

UNIT III ERP – FUNCTIONAL MODULES **9**

Functional modules of ERP software – Financial module, Manufacturing module – HR module – Materials management module – Production planning module – Plant maintenance module – Quality management module – Purchasing module – Sales and distribution module.

UNIT IV ERP IMPLEMETATION AND PROCUREMENT & ISSUES **9**

ERP package selection – Challenges in ERP implementation – Transition strategies: Big bang strategy – phased implementation – Parallel implementation – Hybrid transition strategy – Performance measurement – Problem resolution – ERP training and selection – Success and failure factors – Maintenance of ERP system – Trends in market – Outsourcing ERP.

UNIT V ERP – PRESENT AND FUTURE **9**

ERP to ERP II – Best practices of ERP II – ERP II to ERP III – Future trends: New markets – Fast implantation methodologies – Easier customization tools – New business segments – Need based application – Reduction in implementation time – Popular ERP packages: MFG / PRO – BAAN IV – SAP R/3 – SARA / EMS.

Total hours: 45

STATE OF ART (Not for Exam)

Analysis of cases from 2 Indian companies and 2 international companies.

TEXT BOOKS:

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill, New Delhi, 2000.
2. T.J. Biggerstaff, “Design recovery for maintenance and reuse”, IEEE Corpn. July 1999.

REFERNCES:

1. Jagan Nathan Vaman, “ERP in Practice”, Tata McGraw Hill, 2008.
2. Alexis Leon, “Enterprise Resource Planning”, Second Edition, Tata McGraw Hill, 2008.
3. Mahadeo Jaiswal and Ganesh Vanapalli, “ERP” Macmillan India, 2006.
4. Donald R.Honsa, “Co-ordinate measurement and reverse engineering”, ISBN 1555897, American Gear Manufacturers Association.

14PGE304 MECHANICS OF FRACTURE IN ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives

- *To provide knowledge on elements of solid mechanics.*
- *To understand the crack growth and energy balance.*
- *To study the applications of fracture mechanics.*

UNIT I ELEMENTS OF SOLID MECHANICS **9**

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – Airy's function – field equation for stress intensity factor.

UNIT II STATIONARY CRACK UNDER STATIC LOADING **9**

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement.

UNIT III ENERGY BALANCE AND CRACK GROWTH **9**

Griffith analysis – stable and unstable crack growth –Dynamic energy balance – crack arrest mechanism –K1c test methods - R curves - determination of collapse load. Stress corrosion cracking in Composite materials

UNIT IV FATIGUE CRACK GROWTH CURVE **9**

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum - rain flow method– external factors affecting the K1c values.- leak before break analysis.

UNIT V APPLICATIONS OF FRACTURE MECHANICS **9**

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods. Composite Materials and Fracture Design.

STATE OF ART (Not for Exam)

Tensors in dynamic fracture mechanics; Non-linear and numerical fracture mechanics; Advances in fracture toughness characterization procedures.

Total Hours: 45

TEXT BOOKS

1. David Broek, "Elementary Engineering Fracture Mechanics", Fifthoff and Noerdhoff International Publisher, 1978.
2. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.

REFERENCES

1. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
2. John M.Barson and Stanely T.Rolfe "Fatigue and fracture control in structures" Prentice hall Inc. Englewood cliffs. 1977
3. Ted L. Anderson, " Fracture Mechanics: Fundamentals and Applications", Third edition, Taylor & Francis, 2005
4. Websites: http://www.sv.vt.edu/classes/MSE2094_NoteBook/97ClassProj/exper/gordon/www/composite.html

14PGE305 / 14PAE305 QUALITY CONTROL AND RELIABILITY ENGINEERING

L	T	P	C
3	0	0	3

Course objectives

- *To Understand the basics of quality control and its tools*
- *To understand the concepts of reliability engineering*

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 s 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

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 RELIABILITY 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.

STATE OF ART (Not for Exam)

E-ERP, Software tools for MRP I&MRPI, E-PERT

Note: Use of approved statistical table permitted in the examination.

Total Hours: 45

TEXT BOOKS:

1. Grant, Eugene .V, "Statistical Quality Control", McGraw-Hill, 1996.
2. L.S.Srmah, "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES:

1. R.C.Gupta, “Statistical Quality control”, Khanna Publishers, 1997
2. Besterfield D.H., “Quality Control”, Prentice Hall, 1993.
3. Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publishers, 1998.

14PGE306 / 14PAE 306 ROBUST DESIGN OF PRODUCT/PROCESS

L	T	P	C
3	0	0	3

Course Objectives:

- Designing quality into products and processes using design of experiments, including robust/parameter design and tolerance design techniques.
- To improve the product and/or process quality for a given design.
- To examine the design in order to acquire a better product and process quality.
- To give engineers a current understanding of the techniques and applications of design of experiments in quality engineering design
- To learn a step-by-step process of creating a robust design and use software to facilitate the design

UNIT- I: INTRODUCTION TO ROBUST DESIGN

Robustness Strategy & its primary tools: P-Diagram, Quality Measurement, Quality Loss Function, Signal to Noise (S/N) Ratios, Orthogonal Arrays, Steps in Robust Parameter Design. Robust design and Six-Sigma for Lean Enterprises.

UNIT-II: INTRODUCTION TO TAGUCHI'S EXPERIMENT DESIGN

Criteria for the Use of Experiment Design Methods, Applying Experiment Design Methods According To Situation; Problem Analysis and Empiric Parameter Reduction. Orthogonal Arrays, Graphical representation of factor combinations, linear graphs, Variance Analysis (ANOVA), Inner-Outer arrays Design.

UNIT- III: PARAMETER DESIGN ACCORDING TO TAGUCHI

Direct product design, indirect variance analysis, Product design with characteristic values, taking cost into account, Signal-to-noise ratio according to Taguchi.

UNIT-IV: EXPERIMENT DESIGN ACCORDING TO SHAININ

Multi-variate charts, components search, paired comparisons; Determining decisive parameters (variable search), scatter plots, randomization of experiments, B versus C test, full factorial.

UNIT-V RESPONSE SURFACE METHODOLOGY (RSM)

Linear experiment designs, quadratic experiment designs.

STATE OF ART (Not for Exam)

Relationship between Robust Design and other Quality Processes, Robust Testing

TEXT BOOKS:

1. Phadke S. Madhav, "Introduction to Robust Design (Taguchi Approach)", Phadke Associates Inc., 2006.
2. J. Krottmaier, "Optimizing Engineering Design", McGraw Hill Ltd. England, 1993.

REFERENCES:

1. Philip J. Ross, "Taguchi Techniques for Quality Engineering", McGraw Hill Ltd.
2. Mitra *A*, "Fundamentals of Quality Control and Improvement", Pearson Education, New Delhi, 1998.
3. Logothetis. N, "Managing for total quality", Prentice Hall International, UK, 1992.

14PGE307 / 14PAE204 ENGINEERING ECONOMICS AND CASH FLOW ANALYSIS

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the principles of value engineering*
- *To study the various methods of depreciation*

UNIT I INTRODUCTION TO ECONOMICS **9**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II VALUE ENGINEERING **9**

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III CASH FLOW **9**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS **9**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION **9**

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

STATE OF ART (Not for Exam)

Case studies from few local industries regarding make (or) buy decisions, Break even analysis and Economics of maintenance.

Total Hours: 45

TEXT BOOKS:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, NewDelhi, 2001
2. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002

REFERENCES:

1. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2002
2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 1984.
3. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, “Principles of Engineering Economy”, Ronald Press, New York,1976.

14PGE308 REVERSE ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the principles of reverse engineering concepts*
- *To study the various tools for reverse engineering*

UNIT I INTRODUCTION **5**

Scope and tasks of RE - Domain analysis- process of duplicating

UNIT II TOOLS FOR RE **8**

Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation -software and application- prototyping – verification.

UNIT III CONCEPTS **12**

History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation.

UNIT IV DATA MANAGEMENT **10**

Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics.

UNIT V INTEGRATION **10**

Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering –coordinate measurement – feature capturing – surface and solid members.

STATE OF ART (Not for Exam)

Case study on Reverse Engineering of assembly programs: A model based approach and its logical basics.

Total Hours: 45

TEXT BOOKS:

1. T J Biggerstaff, “Design Recovery for Maintenance and Reuse”, IEEE Corpn. July 1991.
2. White paper, S. Rugaban “RE”, Technical Report, Georgia Instt. of Technology, 1994

REFERENCES:

1. Katheryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, 1994
2. Aiken, Peter, “Data Reverse Engineering”, McGraw-Hill, 1996
3. Linda Wills, “Reverse Engineering”, Kluiver Academic Publishers, 1996

14PGE309 BEARING DESIGN AND ROTOR DYNAMICS

L	T	P	C
3	0	0	3

Course Objectives

- *To study the classification and selection of bearings*
- *to design the film bearings and rolling bearings*

CLASSIFICATION AND SELECTION OF BEARINGS 6

Selection criteria-Dry and Boundary Lubrication Bearings-Hydrodynamic and Hydrostatic bearings- Electro Magnetic bearings-Dry bearings-Rolling Element bearings- Bearings for Precision Applications-Foil Bearings-Special bearings- Selection of plain Bearing materials – Metallic and Non metallic bearings.

DESIGN OF FLUID FILM BEARINGS 10

Design and performance analysis of Thrust and Journal bearings – Full, partial, fixed and pivoted journal bearings design procedure-Minimum film thickness – lubricant flow and delivery – power loss, Heat and temperature distribution calculations- Design based on Charts & Tables and Experimental curves-Design of Foil bearings-Air Bearings- Design of Hydrostatic bearings-Thrust and Journal bearings- Stiffness consideration - flow regulators and pump design.

SELECTION AND DESIGN OF ROLLING BEARINGS 10

Contact Stresses in Rolling bearings- Centrifugal stresses-Elasto hydrodynamic lubrication-Fatique life calculations- Bearing operating temperature- Lubrication- Selection of lubricants-Internal clearance – Shaft and housing fit- -Mounting arrangements-Materials for rolling bearings- Manufacturing methods- Ceramic bearings-Rolling bearing cages-bearing seals selection.

DYNAMICS OF HYDRODYNAMIC BEARINGS 10

Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads , alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions.

ROTOR DYNAMICS 9

Rotor vibration and Rotor critical speeds- support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings.

STATE OF ART(Not for Exam)

Direct and Cross-Coupled Stiffness and Damping Coefficients and Their Effect on Rotor dynamics, Liquid Seals and Their Effect on Pump Rotor dynamics

Total Hours: 45

TEXT BOOKS:

1. Neale, M.J. "Tribology Hand Book", Butterworth Heinemann, United Kingdom 2001.
2. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981

REFERENCES:

1. Halling, J. (Editor) – "Principles of Tribology ", Macmillian – 1984.
2. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.
3. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd , New Delhi, 2005

14PGE310 RELIABILITY AND MAINTENANCE ENGINEERING

L	T	P	C
3	0	0	3

Course objectives:

- *To understand the types of failure models, reliability of systems, design for reliability and the concept of maintainability and availability.*
- *To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.*
- *To explain the different maintenance categories like preventive maintenance, condition monitoring and repair of machine elements.*

UNIT I INTRODUCTION TO RELIABILITY 9

Definition of reliability – reliability vs. quality- reliability function-MTTF-hazard rate function- bathtub curve-derivation of reliability function-constant failure rate model-time dependent failure models- exponential, Weibull distribution

UNIT II RELIABILITY OF SYSTEM AND MODELS 9

Serial configuration – parallel configuration –Combined serial parallel systems–system structure function - minimal path and cut sets – load sharing systems, standby system degraded systems, three state devices – covariate models, static models, dynamic models, physics of failure models

UNIT III RELIABILITY IMPROVEMENT 9

Data collection- empirical methods – ungrouped and grouped – complete , censored data-static life estimation – test time calculation – burn in testing – acceptance, sequential, binomial testing- accelerated life testing –other acceleration models- experimental design – reliability growth process- idealized growth curve- various growth models-identifying failure and repair distributions

UNIT IV PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication

UNIT V CONDITION MONITORING AND REPAIR METHODS 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis - Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development.

STATE OF ART (Not for Exam)

E-ERP, Software tools for MRP I & MRPI, E-PERT, TPM IMPLEMENTATION STAGES: Small group activities, implementing AM, establishing planned maintenance, training and education, developing equipment management program, Case studies.

Total Hours: 45

TEXT BOOKS:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability Engineering", Tata Mc Graw Hill publications, 2000.
2. S. S. Rao, "Reliability Based Design" , Mc-Graw Hill, 1992.
3. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981.
4. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995

REFERENCES:

1. Patrick D T O'Connor, "Practical Reliability Engineering", John Wiley and sons Inc., 2002.
2. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press, New Delhi.
3. K.C. Kapur and L.R. Lamberson, "Reliability in Engineering Design", Wiley Publications.
4. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
5. Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.

14PGE311 ADVANCED STRENGTH OF MATERIALS

L	T	P	C
3	1	0	4

Course Objectives:

- *To understand the concepts of unsymmetrical bending, contact stresses*
- *To understand the concepts of two and three dimensional problems.*

UNIT I SHEAR CENTER & UNSYMMETRICAL BENDING 9

Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections

Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

UNIT II CURVED BEAM THEORY & TORSION 9

Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section ;Hollow thin wall torsion members ,Multiply connected Cross Section.

UNIT III CONTACT STRESSES 9

Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.

UNIT IV TWO DIMENSIONAL ELASTICITY PROBLEMS 9

Plane stress & Plain strain-Problems in Rectangular Co-ordinates, bending of cantilever loaded at the end, bending of a beam by uniform load.

Two dimensional elasticity problems in polar co-ordinators, general equations in polar coordinates, stress distribution symmetrical about an axis, pure bending of curved bars, displacements for symmetrical stress distributions, rotating discs.

UNIT V INTRODUCTION TO THREE DIMENSIONAL PROBLEMS 9

Uniform stress stretching of a prismatical bar by its own weight, twist of circular shafts of constant cross section, pure bending of plates.

STATE OF ART (Not for Exam)

Stress analysis of a composite material and application of CLT.

Theory: 45; Tutorial: 15; Total Hours: 60

TEXT BOOKS:

1. Arthur P Boresi, Richard J. Schmidt, “Advanced mechanics of materials”, John Wiley, 2002.
2. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill.

REFERENCES:

1. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc- millan pub. Co., 1985.
2. Srinath. L.S., “Advanced Mechanics of solids”, Tata McGraw Hill, 1992.
3. G H Ryder, “Strength of Materials”, Macmillan, India Ltd, 2007.

14PGE312 / 14PAE312 ADVANCED OPTIMIZATION TECHNIQUES

L	T	P	C
3	1	0	4

Course Objective

- *To provide knowledge on different types of optimization and its applications in various fields.*

UNIT I LINEAR AND NONLINEAR OPTIMIZATION 9

Introduction to optimization, Linear programming problem (LPP) - Graphical solution-Simplex method. Non Linear programming problem (NLPP) - unconstrained optimization, one dimensional optimization, elimination methods, fibonacci method, golden section methods, Hooks and Jeeves method.

UNIT II UNCONSTRAINED AND CONSTRAINED OPTIMIZATION 9

Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden search– Interpolation methods. Optimization with equality and inequality constraints - Indirect methods using penalty functions, Lagrange multipliers; Geometric programming-Constrained, mixed inequality and unconstrained minimization.

UNIT III INTEGER AND DYNAMIC PROGRAMMING 9

Introduction to Integer Programming – Solution Techniques, Graphical method, the branch and bound technique, Gomary's cutting plane method, Examples on the application in manufacturing / design systems. Introduction to Dynamic Programming, Bellman's principle of optimality, examples on the application on cutting stock problem and inventory problem.

UNIT IV NETWORK OPTIMIZATION MODELS 9

Terminology of Networks – the shortest route problem – the minimum spanning tree problem – the maximum flow problem – the minimum cost flow problem – the network simplex method.

UNIT V META HEURISTIC APPROACHES 9

Introduction to nontraditional(MHA)optimization, Computational Complexity – NP-Hard, NP-Complete, No free lunch theorem. Working principles of Genetic Algorithm, Simulated Annealing, Particle Swarm Optimization and Neural Networks - Simple applications.

STATE OF ART (Not for Exam)

Software in Optimization

Study and practice in Optimization solvers- Lingo and CPLEX.

Theory: 45 Tutorial: 15 Total Hours: 60

TEXT BOOKS:

1. Singiresu S Rao, "Engineering Optimization: Theory and Practice", Wiley,Interscience, 3rd Edition, 1996.
2. Kalyanmoy Deb, "Optimization for engineering design", Prentice Hall India (Pvt) Ltd., New Delhi, 2000.

REFERENCES:

1. R.Saravanan, "Manufacturing optimization through intelligent techniques", Taylor and Francis Publications, CRC Press, 2006.
2. David E Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison, Wesley Pub Co., 1989.
3. Cihan H Dagli**,** "Artificial Neural Networks for Intelligent Manufacturing", Chapman and Hall, London, 1994.

14PGE313 DESIGN OF MATERIAL HANDLING EQUIPMENTS

L	T	P	C
3	0	0	3

Course Objectives

- *To provide knowledge on materials handling equipment.*
- *To study the design of hoist, conveyors and elevators*

UNIT I MATERIALS HANDLING EQUIPMENT **5**

Types, selection and applications

UNIT II DESIGN OF HOISTS **10**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

UNIT III DRIVES OF HOISTING GEAR **10**

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT IV CONVEYORS **10**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT V ELEVATORS **10**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

STATE OF ART(Not for Exam)

Flexible Manufacturing System, Automatic Storage and Retrieval Systems and AGVs.

Note: Use of Approved Data Book Is Permitted

Total Hours: 45

TEXT BOOKS:

1. Rudenko, N., “Materials handling equipment”, ELnvee Publishers, 1970.
2. Spivakovsy, A.O. and Dyachkov, V.K., “Conveying Machines, Volumes I and II”, MIR Publishers, 1985.

REFERENCES:

1. Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, 1981.
2. Boltzharol, A., “Materials Handling Handbook”, The Ronald Press Company, 1958.
3. P.S.G. Tech., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.

14PGE314 PLASTICITY AND METAL FORMING

L	T	P	C
3	0	0	3

Course Objectives

- *To provide knowledge on theory of plasticity*
- *To understand the analysis of metal forming problems.*

UNIT I THEORY OF PLASTICITY **9**

Theory of plastic deformation - Engineering stress and strain relationship – Stress tensor - Strain tensor - Yield criteria's - Plastic stress strain relationship – Plastic work - Equilibrium conditions - Incremental plastic strain

UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY **7**

Uniaxial tension test - Mechanical properties - Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress

UNIT III ANALYSIS OF METAL FORMING PROBLEMS **14**

Slab analysis - Slip line method, upper bound solutions, statistically admissible stress field, numerical methods, contact problems, effect of friction, thermo elastic Elasto plasticity, elasto visco plasticity - Thermo mechanical coupling – Analysis of forging, rolling, extrusion and wire drawing processes - Experimental techniques of the evaluation of metal forming

UNIT IV ANALYSIS OF SHEET METAL FORMING **8**

Bending theory - Cold rolling theory - Hill's anisotropic theory, Hill's general yield theory - Sheet metal forming - Elements used - Mesh generation and formulation Equilibrium equations - Consistent full set algorithm - Numerical solutions procedures - examples of simulation of simple parts - Bench mark tests – Forming limit diagrams

UNIT V ADVANCES IN METAL FORMING **9**

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotropic pressing, high speed extrusion, rubber pad forming, micro blanking –Superplastic forming - Overview of Powder Metal techniques - Powder rolling - Tooling and process parameters

STATE OF ART(Not for Exam)

Introduction to software for manufacturing applications: metal forming and flow analysis software (for metallic /plastic components).

Total Hours: 45

TEXT BOOKS:

1. Wagoner. R H., and Chenot. J.J., "Metal Forming analysis", Cambridge University Press, 2002.
2. Slater. R A. C., "Engineering Plasticity - Theory & Applications to Metal Forming", John Wiely and Sons, 1987.

REFERENCES:

1. Narayanaswamy. R, "Theory of Metal Forming Plasticity", Narosa Publishers, 1999.
2. Hosford. W. F and Caddell. RM., "Metal Forming Mechanics and Metallurgy", Prentice Hall Eaglewood Cliffs, 1993.
3. Surender Kumar, "Technology of Metal Forming Processes", Prentice Hall of India, New Delhi, 2008.

14PGE315 DESIGN OF PRESSURE VESSELS AND PIPING LAYOUT

L	T	P	C
3	0	0	3

Course Objectives

- *To understand the concept of stresses in pressure vessels.*
- *To study procedures and design principles of pressure vessel.*
- *To study the design of piping layout*

UNIT I INTRODUCTION **3**

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

UNIT II STRESSES IN PRESSURE VESSELS **15**

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS **15**

Design of Tall cylindrical self supporting process columns – supports for short and vertical vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design.

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS **8**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING **4**

Introduction – Flow diagram – piping layout and piping stress Analysis.

STATE OF ART(Not for Exam)

Supports for horizontal vessels. Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports.

Total Hours: 45

TEXT BOOKS:

3. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.
4. Henry H. Bedner, "Pressure Vessels-Design Hand Book", CBS publishers and Distributors, 1987.

REFERENCES:

1. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
2. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.

14PGE316 AUTOMOTIVE DESIGN

L	T	P	C
3	0	0	3

Course Objective:

- *To impart knowledge at an advanced level in automobile engineering field.*

UNIT I DESIGN OF ENGINE PARTS **9**

Auto design, aspect of auto design, basic requirement for design, design procedure- Design of piston for I.C Engine, design of piston rings, piston pin - Fuel system- carburetor performance - review questions.

UNIT II DESIGN OF CLUTCH PLATES, GEAR BOX AND PROPELLERSHAFT 9

Function of clutch- requirement of clutch- types of clutch- clutch system derivation - problems for single plate clutch, multi plate clutch, centrifugal clutch- state the factors to be considered for designing a gear drive, design of constant mesh gear box, problems - design of propeller shaft – derivation – problems.

UNIT III DESIGN OF SUSPENSION SPRINGS AND STEERING MECHANISM 9

Types of suspension springs, design of coil spring, problems - types of steering mechanism, types of steering gears turning circle radius problems.

UNIT IV DESIGN OF BRAKING SYSTEM **9**

Classification of brake, braking of vehicle, Band and block brake, internal expanding brake, braking of vehicle, problems.

UNIT V PERFORMANCE OF VEHICLE **9**

Power of propulsion, air resistance, rolling resistance, grade resistance, traction and tractive effort, acceleration, gradiability, draw bar pull, calculation of equivalent weight, problems.

STATE OF ART (Not for Exam)

Design and analysis of emission control device in IC engines – Design and analysis of electric, solar and hybrid vehicles.

Total Hours: (45 +15) = 60

FIELD STUDY & MINI PROJECT WORK

Field Work: (for internal assessment – 10 marks)

Service and maintenance of modern automotive components in any one of the services centers and provides an innovative suggestion for improving their performance. The students are expected to submit a report at the end of the semester covering the various aspects of his/her observation in industry visits / service centers.

Project Work: (for internal assessment – 10 marks)

Design, evaluate and fabricate any one of the sub system in a automobile vehicle. For reference Use PSG Data book & SAE INDIA BAJA/SUPRA rule book.

TEXT BOOKS:

1. M.N.Srinivas Reddy, Automotive Mechanics, Eastern book promoters.
2. Anil Chhikare, Automobile Engineering Volume 1 &2, Satya Prakashan, New Delhi.

REFERENCES:

1. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 1994.
2. Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2004.
3. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.

14PGE317 / 14PAE314 FIELD WORK

Fieldwork is the systematic collection of information, samples, data or other specific source material, or the carrying out of research, or practical work, such as surveying and specimen collecting, undertaken at an external location.

The student has to visit industries related to the subject of his/her field work.

The student has to submit a report at the end of the semester which will be evaluated by the appointed examiner.