K.S. Rangasamy College of Technology

(Autonomous Institution)

Curriculum & Syllabus

of

M.E. Engineering Design

R 2014

Courses Accredited by NBA, Accredited by NAAC with 'A' Grade,
Approved by AICTE, Affiliated to Anna University, Chennai.

KSR Kalvi Nagar, Tiruchengode – 637 215.
Namakkal District, Tamil Nadu, India.

K.S.Rangasamy College of Technology, Tiruchengode – 637 215

Curriculum for the Programmes under Autonomous Scheme

Regulation	**R 2014**
Department	**Department of Mechanical Engineering**
Programme Code & Name	PED : M.E. Engineering Design

Semester I

Course Name		Hours/ Week			Credit
		L	T	P	C
THEORY					
40 PED 001	Advanced Mathematics	3	1	0	4
40 PED 002	Computer Applications in Design	3	0	0	3
40 PED 003	Finite Element Methods in Mechanical Design	3	1	0	4
40 PED 101	Concepts of Engineering Design	3	0	0	3
40 PED 004	Advanced Strength of Materials	3	1	0	4
40 PED E1*	Elective I	3	0	0	3
PRACTICAL					
40 PED 0P1	CAD Laboratory	0	0	3	2
40 PED 0P2	Computer Aided Analysis Laboratory I	0	0	3	2
Total		18	3	6	25

Semester II

Course Name		Hours / Week			Credit
		L	T	P	C
THEORY					
40 PED 005	Mechanical Vibrations	3	1	0	4
40 PED 006	Integrated Mechanical Design	3	1	0	4
40 PED 007	Mechanisms Design and Synthesis	3	1	0	4
40 PED 201	Optimization Techniques in Design	3	1	0	4
40 PED E2*	Elective II	3	0	0	3
40 PED E3*	Elective III	3	0	0	3
PRACTICAL					
40 PED 0P3	Computer Aided Analysis Laboratory II	0	0	3	2
40 PED 2P1	Technical Report Preparation and Presentation	0	0	2	0
Total		18	4	5	24

Semester III

THEORY					
40 PED E4*	Elective IV	3	0	0	3
40 PED E5*	Elective V	3	0	0	3
40 PED E6*	Elective VI	3	0	0	3
PRACTICAL					
40 PED 3P1	Project Work - Phase I	0	0	12	5
Total		9	0	12	14

Semester IV

PRACTICAL					
40 PED 4P1	Project Work - Phase II	0	0	40	15
Total		0	0	40	15

K.S.Rangasamy College of Technology, Tiruchengode - 637 215								
Curriculum for the Programmes under Autonomous Scheme								
Regulation	**R 2014**							
Department	**Department of Mechanical Engineering**							
Program Code & Name	**PED : M.E. Engineering Design**							
List of Electives								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
Electives I								
40 PED E11	Design of Hydraulic and Pneumatic Systems	3	0	0	3	50	50	100
40 PED E12	Applied Elasticity and Plasticity	3	0	0	3	50	50	100
40 PED E13	Tribology in Design	3	0	0	3	50	50	100
40 PED E14	Research Methodology - Engineering and Management Studies	3	0	0	3	50	50	100
40 PED E15	Experimental Stress Analysis	3	0	0	3	50	50	100
Elective II								
40 PED E21	Design of Material Handling Equipments	3	0	0	3	50	50	100
40 PED E22	Theory of Plates and Shells	3	0	0	3	50	50	100
40 PED E23	Wind Energy system	3	0	0	3	50	50	100
40 PED E24	Measurement Techniques	3	0	0	3	50	50	100
40 PED E25	Advanced Materials and Their Processing	3	0	0	3	50	50	100
Elective III								
40 PED E31	Design of Pressure Vessel and Piping	3	0	0	3	50	50	100
40 PED E32	Composite Materials and Mechanics	3	0	0	3	50	50	100
40 PED E33	Propeller Aerodynamics	3	0	0	3	50	50	100
40 PED E34	Artificial Intelligence and its applications	3	0	0	3	50	50	100
40 PED E35	Advanced Internal Combustion Engines	3	0	0	3	50	50	100
40 PED E36	Fuels and Combustion	3	0	0	3	50	50	100
Elective IV								
40 PED E41	Computational Fluid Dynamics	3	0	0	3	50	50	100
40 PED E42	Rapid Prototyping and Tooling	3	0	0	3	50	50	100
40 PED E43	Micro Electro Mechanical Systems Design	3	0	0	3	50	50	100
40 PED E44	Vibration Condition Monitoring	3	0	0	3	50	50	100
40 PED E45	Design of Heat Exchangers	3	0	0	3	50	50	100

Elective V								
40 PED E51	Engineering Fracture Mechanics	3	0	0	3	50	50	100
40 PED E52	Design for Manufacture, Assembly and Environments	3	0	0	3	50	50	100
40 PED E53	Bearing Design and Rotor Dynamics	3	0	0	3	50	50	100
40 PED E54	Microcontroller System Design and Applications	3	0	0	3	50	50	100
40 PED E55	Enterprise Resource Planning	3	0	0	3	50	50	100
Elective VI								
40 PED E61	Machinability of Materials	3	0	0	3	50	50	100
40 PED E62	Advanced Tool Design	3	0	0	3	50	50	100
40 PED E63	Productivity Management and Reengineering	3	0	0	3	50	50	100
40 PED E64	Advances in Casting and Welding Processes	3	0	0	3	50	50	100
40 PED E 65	Quality concepts in Design	3	0	0	3	50	50	100

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 001	**Advanced Mathematics**	3	1	0	4	50	50	100
Objective(s)	At the end of the study of the paper Advanced Mathematics, the student will be able to solve linear systems by methods of elimination, triangularisation and iteration, method of finite differences and Rayleigh Ritz methods, Solve numerically partial differential equations of parabolic, elliptic and hyperbolic types with appropriate boundary and initial conditions encountered in engineering design.							

Simultaneous Equations and Numerical Integration

Simultaneous Equations: Gauss elimination method-Choleski scheme-Gauss seidel method-Relaxation method- Numerical Integration- Trapezoidal rule and Simpson's 1/3 and 3/8 th rules- Weddle's rule.

Boundary & Characteristic Value Problems

BVP Solution through finite differences of second order BVP o Derivative boundary conditions - CVP Finding eigen values / vectors by characteristic polynomial method – Jacobi method – Power method.

Calculus of Variations

Extremum of functional involving one unknown function- Several unknown functions-Functional dependant on higher order derivatives- Several independent variables- Isoperimetric problems- Rayleigh Ritz method.

Elliptic Partial Differential Equations

Finite difference expressions for partial derivatives – Laplace's equation – Liebmann method – Derivative boundary conditions- Poisson equation.

Parabolic and Hyperbolic Partial Differential Equations

Parabolic PDE- Explicit method – Crank- Nicholson method – ADI method for equation of higher order- Hyperbolic PDE - Solution by finite differences, Several types of Boundary conditions Explicit method.

Total hours to be taught: 60

Text book (s) :

1	Rajasekaran,S., "Numerical Method in Science and Engineering", Wheeler Publishing Company, Second edition, 1999.
2	Venkatraman, M.K., "Higher Mathematics for engineering and Science", National Publishing Company, 2000.

Reference(s) :

1	Douglas J. Faires and Riched Burden., "Numerical Methods", Brooks / Cole Publishing Company, Second edition, 1998.
2	John H. Mathews and Kurtis D. Fink., "Numerical Methods using MATLAB", Prentice Hall, 1998.
3	Ward Cheney and David Kincaid., "Numerical Mathematics and Computing", Brooks/Cole Publishing Company, Fourth Edition, 1999.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 002	**Computer Applications in Design**	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on parametric sketching, uses of computers in design, to understand the basic concepts of curves, surfaces, solid modeling and to develop the students ability to utilize the computers for managing product design data and data exchange formats.							

Introduction to Computer Graphics Fundamentals

Output primitives (points, lines, curves etc.,), 2-D&3-D transformation (Translation, scaling, rotations) windowing - view ports - clipping transformation.

Curves and Surfaces Modeling

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bicubic surface- Bezier surface and B-Spline surface- surface manipulations.

NURBS and Solid Modeling

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations – boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling.

Visual Realism

Hidden – Line, surface, solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

Assembly of Parts and Product Data Exchange

Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc.,–Communication standards.

Total hours to be taught: 45

Text book (s) :

1	William M Newman and Robert FSproull., "Principles of Interactive Computer Graphics", McGraw Hill Book Co. Singapore, 2010.
2	Ibrahim Zeid and Sivasubramanian, R., "CAD/CAM – Theory and Practice", Tata McGraw Hill Education Private Ltd., New Delhi, 2010.

Reference(s) :

1	Donald Hearn and M Pauline Baker., "Computer Graphics", Prentice Hall Inc, New Delhi,2006..
2	David F. Rogers, James Alan Adams "Mathematical elements for computer graphics", Second edition, Tata McGraw-Hill edition,2010.
3	Foley, Wan Dam, Feiner and Hughes, "Computer graphics principles & practices", Pearson Education, 2003.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 003	**Finite Element Methods in Mechanical Design**	3	1	0	4	50	50	100
Objective(s)	To develop a thorough understanding of the basic principles of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving practical problems arising in engineering design.							

One Dimensional Analysis

Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational formulation of Boundary Value Problems (BVP) – Ritz Method – Finite Element Modeling – Element Equations – Linear and Quadratic Shape functions – Bar, Truss and Beam Elements – Examples related to one-dimensional Structural problems.

Two Dimensional Analysis

Basic Boundary Value Problems in two-dimensions – Linear triangular elements - higher order elements – Poisson's and Laplace's Equation – Weak Formulation – Element matrices and force vectors.
Introduction to Theory of Elasticity – Plane Stress, Plane Strain and Axisymmetric Formulation – Principle of virtual work – Element matrices using energy approach – Examples related to two-dimensional problems.

Isoparametric Formulation

Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Isoparametric Elements – Quadrilateral elements formulation – Jacobian matrix - rectangular elements – Serendipity elements – Numerical Integration – Gauss quadrature - Illustrative Examples.

Structural Dynamic Analysis

Equations of motion for dynamic problems - Consistent and lumped mass matrices - Formulation of element mass matrices - Free vibration problem formulation - Solution of eigen value problems using 1D elements - Time dependent one-dimensional bar analysis.

Heat Transfer and Fluid Flow Analysis

Heat Transfer Analysis: Basic differential equations of heat transfer – one dimensional finite element formulation using variational method – Examples of one dimensional steady state heat transfer problems involving conduction and convection.
Fluid Flow Analysis: Basic differential equations of fluid flow – One Dimensional Finite Element Formulation – Examples of one dimensional fluid flow problems.

Total hours to be taught: **60**

Text book (s) :

1	Chandrupatla, T. R and Belegundu, A. D., "Introduction to Finite Elements in Engineering", Pearson Education, New Delhi, 2007.
2	Logan, D.L., "A First Course in the Finite Element Method", Sixth Indian Edition, Cengage Learning, 2011.

Reference(s) :

1	Cook, R. D., Malkus S.D., Plesha M. E and Witt R. J., "Concepts and Applications of Finite Element Analysis", Fourth Edition, Wiley Publishers, 2001.
2	Rao, S. S., "The Finite Element Method in Engineering", Fifth Edition,Butterworth-Heinemann, 2010.
3	Rajasekaran, S., "Finite Element Analysis in Engineering Design", S Chand & Co. Ltd., 2006.
4	Seshu, P., "A Text book on Finite Element Analysis", PHI Learning Pvt. Ltd., New Delhi, 2003.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 101	**Concepts of Engineering Design**	3	0	0	3	50	50	100
Objective(s)	To impart knowledge on design process, and its requirements, mathematical modeling, geometric modeling, material selection for design process, material processing, environmental and safety issues.							

The Design Process

The design process - need identification – design requirements – product life cycle– morphology of design steps of product design – conceptual design, embodiment design, detailed design – concurrent engineering – cad & cam, human factors in design.

Tools In Engineering Design

Creativity and problem solving, decision theory, modeling – role of models in engineering design, mathematical modeling, geometric modeling, finite element modeling, rapid prototyping – simulation finite difference method, monte carlo method – optimization – search methods, geometric programming, structural and shape optimization.

Material Selection and Materials In Design

The classification and properties of engineering materials- material standards and specifications – methods of material selection – ashby chart and method of weight factors- derivation of material indices- use of material selection chart-pugh selection method- selection with computed aided databases – design for brittle fracture-design for fatigue failure- design for corrosion resistance- designing with plastics.

Material Processing and Design

Classification of manufacturing processes and their role in design- factors determining the process selection-use of process selection chart and computerized database – design for manufacturing- design for forging and sheet metal forming-design for casting-design for machining, welding and assembly- design for residual stresses and heat treatment.

Legal, Ethical Environmental and Safety Issues In Design and Quality Engineering

The origin of laws- contracts - liability – tort law- product liability – design aspects of product liability- codes of ethics- solving ethical conflicts- design for environment – life cycle assessment – material recycling and remanufacture- design for safety – potential dangers and guidelines for design for safety-design for reliability failure mode effect analysis-robust design.

Total hours to be taught: 45

Text book (s) :

1	George E. Dieter., "Engineering Design – A Materials and Processing Approach", McGraw Hill, International Edition, Singapore, 2010.
2	Karl T. Vlrich and Steven D. Eppinger., “Product Design and Development”, McGraw Hill, International Edition, 2000.

Reference(s) :

1	Pahlgand Beitz W., “Engineering Design”, Springer – Verlag, NY, 1984.
2	Ray M.S., “Elements of Engineering Design”, Printice Hall Inc., 1985.
3	Suh. N. P., “The Principles of Design”,. Oxford University Press, NY, 1990.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 004	**Advanced Strength of Materials**	3	1	0	4	50	50	100
Objective(s)	To understand the interdisciplinary applications of materials in the industry.							

Elasticity

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law - St. Venant's principle – plane stress - Airy's stress function. Energy methods.

Shear Center and Unsymmetrical Bending

Location of shear center for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section.

Stresses In Flat Plates and Curved Members

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions.

Torsion of Non-Circular Sections

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.

Stresses In Rotating Members and Contact Stresses

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress- deflection of bodies in point and line contact applications.

Total hours to be taught: 60

Text book (s) :

1	Srinath, L.S., "Advanced Mechanics of solids", Tata McGraw Hill, 1992.
2	Arthur P. Boresi and Richard J. Schmidt., "Advanced mechanics of materials", John Wiley, 2002.

Reference(s) :

1	Timoshenko and Goodier., "Theory of Elasticity", McGraw Hill.
2	Robert D. Cook and Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co., 1985.
3	Ryder, G. H, "Strength of Materials", Macmillan, India Ltd, 2007.
4	Allan F. Bower., "Applied Mechanics of Solids", CRC press – Special Indian Edition -2012, 2010.
5	Baskar, K and Varadan, T.K., "Theory of Isotropic/Orthotropic Elasticity", Ane Books Pvt. Ltd., New Delhi, 2009.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name			PED : M.E. Engineering Design		
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 0P1	**CAD Laboratory**	0	0	3	2	50	50	100
Objective(s)	To develop the students in solid modeling of mechanical components and to develop the students in feature based packages like pro-E, solid works etc..							

Part and Assembly of Flange Coupling
Part and Assembly of Universal Coupling
Part and Assembly of Bushed Bearing
Part and Assembly of Knuckle Joint
Part and Assembly of Plummer Block
Part and Assembly of Connecting rod
Part and Assembly of Screw Jack
Part and Assembly of Pipe Vice
Part and Assembly of Piston
Part and Assembly of Stuffing box
Part and Assembly of Machine Vice
Part and Assembly of Swivel bearing

Total Hrs: 45

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2014</td></tr>
<tr><td>Department</td><td colspan="2">Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="3">PED : M.E. Engineering Design</td></tr>
<tr><td colspan="9">Semester I</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>40 PED 0P2</td><td>Computer Aided Analysis Laboratory I</td><td>0</td><td>0</td><td>3</td><td>2</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">To develop the students to perform the structural analysis of 2D and 3D trusses, beams, torsion and bending analysis, stress analysis of plate, corner bracket, pressure vessel, cylinder using CAE software.(Ansys, Nastran, Simulia etc)</td></tr>
<tr><td colspan="9">Structural analysis of four bar truss under structural and thermal loading.
Structural analysis of 3D space truss.
Analysis of simply supported beam carrying uniformly distributed load and Oblique loading.
Analysis of continuous beam with overhang and multiple loading conditions.
Torsion analysis of a stepped cantilever bar.
Bending analysis of a simply supported I – beam.
Stress analysis of a rectangular plate with circular holes.
Stress analysis of corner bracket with plane stress condition.
Stress analysis of a long cylindrical pressure vessel using plane strain element.
Stress analysis of closed cylinder under pressure using axisymmetric element

Total Hrs: 45</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering	Programme Code & Name			PED : M.E. Engineering Design			
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 005	**Mechanical Vibrations**	3	1	0	4	50	50	100
Objective(s)	To impart knowledge on mechanical vibrations of single, multiple degrees of freedom and continuous systems, design systems to achieve the vibratory response, analyze and predict vibratory behavior of mechanical systems.							

Fundamentals of Vibration

Introduction – Single degree freedom free vibration systems – Damped vibrations – Single degree freedom forced vibration with elastically coupled viscous dampers, System Identification from frequency response, Support motion, Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation-– Transient Vibration.

Two Degree of Freedom Systems

Free vibration of spring-coupled system – Mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation

Multi Degreeof Freedom Systems

Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – orthogonal properties – Modal matrix-Modal Analysis – Forced Vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies.

Vibration of Continuous Systems

Systems governed by wave equations – Vibration of strings – vibration of rods – Euler Equation for Beams – Effect of Rotary inertia and shear deformation – Vibration of plates.

Experimental Methods In Vibration Analysis

Vibration instruments – Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.

Total hours to be taught: 60

Text book (s) :

1	Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 2002.
2	Rao, J.S and Gupta, K., "Introductory Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., New Delhi, 2013.

Reference(s) :

1	Graham S. Kelly and Shashidar K. Kudari., "Mechanical Vibrations", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
2	Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, New York, 2012.
3	Iyengar, R.N., "Elements of Mechanical Vibration", I K International Publishing House Pvt. Ltd., New Delhi, 2007.
4	Den Hartog, J.P., "Mechanical Vibrations," Dover Publications, New York, 1990.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name			PED : M.E. Engineering Design		
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 006	**Integrated Mechanical Design**	3	1	0	4	50	50	100
Objective(s)	To know the integrated design procedure of different machine elements for mechanical applications.							

Fundamentals and Design of Shafts

Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration –BIS, ISO,DIN, BS, ASTM Standards. Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress – Theories of Failure – Ductile vs. brittle component design -Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity.

Design of Gears and Gear Boxes

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads– Component design of spur, helical, bevel and worm gears – Design for sub assembly –Integrated design of speed reducers and multi-speed gear boxes – application of software packages.

Brakes & Clutches

Dynamics and thermal aspects of brakes and clutches – Integrated design of brakes and clutches for machine tools, automobiles and mechanical handling equipments.

Integrated Design

Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators, Escalators, Gear Box, Valve gear Mechanisms, Machine Tools.

Product Architecture

Product Architecture-Implications of the Architecture-Establishing the Architecture- Delayed Differentiation-Platform Planning-Related System-Level Design Issues.

Total hours to be taught: 45

Text book (s) :

1	Norton, L. R., “Machine Design – An Integrated Approach”, Pearson Education, 2005.
2	Shigley, J.E., “Mechanical Engineering Design”, McGraw Hill, 2011.

Reference(s) :

1	Newcomb, T.P and Spur, R.T., “Automobile Brakes and Braking Systems”, Chapman and Hall, 2nd Edition, 1975.
2	Prasad, L. V., “Machine Design”, Tata McGraw Hill, New Delhi, 1992.
3	Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, 1981.
4	Boltzharol, A., “Materials Handling Handbook”, The Ronald Press Company, 1958.
5	Karl T. Ulrich., Steven D. Eppinger and Anita Goyal., Product Design and Development, 4/e(SIE), 2009.

Approved Data Books

1	P.S.G. Tech., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.
2	Lingaiah,, K. and Narayanalyengar, “Machine Design Data Hand Book”, Vol. 1 &2, Suma Publishers, Bangalore, 1994.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 007	**Mechanisms Design and Synthesis**	3	1	0	4	50	50	100
Objective(s)	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.							

Introduction

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.

Kinematic Analysis

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.

Path Curvature Theory, Coupler Curve

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.

Synthesis of Four Bar Mechanisms

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.

Synthesis of Coupler Curve Based Mechanisms & Cam Mechanisms

Cognate linkages-parallel motion linkages. Design of six bar mechanisms-single dwell - doubled well-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 Software packages. Students should design and fabricate a mechanism model as term project.

Total hours to be taught: 60

Text book (s) :

1	Robert L.Norton., "Kinematics and Dynamics of Machinery", (SIE) Tata McGraw Hill, 2009.
2	Shigley, J.E and Uicker J.J., "Theory of Machines and Mechanisms", Oxford University Press, 2005.

Reference(s) :

1	Sandor, G.N., and Erdman, A.G., "Advanced Mechanism Design Analysis and Synthesis",Prentice Hall, 1984.
2	Amitabha Ghosh and Asok Kumar Mallik., "Theory of Mechanism and Machines", EWLP, New Delhi, 1999.
3	Kenneth J. Waldron and Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", JohnWiley-sons, 2004.
4	Waldron, K.J and Kinzel, G.L., "Kinematics and Design of Machinery" Wiley India P Ltd, New Delhi, 2011.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 201	**Optimization Techniques in Design**	3	1	0	4	50	50	100
Objective(s)	To impart knowledge on static, dynamic constrained and unconstrained optimization techniques in design.							

Introduction

General Characteristics of mechanical elements - Adequate and Optimum design - Principles of optimization - Formulation of objective function - Design constraints – Classification of optimization problem.

Unconstrained Optimization

Single variable and Multivariable optimization- Techniques of unconstrained minimization – Golden section, Pattern and Gradient search methods – Interpolation methods.

Constrained Optimization

Optimization with equality and inequality constraints - Indirect methods using penalty functions - Lagrange multipliers - Geometric programming - Constrained, mixed inequality and unconstrained minimization - Genetic algorithm.

Static Applications

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs.

Dynamic Applications

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

Total hours to be taught: 45

Text book (s) :

1	Rao Singiresu, S., “Engineering Optimization: Theory and Practice”, New Age International (P) Limited, Publishers New Delhi, 2010.
2	Deb Kalyanamoy., “Optimization for Engineering Design: Algorithms and Examples”, Prentice Hall of India Pvt. New Delhi, 2009.

Reference(s) :

1	Johnson Ray, C., “Optimum Design of Mechanical Elements”, John Wiley & Sons, New York, 1990.
2	Goldberg, D.E., “Genetic Algorithms in Search, Optimization and Machine”, Barnen, Addison-Wesley, New York, 2005.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering			Programme Code & Name		PED : M.E. Engineering Design		
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED 0P3	**Computer Aided Analysis Laboratory II**	0	0	3	2	50	50	100
Objective(s)	To develop the students to perform the Modeling, Meshing, helical spring deflection, Modal and Transient analysis, Design optimization, Drop test, Contact analysis, Steady state and Transient heat transfer analysis using CAE software. (Ansys, Nastran, Simulia etc)							

Modeling of a Bearing block.
Modeling and Meshing of a connecting rod.
Analysis on axial deflection of an Open – coiled Helical spring.
Modal analysis of cantilever beam.
Transient analysis of cantilever beam.
Design optimization of cantilever beam cross section.
Drop test analysis of Aluminum container on steel plate.
Interference Fit and Pin Pull-Out Contact Analysis.
Steady state heat transfer analysis on composite wall.
Transient heat transfer analysis of slab.

Total Hrs: 45

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="4">R 2014</td></tr>
<tr><td>Department</td><td colspan="3">Mechanical Engineering</td><td colspan="3">Programme Code & Name</td><td colspan="3">PED : M.E. Engineering Design</td></tr>
<tr><td colspan="10">Semester II</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>40 PED 2P1</td><td colspan="2">Technical Report Preparation and Presentation</td><td>0</td><td>0</td><td>2</td><td>0</td><td>100</td><td>00</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="9">To provide exposure to the students to refer, read and review the research articles in referred journals and conference proceedings and to Improve the technical report writing and presentation skills of the students.</td></tr>
<tr><td>Methodology</td><td colspan="9">• Each student is allotted to a faculty of the department by the HOD
• By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student
• The students have to refer the Journals and Conference proceedings and collect the published literature
• The student is expected to collect at least 20 such Research Papers published in the last 5 years
• Using OHP/Power Point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion
• The student has make two presentations, one at the middle and the other near the end of the semester
• The student has to write a Technical Report for about 30-50 pages (Title page, One page Abstract, Review of Research paper under various subheadings, Concluding Remarks and List of References). The technical report has to be submitted to the HOD one week before the final presentation, after the approval of the faculty guide</td></tr>
<tr><td rowspan="9">Execution</td><td>Week</td><td colspan="8">Activity</td></tr>
<tr><td>I</td><td colspan="8">Allotment of Faculty Guide by the HoD</td></tr>
<tr><td>II</td><td colspan="8">Finalizing the topic with the approval of Faculty Guide</td></tr>
<tr><td>III-IV</td><td colspan="8">Collection of Technical papers</td></tr>
<tr><td>V-VI</td><td colspan="8">Mid semester presentation</td></tr>
<tr><td>VII-VIII</td><td colspan="8">Report writing</td></tr>
<tr><td>IX</td><td colspan="8">Report submission</td></tr>
<tr><td>X-XI</td><td colspan="8">Final presentation</td></tr>
<tr><td rowspan="6">Evaluation</td><td colspan="9">❖ 100% by Continuous Assessment
❖ 3 Hrs/week</td></tr>
<tr><td colspan="7">Component</td><td colspan="2">Weightage</td></tr>
<tr><td colspan="7">Phase -I Presentation</td><td colspan="2">25 %</td></tr>
<tr><td colspan="7">Phase - II Presentation</td><td colspan="2">25 %</td></tr>
<tr><td colspan="7">Report Preparation and Submission</td><td colspan="2">30 %</td></tr>
<tr><td colspan="7">Final Presentation</td><td colspan="2">20 %</td></tr>
<tr><td colspan="7">Total</td><td colspan="2">100 %</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E11	**Design of Hydraulic and Pneumatic Systems**	3	0	0	3	50	50	100
Objective(s)	To impart students on the science, use and application of hydraulics and pneumatics as fluid power in Industry. Also to impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems.							

Oil Hydraulic Systems and Hydraulic Actuators

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

Control and Regulation Elements

Pressure - Direction and Flow control valves - Relief valves, non-return and safety valves – actuation systems.

Hydraulic Circuits

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

Pneumatic Systems and Circuits

Pneumatic fundamentals - control elements, pneumatic sensors - logic circuits – switches – fluidic logic circuits - Sequential circuits – Cascade methods – K-V Mapping methods - Step counter method – Classic methods.

Installation, Maintenance and Special Circuits

Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Total hours to be taught: 45

Text book (s) :

1	Antony Espossito., “Fluid Power with Applications”, Pearson Education, 2011.
2	Srinivasan, R., “Hydraulic and Pneumatic Controls”, Tata McGraw Hill, 2009.

Reference(s) :

1.	Dudleyt, A. Pease and John J. Pippenger., “Basic fluid power”, Prentice Hall, 1987.
2.	Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.
3.	Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.
4.	Majumdar S.R., “ Peumatic systems, Principles and maintanance” Tata Mc Graw Hill, 2010.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E12	**Applied Elasticity and Plasticity**	3	0	0	3	50	50	100
Objective(s)	To understand the concept of stress, strain analysis and its applications. To understand the advances in plasticity and plastic strain analysis.							

Analysis of Stress and Strain

Stress at a point, stress tensor, stress transformations, principal stresses, octahedral stress, equations of equilibrium, strain tensor, principal strains, strain-displacement relations, compatibility conditions, measurement of surface strains using strain gauges.

Constitutive Equations

General theory, generalized Hooke's law, equations of elasticity, formulation of the general elasticity problem, boundary conditions, two dimensional problems in rectangular and polar co-ordinates, Airy's stress function.

Membrane and Contact Stresses

Membrane stresses in axisymmetric shells, meridonial stress and circumferential stress, Introduction, geometry of contact surfaces, notation and meaning of terms, expressions for principal stresses, method of computing contact stresses.

Plasticity

Plastic flow and its microscopic and macroscopic descriptions, stress-strain curves of real materials, definition of yield criterion, concept of a yield surface in principal stress space, yield criteria, Tresca, Von Mises.

Plastic Strain Analysis

Prandtl-Reuss and Levy-Mises equations, deformation in plane stress-yielding of thin sheet in biaxial and uniaxial tension. Plane strain deformation-stress tensor, hydrostatic and deviatoric components, plastic potential, plastic instability, effect of strain rates and temperature effects on flow stress. Introduction to slip line theory.

Total hours to be taught: 45

Text book (s) :

1.	Timoshenko, S. P, and Goodier, J. N., "Theory of Elasticity", McGraw Hill International Editions, Third Edition, 1970.
2.	Chakrabarthy, J., "Theory of Plasticity", McGraw Hill Co, 1987.

Reference(s) :

1.	Durelli, A. J., Phillips, E. A and Tsao, C. H, "Introduction to the Theoretical and Experimental Analysis of Stress and Strain", McGraw Hill, New York, 1958.
2.	Sadhu Singh. "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
3.	Dieter G E., "Mechanical Metallurgy", McGraw Hill, 1988.
4.	Sokolnikoff, I. S., "Mathematical Theory of Elasticity", McGraw Hill International Editions, Second Edition, 1956.
5.	Jhonson, W and Mellor, P. B., "Engineering Plasticity", Van Nostrant Reinhold, 1983.
6.	Boresi, A. P, Schmidt, R. J and Sidebottom, O. M., "Advanced Mechanics of Materials", John Wiley and Sons, Inc., Fifth Edition, 1993.
7.	Calladinev, C R., "Plasticity for Engineers", Ellis Horwood, 1985.
8.	http://nptel.iitm.ac.in/video.php?courseId=1006.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name			PED : M.E. Engineering Design		
Elective I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E13	**Tribology in Design**	3	0	0	3	50	50	100
Objective(s)	To impart knowledge in the friction, wear and lubrication aspects of machine components, To understand the material properties which influence the tribological characteristics of surfaces. To understand the analytical behavior of different types bearings and design of bearings based on analytical /theoretical approach							

Surface Interaction and Friction

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

Wear and Surface Treatment

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

Lubricants and Lubrication Regimes

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

Theory of Hydrodynamic and Hydrostatic Lubrication

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

High Pressure Contacts and Elasto Hydrodynamic Lubrication

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory- Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives.

Total hours to be taught: 45

Text book (s) :

1.	Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.
2.	Stolarski, T.A., "Tribology In Machine Design" Industrialpress, New York,1991.

Reference(s) :

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

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E14	**Research Methodology - Engineering and Management Studies**	3	0	0	3	50	50	100

Research Methodology

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.

Scales and Measurements

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.

Hypotheses Testing

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.

Sample Tests

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 Walls test (H-Test)

Analysis and Report

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

Total hours to be taught.45

Reference(s):

1.	Kothari, C.R., "Research Methodology –Methods and techniques", 3rd Edition, New Age Publications, New Delhi,2014
2.	Panneerselvam, R., "Research Methodology", 2nd revised edition, Prentice-Hall of India, New Delhi, 2014.
3.	Bhattacharyya D K,"Research Methodology", Excel Books, New Delhi 2006
4.	Gupta M, "Research Methodology", Prentice-Hall of India, New Delhi, 2012.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name			PED : M.E. Engineering Design		
Elective I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E15	**Experimental Stress Analysis**	3	0	0	3	50	50	100
Objective(s)	To impart knowledge on various measurement techniques and to know non destructive testing methods.							

Forces and Strain Measurement

Strain gauge, principle, types, performance and uses. Photo elasticity – principle and applications – Moire Fringe - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines.

Vibration Measurements

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters –Digital data Acquisition systems.

Acoustics and Wind Flow Measures

Principles of Pressure and flow measurements – pressure transducers – sound level meter – Venturimeter and flow meters – wind tunnel and its use in structural analysis – structural modeling – direct and indirect model analysis.

Distress Measurements

Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled blasting for demolition.

Non Destructive Testing Methods

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating.

Total hours to be taught: 45

Reference(s) :

1	L.S.Srinath et al, Experimental Stress Analysis, Tata McGraw Hill Company, New Delhi, 1991
2	JW Dalley and WF Riley, “Experimental Stress Analysis”, McGraw Hill Book Company, N.Y. 1991
3	Doyle J F, “Modern Experimental Stress Analysis” Wiley Publications, 2014.
4	Sadhu Singh, “Experimental Stress Analysis” , Khanna Publishers, New Delhi, 1996.
5	R.S.Sirohi and HC Radhakrishna, “Mechanical Measurements”, New Age International (P) Ltd. 1997

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E21	**Design of Material Handling Equipments**	3	0	0	3	50	50	100
Objective(s)	To impart students on the need, use, application and design of different material handling techniques, equipments and machines used in common use and in industrial sector.							

Materials Handling Equipment

Intraplant transporting facilities - types - Principle groups of material handling equipment - Choice of material handling equipment – Types of material handling equipment – General characteristics - applications.

Design of Hoist

Welded and roller chains - Hemp and steel wire ropes - pulleys, pulley systems, sprockets and drums - Load handling attachments - Forged hooks and eye hooks - Crane grabs – Electric lifting magnets - Grabbing attachments – Ladles - Arresting gear and Brakes.

Hoisting Gear

Drives of Hoisting gear - Hand and power drives – Traveling gear - Rail traveling mechanism - Cantilever and monorail cranes – Trackless travelling mechanisms - Slewing, jib and luffing gear - Selecting the motor ratings - Cogwheel drive.

Conveyors

Types - Belt conveyor - Pneumatic conveyor - Screw conveyor - apron conveyor - Vibratory conveyor – Design and applications.

Elevators

Bucket elevators - design - Loading and bucket arrangements - Cage elevators - Shaft way, guides, counter weights, hoisting machine, safety devices – Fork lift truck – Escalators.

Total hours to be taught: 45

Text book (s) :

1	Rudenko, N., “Materials handling equipment”, Peace publications, Mascow,1964.
2	Spivakovsy, A.O and Dyachkov, V.K., “Conveying Machines”, Volumes I and II, MIR Publishers, 1985.

Reference(s) :

1	Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, 1981.
2	Ray Siddhartha., “Introduction to material handling”, New age International,2007.
3	Arora,.K.C and Vikas V. Shinde., “Aspects of Material handling”, First edition, Laxmi publications,2007.
4	Fayed,.M.E and Thomas S.Skoair, “Mechanical conveyors", Selection and operation”, First edition, CRC press,1996.
5	P.S.G. Tech, “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2011.

K.S.Rangasamy College of Technology - Autonomous Regulation			R 2014
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective II

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E22	**Theory of Plates and Shells**	3	1	0	4	50	50	100
Objective(s)	To impart knowledge on the behavior of plates and shell elements, their places of utility and of course the design procedure of such elements in practical applications.							

General Introduction

Review of equations of elasticity- kinematics, compatibility equations, stress measures – equations of motions- constitutive relations- transformation of stresses, strains and stiffness – energy principles and variational methods in elasticity- virtual work-external and internal virtual work variational operator –functionals- Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential– applications.

Classical Theory of Plates

Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

Buckling Analysis of Rectangular Plates

Buckling of simply supported plates under compressive forces- governing equations- the Navier solution- biaxial compression of a plate- uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions- general formulation- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination).

Vibration of Plates

Governing equations for natural flexural vibrations of rectangular plates - natural vibrations of plates simply supported on all edges - vibration of plates with two parallel sides simply supported - Levy's solution - vibration of plates with different boundary conditions – Rayleigh - Ritz method - Natural vibration of plates with general boundary conditions - transient analysis of rectangular plates - finite element analysis (elementary treatment only; discussion of various elements used and their capabilities- not for examination).

Analysis of Thin Elastic Shells of Revolution

Classification of shell surfaces - geometric properties of shells of revolution - general strain displacement relations for shells of revolution - stress resultants - equations of motion of thin shells analytical solution for thin cylindrical shells - membrane theory - flexure under axisymmetric loads shells with double curvature- geometric considerations - equations of equilibrium - bending of spherical shells - vibration of cylindrical shells - finite element analysis (elementary treatment only; discussion of various elements used and their capabilities- not for examination).

Total hours to be taught: 45

Text book (s) :

1	Baskar, K and Varadan, T. K., "Plates- Theories and Applications", Ane Books Pvt. Ltd., New Delhi, 2013.
2	Timoshenko, S., "Theory of Plates and Shells", McGraw Hill, 1990.

Reference(s) :

1	Timoshenko, S and Krieger, S.W., "Theory of Plates and Shells", McGraw Hill Book Company, New York, 1990.
2	Reddy, J.N., "Theory and Analysis of Elastic Plates and Shells", C.R.C.Press, NY, USA, 2nd Edition, 2006.
3	Szilard, R., "Theories and Applications of Plate Analysis: Classical Numerical and Engineering Methods", Wiley, 2004.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E23	**Wind Energy System**	3	0	0	3	50	50	100
Objective(s)	To understand the fundamentals of wind energy and its conversion techniques for electrical energy applications, To understand the fundamentals of wind energy and its conversion system To Learn wind turbine components and their construction, To learn modern wind turbine control & monitoring							

Wind Energy Fundamentals and Wind Measurements

Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Class of wind turbines, Atmospheric Boundary Layers, Turbulence. Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis

Aerodynamics Theory and Wind Turbine Types

Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control , Pitch Control, Gear Coupled Generator type, Direct Generator Drive /PMG/Rotor Excited Sync Generator, Calculation of axial thrust and efficiency, Lift and drag coefficients, thrust and torque calculations, Tip losses, Characteristics of horizontal axis wind turbines and power curve. Concepts of blade design

Direct Rotor Coupled Generator (Multipole) [Variable Speed Variable Freq.]

Excited Rotor Synchronous Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / Boost Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage and Current), Transformer, Safety Chain Circuits

Special Machines

Permanent magnet synchronous machines, Principle of operation, Power input and torque expressions, phasor diagram, Voltage regulation and control. Permanent magnet brushless DC machines: Commutation in DC machine, mechanical and electronic commutators, Torque and EMF equation, Voltage regulation and control. Position sensors, Losses and efficiency of electric generators, Specification and Testing, High efficiency, generators.

Modern Wind Turbine Control and Monitoring System

Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation & Maintenance for Product Life Cycle, Balancing technique (Rotor & Blade), FACTS control & LVRT & New trends for new Grid Codes.

Total hours to be taught 45

Text book (s) :

1	Freris, L.L., Wind Energy Conversion Systems, Prentice Hall, 1990
2	Kaldellis J.K, Stand – alone and Hybrid Wind Energy Systems, CRC Press, 2010

Reference(s) :

1	Mario Garcia –Sanz, Constantine H. Houpis, Wind Energy Systems,CRC Press 2012
2	Spera, D.A., Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press, 1994.
3	Duffie, A and Beckmann, W. A., Solar Engineering of Thermal Processes, John Wiley, 1991.
4	Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press,1996.
5	Anna Mani : Wind Energy Data for India
6	C-Wet : Wind Energy Resources Survey in India VI
7	Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1983
8	John D Sorensen and Jens N Sorensen, Wind Energy Systems, Wood head Publishing Ltd, 2011

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E24	**Measurement Techniques**	3	0	0	3	50	50	100
Objective(s)	To prove in depth study on forces, strain and vibration measurements, principles of acoustics and distress measurements and non- destructive testing methods.							

Forces and Strain Measurement

Strain gauge, principle, types, performance and uses. Photo elasticity – principle and applications - Moire Fringe - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines.

Vibration Measurements

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

Acoustics and Wind Flow Measures

Principles of Pressure and flow measurements – Pressure transducers – Sound level meter – Venturimeter and flow meters – Wind tunnel and its use in structural analysis – Structural modeling – Direct and indirect model analysis.

Distress Measurements

Diagnosis of distress in structures – Crack observation and measurements – Corrosion of reinforcement in concrete – Half-cell, construction and use – Damage assessment – Controlled blasting for demolition.

Non Destructive Testing Methods

Load testing on structures, buildings, bridges and towers – Rebound Hammer – Acoustic emission – Ultrasonic testing principles and application – Holography – Use of laser for structural testing – Brittle coating.

Total hours to be taught:45

Text book (s) :

1	Dalley JW and Riley WF, “Experimental Stress Analysis”, McGraw Hill Book Company, N.Y. 1991.
2	Srinath L.S., “Experimental Stress Analysis”, Tata McGraw Hill Company, New Delhi, 1984.

Reference(s) :

1	Sadhu Singh “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 1996.
2	Sirohi R.S., Radhakrishna HC, “Mechanical Measurements”, New Age International (P) Ltd. 1997.
3	Garas F.K,. Clarke J.L and Armer GST, “Structural Assessment”, Butterworths, London, 1987.
4	Bray D.E. & Stanley R. K., “Non-destructive Evaluation”, McGraw Hill Publishing Company, N.Y.1989.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E25	**Advanced Materials and Their Processing**	3	0	0	3	50	50	100
Objective(s)	To impart knowledge on the structure, properties, fracture behavior, selection of materials and applications of modern metallic and non metallic materials so as to identity and select suitable materials for various applications.							

Behaviour of Materials

Elasticity in metals and polymers - Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solution hardening, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviors - Super plasticity - Deformation of non crystalline material.

Fracture Behaviour

Griffith's theory, stress intensity factor and fracture toughness - Toughening mechanisms - Ductile, brittle transition in steel - High temperature fracture, creep - Larson-Miller parameter - Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law - Effect of surface and metallurgical parameters on fatigue - Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

Selection of Materials

Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

Modern Metallic Materials

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel - Intermetallics, Ni and Ti aluminides - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials.

Non Metallic Materials

Polymeric materials - Formation of polymer structure - Production techniques of fibres, foams, adhesives and coatings - Structure, properties and applications of engineering polymers - Advanced structural ceramics, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond - properties, processing and applications.

Total hours to be taught: 45

Reference(s) :

1	Thomas H.Courtney, "Mechanical Behaviour of Materials ", McGraw-Hill, second edition 2005.
2	Charles J.A., Crane, F.A.A and Furness, J.A.G., " Selection and use of Engineering Materials" Butterworth- Heiremann, 1997.
3	Flinn, R.A. and Trojan, P.K., " Engineering Materials and their Applications ", (4th Edition), Jaico, 1999
4	George E.Dieter, "Mechanical Metallurgy ", McGraw Hill, 1988.
5	Metals Hand Book, Vol.10, "Failure Analysis and Prevention ", (10th Edition), 2002.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	CA	C	CA	ES	Total
40 PED E31	**Design of Pressure Vessels and Piping**	3	0	0	3	50	50	100
Objective(s)	The main objective is to present the industrial related problems, procedures and design principles for pressure vessels and enhance the understanding of design procedure of pressure vessel and Design of piping layout.							

Introduction

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

Stresses in Pressure Vessels

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.

Design of Vessels

Design of Tall cylindrical self supporting process columns –Supports for short, vertical and horizontal 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. Introduction to ASME pressure vessel codes.

Buckling of Vessels

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.

Piping

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

Total hours to be taught: 45

Text book (s) :

1	John F. Harvey., “Theory and Design of Pressure Vessels”, CBS Publishers and Distributors, 1987.
2	Henry H. Bedner., “Pressure Vessels, Design Hand Book”, CBS publishers and Distributors, 1987.

Reference(s) :

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.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering	Programme Code & Name			PED : M.E. Engineering Design			
Elective III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E32	**Composite Materials and Mechanics**	3	0	0	3	50	50	100
Objective(s)	To provide knowledge of simple stresses, strains and deformation due to external loads and their relations in orthotropic materials and their manufacturing.							

Introduction to Composite Materials

Definition – Classification, Advantages and Applications – Matrix: Types – Polymer, Metal, Ceramics - Properties and Applications – Fibers: Glass – Carbon -Ceramic and Aramid fibers - Characteristics, Manufacturing of Fibers –Fiber Surface Treatments- Fillers and additives.

Manufacturing of Composites

Manufacturing of Polymer Matrix Composites (PMCs):, Handlay -up, Bag Moulding, Compression Moulding, Pultrusion, Filament Winding, Resin Transfer Moulding (RTM). Manufacturing of Metal Matrix Composites (MMCs): Solid State Processing, Liquid State Processing, Vapour State Processing. Manufacturing of Ceramic Matrix Composites (CMCs): Hot Pressing, Reaction Bonding Process, Infiltration Technique, Direct Oxidation - Quality Inspection methods.

Micro and Macro Mechanical Behaviour of Lamina

Micro Mechanical Behaviour: Volume and Mass Fractions, Mechanics of Materials Approach - Evaluation of Elastic Moduli, Evaluation of Strength. Macro Mechanical Behaviour: Stress Strain relationship for Anisotropic Materials, Stiffness, Compliances and Engineering Constants for Orthotropic Materials, Stress Strain relations for a lamina of arbitrary orientation, Strength of an Orthotropic Lamina.

Macro Mechancal Behaviour of Laminate

Classical lamination theory: Lamina Stress Strain Behaviour, Resultant Forces and Moments in a Laminate - Types of Laminates - Strength and Stiffness of Laminates – Interlaminar Stresses in Laminates.

Design and Failure Analysis

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.Failure Predictions – Failure Theories.

Total hours to be taught: 45

Text book (s) :

1	Robert M. Jones., “Mechanics of Composite Materials“, CRC Press, Second Edition, 1998.
2	Autar K. Kaw., “Mechanics of Composite Materials”, CRC Press, Second Edition, 2005.

Reference(s) :

1	Krishnan K. Chawla., “Composite materials: Science and Engineering”, Springer Publishers, 2010.
2	Mallick, P.K., ”Fiber - Reinforced Composites: Materials, Manufacturing and Design”, Maneel Dekker Inc, 2007.
3	MadhujitMukhopadhyay., “Mechanics of Composite Materials and Structures”, University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008).
4	Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994,Second Edition - CRC Press in progress

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E33	**Propeller Aerodynamics**	3	0	0	3	50	50	100
Objective(s)	To impart knowledge of aerodynamics. To understand the concept ofair screw theory, the axial momentum theory, the blade element theory and the vortex theory along with experimental and simulation approach.							

Air Screw Theory

Introduction-Non-Dimensional Coefficients-Air screw design-development of airscrew theory. The actuator-disc theory, working states of rotor, Optimum rotor, Efficiency of rotor.

The Axial Momentum Theory

The Rankine-Froude theory-The momentum Equation-Ideal efficiency of a propeller.The general Momentum theory-General equations-constant circulation-approximate solution-minimum loss of energy-constant efficiency.Propeller efficiency-Energy Equation-approximate solution-efficiency-Numerical results.

The Blade Element Theory

Primitive Blade Element Theory-Efficiency of the blade element-Blade interface-The vortex system of a propeller-induced velocity-The airfoil characteristics-Multi plane Interference-cascade of airfoils-Airfoil characteristics in a Cascade.

The Vortex Theory

The Propeller blades- Energy and Momentum-Propeller Characteristics-The application of the Vortex Theory-The effect of solidity and pitch-Approximate method of solution-Effective Aspect ratio of the blades. Propellers of Highest efficiency- Minimum loss of Energy- Lightly Loaded propellers-Effect of profile Drag- The effect of Number of Blades-Application of Prandtl's Formula.

Experimental and Simulation Approach of Propellers

Experimental Methods- Wind tunnel interference-Thrust and Torque Distribution-Scale effect-Compressibility Effect. Basics of propeller simulations- Domain selection- Grid independency study- Turbulence model investigation.

Total hours to be taught:45

Text book (s) :

1	Durand, W.F., "Applied Aerodynamics- Volume IV", Stanford University, California, 2005.

Reference(s) :

1	Seddon, J., "Basic Helicopter Aerodynamics", BSP Professional Books, Oxford London, 1990
2	Kerwin, Justin E., and Jacques B. Hadler. *Principles of Naval Architecture Series: Propulsion*, 2010
3	Wald, Q.R., "The Wright Brothers Propeller Theory and Design", AIAA 2001-3386
4	"Propeller/Body Interaction For Thrust And Drag"-ESDU 86017
5	"Modeling Propeller Flow-Fields Using CFD"- AIAA 2008-402
6	Marc Johannes Root, "Numerical Analysis of Turbine Blade cooling Ducts" University Press Facilities, Eindhoven, 1997

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E34	**Artificial Intelligence and its Applications**	3	0	0	3	50	50	100
Objective(s)	To impart knowledge on Artificial Intelligent fuzzy logic and fuzzy sets. To develop Genetic Algorithm and Hybrid System using various theorem.							

Artificial Intelligence

Introduction - Intelligent Agents – Problem-solving – Solving problems by searching – Informed search methods – Game Playing - Acting Logically – Planning – Practical Planning – Learning – Reinforcement Learning

Fuzzy Logic and Fuzzy Sets

fuzzy sets – operations on fuzzy sets – fuzzy relations - fuzzy rules and fuzzy reasoning – fuzzy inference systems – fuzzy logic – fuzzy expert systems – fuzzy decision making

Neural Network

Neural networks - Basic models of artificial neural networks: simple layer perception - Feed forward multilayer perceptron - Applications of neural networks - Adaptive filtering and adaptive pattern recognition

Genetic Algorithm

Simple genetic algorithm – Mathematical foundations –Data structures – Reproduction – Cross over and mutation – Schema theorem and convergence of genetic algorithm

Hybrid Systems

Neural-network-based fuzzy systems – fuzzy logic based neural networks – genetic algorithm for neural network design and learning – fuzzy logic and genetic algorithm for optimization – applications.

Total hours to be taught: 45

Text book (s) :

1. Stuart Russell & Peter Norvig, “Artificial Intelligence – A Modern Approach”, Second Edition, Pearson Education, (3rd Edition), 2009.
2. Chin-Teng Lin & C.S. George Lee, “Neural Fuzzy Systems”, Prentice Hall PTR,1996

Reference(s) :

1. klir & yuan, “fuzzy sets and fuzzy logic”, phi, 1997.
2. S.Haykin, “Neural Networks”, Pearson Education, Second Edition, 2001.
3. S.Rajasekaran & G.A.V. Pai, “Neural Networks, Fuzzy logic and Genetic Algorithms”, PHI, Jan 2003
4. Jang, Sun & Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 1997
5. V.Kecman, “Learning and Soft Computing”, MIT Press, 2001.
6. D.Ruan, “Intelligent Hybrid Systems”, Kluwer Academic Publisher, 1997.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E35	**Advanced Internal Combustion Engines**	3	0	0	3	50	50	100
Objective(s)	To provide sound knowledge in the basic concepts Advanced Internal Combustion Engines							

Fundamentals of I.C Engine

Spark Ignition Engines, mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – factors affecting knock – Combustion chambers

Combustion Techniques in C.I. Engine

Compression ignition engines, Stages of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Fuel spray behaviour – spray structure, spray penetration and evaporation – air motion – Introduction to Turbo charging and supercharging.

Concepts of Engine Simulation

Combustion modeling, Basic concepts of engine simulation, governing equations, simulation of various engine processes for SI and CI Engines. Thermodynamic and fluid mechanic based models.

Alternative Fuels

Alternative fuels, Alcohol, Hydrogen, Natural Gas Bio diesel, fuel cell. Other possible fuels and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications. Dual fuel operation.

Recent Trends in I.C. Engine

Recent trends, Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Zero Emission Vehicles, Engines for special applications – Mining, Defence, Off-highway -Tractor, Bulldozer etc. Submarines, Race car Engine systems, Flexible fuel systems. Surface ignition,

Total hours to be taught: 45

Text book (s) :

1. K.K. Ramalingam, Internal Combustion Engine Fundamentals, Third edition, Scitech Publications, 2015.
2. V. Ganesan, Int. Combustion Engines, IV Edition, TMH, 2012.

Reference(s) :

1. John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, 1988.
2. M.L. Mathur and R.P.Sharma, A course in internal Combustion Engines, Dhanapat Rai Publications, New Delhi.
3. R.B.Mathur and R.P. Sharma, Internal combustion Engines. Dhanpat Rai and Sons, 1998.
4. Duffy Smith, Auto fuel Systems, The Good Heart Willox Company, Inc. 1987.
5. Ganesan V. Computer simulation of spark ignition process: University process. Hyderabad, 1993.
6. Ganesan V. Computer simulation of compression ignition engine. Orient Long man, 2000.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E36	**Fuels and Combustion**	3	0	0	3	50	50	100
Objective(s)	To impart knowledge on various types of fuels, combustion and coal preparation system.							

Introduction

Fuels-Types And Characteristics Of Fuels-Determination Of Properties Of Fuels-Fuels Analysis- Proximate And Ultimate Analysis-Moisture Determination-Calorific Value- Gross & Net Calorific Values – Calorimetry - Dulong's Formula For Cv Estimation-Flue Gas Analysis –Orsat Apparatus- Fuel & Ash Storage & Handling – Spontaneous Ignition Temperatures.

Solid and Liquid Fuels

Solid fuels Types – Coal Family – Properties – Calorific Values – ROM, DMMF, DAG AND Bone Dry Basis – Ranking – Bulk & Apparent Density – Storage – Washability –Coking & Caking Coals – Renewable Solid Fuels – Biomass – Wood Waste – Agro Fuels– Manufactured Solid Fuels. Liquid Fuels Types – Sources – Petroleum Fractions-Classification – Refining – Properties Of Liquid Fuels – Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number Etc, - Alcohols – Tar Sand Oil – Liquefaction Of Solid Fuels.

Gaseous Fuels

Classification – Composition & Properties – Estimation Of Calorific Value – Gas Calorimeter. Rich & Lean Gas – Wobbe Index – Natural Gas – Dry & Wet Natural Gas Stripped NG – Foul & Sweet NG – LPG – CNG – Methane – Producer Gas Gasifiers Water Gas – Town Gas – Coal Gasification – Gasification Efficiency – Non – Thermal Route – Biogas – Digesters – Reactions – Viability – Economics.

Combustion

Stoichiometry – Mass Basis & Volume Basis – Excess Air Calculation – Fuel & Flue Gas Compositions – Calculations – Rapid Methods – Combustion Processes – Stationary Flame Combustion Explosive Combustion. Mechanism Of Combustion – Ignition & Ignition Energy – Spontaneous Combustion- Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion – Flame Temperature – Theoretical, Adiabatic & Actual –Ignition Limits – Limits Of Inflammability.

Coal Preparation System

Coal Burning Equipments – Types – Pulverized Coal Firing – Fluidized Bed Firing – Fixed Bed & Recycled Bed – Cyclone Firing – Spreader Stokers – Vibrating Grate Stokers Sprinkler Stokers, Traveling Grate Stokers. Oil Burners – Vaporizing Burners –Air Aspiration Gas Burners – Burners Classification According To Flame Structures –Factors Affecting Burners & Combustion.

Total hours to be taught: 45

Reference(s) :

1.	Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Logman, latest Edition
2.	Bhatt,Vora Stoichiometry, 2nd Edition, tata Mcgraw Hill, 1984
3.	Blokh AG, Heat Transfer in Steam Boiler Furance, Hemisphere Publishing Corpn,1988
4.	Civil Davies, Calculations in Furance Technology, Pergamon Press,Oxford,1966
5.	Sharma SP,Mohan Chander,Fuels & Combustion, Tata Mcgraw Hill,1984

K.S.Rangasamy College of Technology – Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective IV

40 PED E41 Computational Fluid Dynamics

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To develop finite difference and finite volume discredited forms of the CFD equations. To formulate explicit & implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

Governing Differential Equation and Finite Difference Method

Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

Conduction Heat Transfer

Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

Incompressible Fluid Flow

Governing Equations, Stream Function – Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and spalding, Computation of Boundary layer flow, Finite difference approach.

Convection Heat Transfer And Fem

Steady One-Dimensional and Two-Dimensional Convection – dimensional convection – Diffusion, Unsteady two-dimensional Introduction to finite element method – Solution of steady heat Incompressible flow – Simulation by FEM.

Turbulence Models

Algebraic Models – One equation model, K - □ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

Text Book(s):

1	Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 2013.
2	Ghoshdasdidar, P.S., “Computer Simulation of Flow and Heat Transfer” Tata McGraw Hill Publishing Company Ltd., 1998.
3	Subas, V.Patankar “Numerical heat transfer fluid flow”, Hemisphere Publishing Corporation, 1989.

Reference(s):

1	Taylor, C and Hughes, J.B. “Finite Element Programming of the Navier Stock Equation”, Pineridge Press Limited, U.K., 1981.
2	Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., “Computational fluid Mechanic and Heat Transfer “ Hemisphere Publishing Corporation, Newyork, USA, 2011.
3	Fletcher, C.A.J. “Computational Techniques for Fluid Dynamics 1” Fundamental and General Techniques, Springer – Verlag, 2006.
4	Fletcher, C.A.J. “Computational Techniques for Fluid Dynamics 2” Specific Techniques for Different Flow Categories, Springer – Verlag, 2006.
5	Bose, T.X., “Numerical Fluid Dynamics” Narosa Publishing House, 1997.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective IV

40 PED E42 Rapid Prototyping and Tooling

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	At the end of this course the students would have developed a thorough understanding of the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies

Introduction

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping.

Liquid Based and Solid Based Rapid Prototyping Systems

Stereolithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, Three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

Powder Based Rapid Prototyping Systems

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

Reverse Engineering and CAD Modeling

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 – 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 Tooling

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

Text book (s):

1	Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2013.
2	Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

Reference(s):

1	Rapid Prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
2	Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
3	Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective IV

40 PED E43 Micro Electro Mechanical Systems Design

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To impart knowledge of design, fabrication and characterization of Micro Electro Mechanical Systems.

Introduction

Overview of MEMS and Microsystems: MEMS and Microsystems, Evolution of Micro fabrication,Microsystems and Microelectronics, Microsystems and miniaturization-Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, Silicon, Gallium Arsenide, Piezoelectric Crystals, Polymers, Packaging materials-Working principles of Microsystems: micro sensors, micro actuation, MEMS with micro actuators, Micro accelerometers, micro fluidics- Applications of Microsystems in various industries.

Mechanics, Scaling and Design

Engineering Mechanics for Microsystems design: Introduction, Static bending of Thin Plates,Mechanical Vibration, Thermomechanics, Thermofluid, Engineering and micro system design, Laminar fluid flow, Incompressible fluid Flow, Heat conduction in solids-Scaling Laws in Miniaturization, Introduction to scaling, Scaling in (Electrostatic forces electromagnetic forces, Electricity, fluid mechanics, heat transfer)-Microsystems Design: Design Consideration, Process design, Mechanical Design, Design of Micro fluidic Network systems

Micro System Fabrication Processes

Introduction- Photolithography- Ion implantation- Chemical Vapor Deposition-Physical Vapor Deposition - clean room- Bulk micromachining :etching, isotropic and anisotropic etching, wet and dry etching- Surface micro machining :process, mechanical problems associated with surface micro machining- LIGA process :general description, materials for substrates and photo resists-SLIGA process-Abrasive jet micro machining-Laser beam micro machining- Micro Electrical Discharge Micro Machining –Ultrasonic Micro Machining- Electro chemical spark micro machining- Electron beam micro machining-Focused Ion Beam machining

Microsystems Packaging

Introduction - Microsystems Packaging-Interfaces in Microsystems Packaging-Essential Packaging Technologies- Die preparation, surface bonding, wire bonding, sealing- Three dimensional Packaging-Assembly of Microsystems, Signal Mapping and Transduction

Micrometrology and Characterization

Microscopy and visualization- Lateral and vertical dimension- optical microscopy, Scanning white light interferometry,Confocal Laser scanning microscopy, Molecular measuring machine, Micro coordinate measuring machine- Electrical measurements – Physical and chemical analysis – XRD- SEM - Secondary Ion mass spectrometry- Auger Electron Spectroscopy, SPM

Text book (s):

1	Hsu, T.R., “MEMS & Microsystems Design and Manufacture”, Tata McGraw Hill, 2002,ISBN: 9780070487093, 2009.
2	Franssila, S., “Introduction to Micro Fabrication” John Wiley & sons Ltd, 2004.ISBN:470-85106-6, 2010
3	Jain, V.K., “Introduction to Micromachining” Narosa Publishing House, 2010.

Reference(s):

1	Jackson, M.J., “Microfabrication and Nanomanufacturing” Taylor and Francis 2006
2	McGeough, J.A., “Micromachining of Engineering Materials”, CRC Press, ISBN: 0824706447, 2011.
3	Hak M.G., “MEMS Handbook”, CRC Press, ISBN: 8493-9138-5, 2006.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective IV

40 PED E44 Vibration Condition Monitoring

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	At the end of the course, the student should be able to understand the vibration control in design and principles & applications, dynamic balancing and alignment of machinery.

Introduction

Review of Fundamentals of Single Degree Freedom Systems – Two Degree Freedom Systems - Multi Degree Freedom System - Continuous system - Determination of Natural frequencies and mode shapes – Numerical methods in Vibration Analysis.

Vibration Control

Introduction – Reduction of Vibration at the Source - Control of Vibration – by Structural design – Material Selection – Localized additions – Artificial damping – Resilient isolation - Vibration isolation – Vibration absorbers.

Active Vibration Control

Introduction – Concepts and applications - Review of smart materials – Types and Characteristics - Review of smart structures – Characteristics Active vibration control in smart structures.

Condition Based Maintenance Principles and Applications

Introduction - Condition Monitoring Methods - The Design of Information system -Selecting methods of monitoring - Machine condition monitoring and diagnosis – Vibration severity criteria – Machine maintenance techniques – Machine condition monitoring techniques – Vibration monitoring techniques – Instrumentation systems – Choice of monitoring parameter.

Dynamic Balancing and Alignment of Machinery

Introduction - Dynamic Balancing of Rotors - Field Balancing in one Plane, two Planes and in several Planes- Machinery Alignment - “Rough” Alignment Methods -The Face - Peripheral Dial Indicator Method – Reverse Indicator Method - Shaft-to-coupling spool method.

Text book (s):

1	Bathe K.J. and Wilson, F.I., “Numerical Methods in Finite Element Analysis”, Prentice Hall of India, New Delhi, 2002.
2	Hartog, J.O. Den., “Mechanical Vibrations”, McGraw-Hill, New York, 2008

Reference(s):

1	Rao, J.S., “Vibratory Condition Monitoring of Machines”, CRC Press, London, 2013.
2	“Hand Book of Condition Monitoring”, Elsevier Science, Astmerdam, 1996.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective IV

40 PED E45 Design of Heat Exchangers

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To educate the ways and means of flow distribution and stress analysis, constructional details of Heat Exchangers, Design aspects of heat exchangers, condensers, evaporators and cooling towers.

Constructional Details and Heat Transfer

Types - Shell and Tube Heat Exchangers - Regenerators and Recuperates Industrial Applications Temperature Distribution and its Implications - LMTD - Effectiveness

Flow Distribution and Stress Analysis

Effect of Turbulence - Friction Factor - Pressure Loss - Channel Divergence Stresses in Tubes - Heater sheets and Pressure Vessels - Thermal Stresses - Shear Stresses - Types of Failures

Design Aspects

Heat Transfer and Pressure Loss - Flow Configuration - Effect of Baffles - Effect of Deviations from Ideality – Design of Typical Liquid - Gas-Gas-Liquid Heat Exchangers

Condensers and Evaporators Design

Design of Surface and Evaporative Condensers - Design of Shell and Tube - Plate Type Evaporators

Cooling Towers

Packing - Spray Design - Selection of Pumps - Fans and Pipes - Testing and Maintenance – Experimental Methods.

Text book (s):

1	Taborek T., Hewitt G.F. and Afgan, N. “Heat Exchangers - Theory and Practice”, McGraw Hill Book Co., 1980.
2	Walker “Industrial Heat Exchangers - A Basic Guide”, McGraw Hill Book Co., 1982.

Reference(s):

1	Nicholas Cheremisioff “Cooling Tower”, Ann Arbor Science Publishers, 1989.
2	Arthur P. Fraas “Heat Exchanger Design”, John Wiley & Sons, 2011.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective V

40 PED E51 Engineering Fracture Mechanics

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To impart knowledge on mechanics of cracked components of different modes by which these components fail under static load conditions. To impart knowledge on mechanics of cracked components of different modes by which these components fail under fatigue load conditions

Elements of Solid Mechanics

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

Stationary Crack Under Static Loading

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.

Energy Balance and Crack Growth

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

Fatigue Crack Growth Curve

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.

Applications of Fracture Mechanics

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

Text book (s):

1	David Broek, "Elementary Engineering Fracture Mechanics ", Fifthoff and Noerdhoff International Publisher, 2013.
2	Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 1985.

Reference(s):

1	Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 2013.
2	John M.Barson and Stanely T.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood cliffs. 1986.
3	Tribikram Kundu, "Fundamentals of Fracture Mechanics", Ane Books Pvt. Ltd. New Delhi/ CRC Press, 1st Indian Reprint, 2013.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective V

40 PED E52 Design for Manufacture, Assembly and Environments

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To know the concept of design for manufacturing, assembly and environment. To know the computer application in design for manufacturing and assembly.

Introduction

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

Factors Influencing form Design

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

Component Design - Machining Consideration

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

Component Design – Casting Consideration

Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - - Modifying the design - group technology - Computer Applications for DFMA

Design for The Environment

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T"s environmentally responsible product assessment - Weighted sum assessment method – Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

Text book (s):

1	Boothroyd, G, Design for Assembly Automation and Product Design. New York, Marcel Dekker, 2013
2	Bralla, Design for Manufacture handbook, McGraw hill, 2013.
3	Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 2013.

Reference(s):

1	Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
2	Fixel, J. Design for the Environment McGraw hill., 2013.
3	Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 2014.
4	Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2013

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective V

40 PED E53 Bearing Design and Rotor Dynamics

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To know about different types of bearings available for machine design and their operating principles To design hydrodynamic/ hydrostatic / rolling bearing for given specifications and analyze the bearings for their performance To understand the bearing behavior under dynamic conditions

Classification and Selection Of Bearings

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

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

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

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

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

Text book (s):

1	Neale, M.J. “Tribology Hand Book”, Butterworth Heinemann, United Kingdom 2001
2	Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1983

Reference(s):

1	Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 2010
2	Williams J.A. “ Engineering Tribology”, Oxford Univ. Press, 2005
3	S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2013
4	G.W.Stachowiak & A.W .Batchelor , Engineering Tribology, Butterworth-Heinemann, UK, 2014

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective V

40 PED E54 Microcontroller System Design and Applications

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To provide sound knowledge in the basic concepts of microcontroller and design and applications.

8051 Architecture

Basic organization – 8051 CPU structure – Register file – Interrupts – Timers – Port circuits – Instruction set – Timing diagram – Addressing modes – Simple Program and Applications

Peripherals and Interfacing

Typical Bus structure – Bus – Memory organization – Timing characteristics –Extended Model and Memory Interfacing – Polling – Interfacing Basic I/O devices –Analog and Digital interfacing – PWM mode operation – Serial port application.

8096 Architecture

CPU operation – Interrupt structure – Timers – High Speed Input / Output Ports – I/O control and Status registers – Instruction Set – Addressing Modes – Simple Programming – Queues – Tables and Strings – Stack Memories – Key Switch –Parsing.

Peripherals and Interfacing

Analog Interface – Serial Ports – Watch dog timers – Real Time Clock – Multitasking – Bus Control – Memory Timing – External ROM and RAM expansion – PWM control – A/D interfacing

Case Study For 8051 and 8096

Real Time clock – DC Motor Speed Control – Generation of Gating Signals for Converters and Inverters – Frequency Measurement – Temperature Control

Text Book(s):

1	John B.Peatman, “Design with Micro controllers”, McGraw Hill international Limited, Singapore, 1989.
2	Michael Slater, “Microprocessor based design A comprehensive guide to effective Hardware design” Prentice Hall, New Jersey, 2001

Reference(s):

1	Ayala, Kenneth, “The 8051 Microcontroller” Upper Saddle River, New Jersey Prentice Hall, 2009.
2	Intel Manual on 16 bit embedded controllers, Santa Clara, 1991.
3	Muhammad Ali Mazidi, Janice Gillispie mazidi. “The 8051 Microcontroller and Embedded systems”, Person Education, 2008.

K.S.Rangasamy College of Technology - Autonomous								
Department	Mechanical Engineering			Programme Code & Name		PED : M.E. Engineering Design		
Elective V								
40 PED E55 Enterprise Resource Planning								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100
Objective(s)	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 products in the area of ERP and to appreciate the current and future trends in ERP							

Introduction

Principle – ERP framework – Business Blue Print – Business Engineering vs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models.

Technology and Architecture

Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.

ERP System Packages

SAP, People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organizational and social issues.

Application and Training

Overview – Architecture – AIM – applications – Oracle SCM. SAP: Overview – Architecture – applications - Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET.

ERP Procurement Issues

Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.

Text Book(s):

1	Sadagopan.S , “ERP-A Managerial Perspective”, Tata Mcgraw Hill, 2013.
2	Jose Antonio Fernandez, “The SAP R/3 Handbook”, Tata Mcgraw Hill, 2013
3	Vinod Kumar Crag and Venkitakrishnan N.K. , “Enterprise Resource Planning – Concepts and Practice”, Prentice Hall of India, 1998

Reference(s):

1	Garg & Venkitakrishnan “ERPWARE ERP Implementation Framework”, , Prentice Hall, 1999.
2	Thomas E Vollmann and Bery Whybark , “Manufacturing and Control Systems”, Galgothia Publications, 1998.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2014
Department	Mechanical Engineering		Programme Code & Name		PED : M.E. Engineering Design			
Elective VI								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
40 PED E61	**Machinability of Materials**	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on Tool nomenclature, Tool wear and tool life. to understand the basic concepts of machinability of ferrous and Non ferrous materials so as to identify and select suitable materials for various applications.							

Fundamentals of Machining Process

Orthogonal and oblique cutting – Mechanics of chip formation – Forces, power and stresses in machining – surface finish and surface integrity – Tool nomenclature Tool wear and tool life.

Cutting Tool Materials and Cutting Fluids

High speed tool steels – Cemented carbides – Cermets – Ceramics – CBN – PCD – coated tools – Properties, Applications and limitations of tool materials – Metal cutting and grinding fluids – Water soluble – semi-synthetic and synthetic fluids

Ferrous Materials

Machinability test methods – machinability ratings - Machinability of cast irons and Nickel alloys – Machinability of plain carbon steels, alloy steels, stainless steels recommended tool geometry and machining parameters.

Non Ferrous Materials

Machinability of aluminium and aluminium silicon alloys – Machinability of copper base alloys, brass and bronze - Machinability of Titanium alloys.

Nonconventional Machining Process

Abrasive Machining – Water Jet Machining- Abrasive Water Jet Machining – Chemical Machining. (AJM, WJM,AWJM and CHM).Working Principles –Applications.

Text book (s) :

1	Winston A Knight and Boothroyd G, Fundamentals of Metal Machining and Machine Tools, 3rd Edition, 2005, Marcel Dekker

Reference(s) :

1	Edward M.Trent and Paul K.Wright,Metal Cutting,4th Edition,2010,Elsevier India Private Ltd
2	Milton C.Shaw, Metal Cutting Principles, 2003, CBS Publishers & Distributors.
3	Vijay.K.Jain “Advanced Machining Process “Allied Publishers Pvt.Ltd.,New Delhi,2007
4	David A Stephenson and John S Agapiou, “Metal Cutting Theory and Practice”,(2nd Edition), Marcel Dekker,2010
5	Graham T Smith, Cutting Tool Technology – Industrial Handbook, 2008, Springer

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective VI

40 PED E62 Advanced Tool Design

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To Impart knowledge on Tool design methods, Tooling materials and Heat Treatment design of drill jigs, design of fixtures and dies and tool design for NC machine.

Tool-Design Methods

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 – Electro-discharge machining for cavity.

Tooling Materials and Heat Treatment

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

Design of Drill Jigs

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

Design of Fixtures And Dies

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.

Tool Design for Numerically Controlled Machine

Introduction – The need for numerical control – A basic explanation of numeric control –Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – 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

Text Book(s):

1	Donaldson, Cyrll., LeCain, George H. and Goold, V.C., “Tool Design”, Tata McGraw- Hill, New York, 2013.
2	Joshi, Prakash Hiralal., “Tooling Data”, Wheeler Publishing, Allagabad, 2013.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective VI

40 PED E63 Productivity Management and Re-Engineering

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To Integrate the concepts of productivity models, organizational transformation, Reengineering process, Re-engineering tools and Implementation.

Introduction

Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle.

Productivity Models

Productivity measurement at International, National and Organizational level, Total productivity models. Productivity management in manufacturing and service sector. Productivity evaluation models, Productivity improvement models and techniques.

Organizational Transformation

Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the workforce for transformation and reengineering, methodology, guidelines, DSMCQ and PMP model

Re-Engineering Process Improvement Models

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

Re-Engineering Tools and Implementation

Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE-opportunities, process redesign - cases. Software methods in BPR - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability

Text Book(s):

1	Sumanth, D.J., "Productivity Engineering and Management", Tata Mc Graw Hill, New Delhi, 1990.
2	Edosomwan, J.A.,“Organizational Transformation and Process Re-Engineering", British Library cataloguing in pub. Data, 1996.

Reference(s):

1	Rastogi, P.N. “Re-Engineering and Re-inventing the Enterprise ", Wheeler pub. New Delhi, 1996.
2	Premvrat, Sardana, G.D. and Sahay, B.S, “Productivity Management - A Systems Approach", Narosa Publishers, New Delhi, 1998.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective VI

40 PED E64 Advances in Casting and Welding Processes

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To study the metallurgical concepts and applications of casting and welding process. To acquire knowledge in CAD of casting and automation of welding process.

Casting Design

Heat transfer between metal and mould –Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

Casting Metallurgy

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

Recent Trends in Casting and Foundry Layout

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry – Computer aided design of casting.

Welding Metallurgy and Design

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

Recent Trends in Welding

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag weldingnarrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

Text Book(s):

1	Parmer R.S., Welding Engineering and Technology, Khanna Publishers, 2002.
2	Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd.6thEdition, 2004
3	CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 2011.

Reference(s):

1	ASM Handbook, Vol 15, Casting, 2011.
2	ASM Handbook vol.6, welding Brazing & Soldering, 2003.
3	Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002.
4	Heineloper & Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2005.
5	Jain P.L., Principles of Foundry Technology,Tata McGrawHill Publishers, 2013.

K.S.Rangasamy College of Technology - Autonomous			
Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective VI

40 PED E65 Quality Concepts in Design

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	To study about robust design, embodiment principles, various methods in design of experiments, reliability charts and histograms and six sigma techniques.

Design for Quality

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –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.

Failure Mode Effect Analysis

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.

Design of Experiments

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 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.

Statistical Consideration and Reliability

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

Design for Six Sigma

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

Text Book(s):

1	Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2007.
2	Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA Mc GRAW-HILL- 4th Edition, 2012

Reference(s):

1	Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001
2	The Management and control of Quality-8th edition-James R. Evens, William M Lindsay Pub:son southwestern,2010.

K.S.Rangasamy College of Technology - Autonomous								
40 PED 3P1 Project Work - Phase I								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	12	45	5	50	50	100
Objective(s)	To import the practical knowledge to the students and also to make them to carry out the technical procedures in their project work. To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work and placing this as their beginning stage for their final presentation.							

Methodology

- Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide
- Problem should be selected
- Students have to collect about 20 papers related to their work
- Report has to be prepared by the students as per the format.
- Preliminary implementation can be done if possible
- Internal evaluation has to be done for 100marks

K.S.Rangasamy College of Technology – Autonomous

40 PED 4P1 Project Work - Phase II

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	40	45	15	50	50	100

Objective(s)	This enables and strengthens the students to carryout the project on their own and to implement their innovative ideas to forefront the risk issues and to retrieve the hazards by adopting suitable assessment methodologies and staring it to global.

Methodology

- Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide
- Each review has to be evaluated for 100 marks
- Attendance is compulsory for all reviews.
- They should publish the paper preferably in the journals/conferences
- Final review will be done by the committee that consists of minimum of three members one of which should be the guide(If possible include one external expert examiner within the college)