K.S. Rangasamy College of Technology

(Autonomous Institution)

Curriculum & Syllabus

of

M.E. Computer Aided Design
&
M.E. Engineering Design

(For the batches admitted in 2010-11 onwards)

R 2010

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 2010							
Department	Department of Mechanical Engineering							
Programme Code & Name	PCA : M.E. Computer Aided Design							
Semester I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
	THEORY							
10 PCA 101	Advanced Mathematics (PED, PCA)	3	1	0	4	50	50	100
10 PCA 102	Computer Applications in Design (PED, PCA)	3	0	0	3	50	50	100
10 PCA 103	Finite Element Analysis (PED, PCA)	3	1	0	4	50	50	100
10 PCA 104	Concepts of Engineering Design (PED, PCA)	3	0	0	3	50	50	100
10 PCA 105	Engineering System Dynamics	3	1	0	4	50	50	100
10 PCA E**	Elective I	3	0	0	3	50	50	100
	PRACTICAL							
10 PCA 106	CAD Laboratory (PED, PCA)	0	0	3	2	50	50	100
10 PCA 107	Computer Aided Analysis Laboratory I (PED, PCA)	0	0	3	2	50	50	100
	Total	18	3	6	25	800		
Semester II								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
	THEORY							
10 PCA 201	Mechanical Vibrations (PED, PCA)	3	1	0	4	50	50	100
10 PCA 202	Product Design And Development (PED, PCA)	3	0	0	3	50	50	100
10 PCA 203	Integrated Mechanical Design	3	1	0	4	50	50	100
10 PCA 204	Metallic Materials and Manufacturing Process	3	0	0	3	50	50	100
10 PCA E**	Elective II	3	0	0	3	50	50	100
10 PCA E**	Elective III	3	0	0	3	50	50	100
	PRACTICAL							
10 PCA 205	Computer Aided Analysis Laboratory II (PED, PCA)	0	0	3	2	50	50	100
10 PCA 206	Technical Report Preparation and Presentation	0	0	2	0	100	00	100
	Total	18	2	5	22	800		

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Curriculum for the programmes under Autonomous Scheme								
Regulation	R 2010							
Department	Department of Mechanical Engineering							
Programme Code & Name	PCA : M.E. Computer Aided Design							
Semester III								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
	THEORY							
10 PCA E**	Elective IV	3	0	0	3	50	50	100
10 PCA E**	Elective V	3	0	0	3	50	50	100
10 PCA E**	Elective VI	3	0	0	3	50	50	100
	PRACTICAL							
10 PCA 301	Project Work - Phase I	0	0	12	2	100	00	100
	Total	9	0	12	11	400		
Semester IV								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
	PRACTICAL							
10 PCA 401	Project Work - Phase II	0	0	40	10	50	50	100
	Total	0	0	40	10	100		

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Curriculum for the programmes under Autonomous Scheme								
Regulation	R 2010							
Department	Department of Mechanical Engineering							
Programme Code & Name	PCA : M.E. Computer Aided Design							
List of Electives								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
Electives								
10 PCA E01	Advanced Finite Element Analysis	3	0	0	3	50	50	100
10 PCA E02	Optimization Techniques in Design	3	0	0	3	50	50	100
10 PCA E03	Tribology in Design	3	0	0	3	50	50	100
10 PCA E04	Advanced Strength of Materials	3	0	0	3	50	50	100
10 PCA E05	Product Data Management	3	0	0	3	50	50	100
10 PCA E06	Design of Hydraulic and Pneumatic Systems	3	0	0	3	50	50	100
10 PCA E07	Applied Engineering Acoustics	3	0	0	3	50	50	100
10 PCA E08	Advanced Tool Design	3	0	0	3	50	50	100
10 PCA E09	Micro Electro Mechanical Systems Design	3	0	0	3	50	50	100
10 PCA E10	Mechanics of Composite Materials	3	0	0	3	50	50	100
10 PCA E11	Rapid Prototyping and Tooling	3	0	0	3	50	50	100
10 PCA E12	Mechanics of Fracture	3	0	0	3	50	50	100
10 PCA E13	Applied Object Oriented Programming	3	0	0	3	50	50	100
10 PCA E14	Design of Material Handling Equipments	3	0	0	3	50	50	100
10 PCA E15	Measurement Techniques	3	0	0	3	50	50	100
10 PCA E16	Vibration Condition Monitoring	3	0	0	3	50	50	100
10 PCA E17	Composite Materials and its Mechanics	3	0	0	3	50	50	100
10 PCA E18	Modal Analysis of Mechanical Systems	3	0	0	3	50	50	100
10 PCA E19	Integrated Manufacturing Systems	3	0	0	3	50	50	100
10 PCA E20	Theory of Plates and Shells	3	0	0	3	50	50	100
10 PCA E21	Design of Heat Exchangers	3	0	0	3	50	50	100
10 PCA E22	Bearing Design and Rotor Dynamics	3	0	0	3	50	50	100
10 PCA E23	Computational Fluid Dynamics	3	0	0	3	50	50	100
10 PCA E24	Productivity Management and Re-Engineering	3	0	0	3	50	50	100
10 PCA E25	Mechatronics in Manufacturing Systems	3	0	0	3	50	50	100
10 PCA E26	Industrial Robotics	3	0	0	3	50	50	100
10 PCA E27	Creativity in Design	3	0	0	3	50	50	100
10 PCA E28	Enterprise Resource Planning	3	0	0	3	50	50	100

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="4">PCA : M.E. Computer Aided Design</td></tr>
<tr><td colspan="9">Semester I</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>10 PCA 101</td><td colspan="2">ADVANCED MATHEMATICS (PED, PCA)</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">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, Solve BVP be the method of finite differences and Rayleigh Ritz methods and solve numerically partial differential equations of parabolic, elliptic and hyperbolic types with appropriate boundary and initial conditions encountered in engineering design.</td></tr>
<tr><td>1</td><td colspan="5">SIMULTANEOUS EQUATIONS AND NUMERICAL INTEGRATION</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Simultaneous Equations: Gauss elimination method-Choleski scheme- Gauss seidel method-relaxation method. Numerical Integration: Trepezoidal rule and simpson's 1/3 and 3/8 th rules-Weddle's rule.</td></tr>
<tr><td>2</td><td colspan="5">BOUNDARY & CHARACTERISTIC VALUE PROBLEMS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">BVP Solution through finite differences of second order BVP - Derivative boundary conditions - CVP Finding eigenvalues / vectors by characteristic polynomial method – Jacobi method – power method.</td></tr>
<tr><td>3</td><td colspan="5">CALCULUS OF VARIATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Extremum of functionals involving one unknown function- several unknown functions-functional dependant on higher order derivatives- several independent variables- Isoperimetric problems. Rayleigh Ritz method.</td></tr>
<tr><td>4</td><td colspan="5">ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Finite difference expressions for partial derivatives – Laplace's equation – Liebmann method – derivative boundary conditions- Poisson equation.</td></tr>
<tr><td>5</td><td colspan="5">PARABOLIC AND HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td>60</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Rajasekaran.S "Numerical method in Science and Engineering" – Wheeler Publishing, 1999, Second edition.</td></tr>
<tr><td>2</td><td colspan="8">M.K.Venkatraman, Higher mathematics for engineering and Science; National Publishing company, 2000.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Douglas J Faires and Riched Burden, "Numerical Methods" Brooks / Cole Publishing Company, 1998, second edition.</td></tr>
<tr><td>2</td><td colspan="8">John H Mathews and Kurtis D Fink, "Numerical Methods using MATLAB", Prentice Hall, 1998.</td></tr>
<tr><td>3</td><td colspan="8">Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Brooks/Cole Publishing Company, Fourth Edition, 1999.</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 102	COMPUTER APPLICATIONS IN DESIGN (PED, PCA)	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on parametric sketching, data exchange formats, use of computers in design, to learn softwares like Lisp, visual basic in designing mechanical components and to develop the students ability to utilize the computers for managing product design data.							

1	INTRODUCTION TO COMPUTER APPLICATIONS IN NEW PRODUCT DESIGN	Total Hrs	9
Concept design – Parametric sketching – Constraints – Computer graphics principles-2D transformation, Scaling, Rotation – Windowing, View ports – Clipping – Data exchange formats.			
2	COMPUTERS IN DESIGN	Total Hrs	9
Solid modeling of Mechanical components – Associative features – Sheet metal components, Nesting and development – Plastic parts with draft and shrinkage allowance – Reverse engineering of components – Assembly of parts – Tolerance analysis – Mass property calculations.			
3	COMPUTERS IN TOOLING DESIGN	Total Hrs	9
Mould design – Jigs and fixtures design – Check for interferences – Mechanism design and analysis – Rapid tooling			
4	COMPUTERS IN DESIGN PRODUCTIVITY	Total Hrs	9
Customizing various software by using visual basic, pro/program, script, LISP etc to write applications like design of shafts, gears etc.,			
5	MANAGING PRODUCT DESIGN DATA	Total Hrs	9
Version control – Library creation – Catalog making – Standardization for design –Collaborative design among peer groups – Design optimization for geometry – Design check, approval and validation.			
Total hours to be taught			45

Text book (s) :

1	William M. Neumann and Robert Sproul “Principles of Computer Graphics” McGraw Hill Book Co. Singapore, 1989.
2	Ibrahim Zeid “CAD/CAM – Theory and Practice” – McGraw Hill, International Edition 1998.

Reference(s) :

1	P N Rao “CAD/CAM: Principles and Applications” Tata McGraw Hill, Second Edition. 2004.
2	Schlechtendahl, E. G, CAD – Data transfer for Solid Models, Springer Verlag,Berlin, 1989.
3	Donald Hearn and M Pauline Baker “Computer Graphics” Prentice Hall Inc1992.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering			Programme Code & Name		PCA : M.E. Computer Aided Design		
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 103	FINITE ELEMENT ANALYSIS (PED, PCA)	3	1	0	4	50	50	100
Objective(s)	To teach students the concepts in finite element method as related to solving engineering problems and working knowledge of computer-aided engineering analysis tools and their use in design.							
1	INTRODUCTION & ONE-DIMENSIONAL PROBLEMS				Total Hrs	12		
Relevance of finite element analysis in design - Variational principles and methods –Weighted-Integral statements – Weak formulations – Ritz method – Method of weighted residuals Applications of FEA - Finite element modeling – Co-ordinates and shape functions – Potential energy approach – Galerkin's approach – One dimensional finite element models in Solid mechanics and Heat transfer – Finite element model for beams.								
2	TWO-DIMENSIONAL PROBLEMS				Total Hrs	12		
Poisson equation – Laplace equation – Weak form – Element matrices for triangular and rectangular elements – Evaluation of integrals – Assembly – Axi-symmetric problems – Applications – Conduction and convection heat transfer – Torsional cylindrical member – Transient analysis - Theory of elasticity – Plane strain – Planestress – Axi-symmetric problems – Principle of virtual displacement.								
3	ISOPARAMETRIC ELEMENTS				Total Hrs	12		
Introduction – Bilinear quadrilateral elements – Quadratic quadrilaterals –Hexahedral elements - Numerical integration – Gauss quadrature – Static condensation – Load considerations – Stress calculations – Examples of 2D and 3D applications.								
4	STRUCTURAL DYNAMICS APPLICATIONS				Total Hrs	12		
Dynamic equations – Mass and damping matrices – Natural frequencies and modes– Reduction of number of DOF-response history – Model methods – Ritz vectors –Component mode synthesis – Harmonic response – Direct integration techniques –Explicit and implicit methods – Analysis by response spectra – Example problems.								
5	NON-LINEAR PROBLEMS & ERROR ESTIMATES				Total Hrs	12		
Introduction – Material non-linearity – Elasto Plasticity – Plasticity – Visco plasticity –Geometric non-linearity – Large displacement – Error norms and convergence rates– H-refinement with adaptivity – adaptive refinement.								
Total hours to be taught						60		
Text book (s) :								
1	Reddy J.N., "An Introduction to the Finite Element Method", McGraw Hill,International Edition, 1993.							
2	Logan D.L, "A First Course in the Finite Element Method", Third Edition,Thomson Learning, 2002.							
Reference(s) :								
1	Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis", Wiley, John & Sons 1999.							
2	Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984.							
3	S.S.Rao, "Finite Element Analysis", 2002 Edition.							
4	Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics Services, 1991.							
5	Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1990.							

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering			Programme Code & Name		PCA : M.E. Computer Aided Design		
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 104	CONCEPTS OF ENGINEERING DESIGN (PED, PCA)	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.							

1	THE DESIGN PROCESS	Total Hrs	9
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.			
2	TOOLS IN ENGINEERING DESIGN	Total Hrs	9
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.			
3	MATERIAL SELECTION AND MATERIALS IN DESIGN	Total Hrs	9
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.			
4	MATERIAL PROCESSING AND DESIGN	Total Hrs	9
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.			
5	LEGAL, ETHICAL ENVIRONMENTAL AND SAFETY ISSUES IN DESIGN AND QUALITY ENGINEERING	Total Hrs	9
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	Dieter, George E, Engineering Design –“A materials and processing Approach,”.Mc Graw Hill, International Edition, Singapore 2000.
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” Springr – 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 2010
Department	Mechanical Engineering	Programme Code & Name	PCA : M.E. Computer Aided Design

Semester I

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 105	ENGINEERING SYSTEM DYNAMICS	3	1	0	4	50	50	100

Objective(s)	To Impart knowledge on control System, system representation performance and stability of feedback systems to the student.

1	INTRODUCTION	Total Hrs	12

Introduction – Dynamic system classification, Analysis and Design of Dynamic system, Mathematical modeling of Dynamic systems – Mechanical systems – Electrical systems, Electromechanical Systems – Fluid & Thermal system, Review of vibration of single degree, Two degree freedom systems, Review of matrix algebra and Laplace Transforms.

2	INTRODUCTION TO CONTROL SYSTEMS	Total Hrs	12

Introduction – Control systems – Control system configurations – Control system Terminology – Control system classes – Feedback systems – Analysis of Feedback – Historical Developments of control systems – Control system analysis and Design Objectives.

3	SYSTEM REPRESENTATION	Total Hrs	12

Introduction – Block Diagrams – Block Diagrams Representation – Block Diagram Reduction – Signal flow graphs – Signal flow graph algebra – Mason's Gain formula – Zeros and Additional poles.

4	PERFORMANCE AND STABILITY OF FEEDBACK SYSTEMS	Total Hrs	12

Introduction – Properties of feedback – Transient response specifications – Controller types and actions – Stability of control systems – Routh-Hurwitz criterion – Steady state error – Control system types.

5	ANALYSIS OF CONTROL SYSTEMS	Total Hrs	12

Introduction – analysis of control systems – Root-Locus analysis – Bode analysis – Nyquist analysis - Nyquist stability criterion – Nichols chart analysis – Frequency Domain specifications

Total hours to be taught	60

Text book (s) :

1	Rao.V.Dukkipati, 'Engineering system Dynamics', Narosa Publishing House, New Delhi. 2004.
2	Benjamin C.Kuo, '- Automatic Control systems', Prentice-Hall of India Pvt. Ltd., New Delhi 1995.

Reference(s) :

1	Thomson W.T., 'Theory of Vibration with Applications', CBS Publishers and Distributors, New Delhi.1990.

K.S.Rangasamy College of Technology - Autonomous Regulation			R 2010
Department	Mechanical Engineering	Programme Code & Name	PCA : M.E. Computer Aided Design

Semester I

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 106	CAD LABORATORY (PED, PCA)	0	0	3	2	50	50	100
Objective(s)	To develop the students in solid modeling, sheet metal and mechanism design of mechanical components and to develop the students in feature based packages like pro-E, solid works etc..							

1. Part diagrams of Mechanical parts
2. Part diagram of screw threads.
3. Part and Assembly of Flange Coupling
4. Part and Assembly of Universal Coupling
5. Part and Assembly of Bushed Bearing
6. Part and Assembly of Knuckle Joint
7. Part and Assembly of Plummer Block
8. Part and Assembly of Connecting rod
9. Part and Assembly of Screw Jack
10. Part and Assembly of Pipe Vice
11. Part and Assembly of Piston
12. Part and Assembly of Stuffing box
13. Part and Assembly of Machine Vice
14. Part and Assembly of Swivel bearing

Total Hrs	45

K.S.Rangasamy College of Technology - Autonomous Regulation			R 2010
Department	Mechanical Engineering	Programme Code & Name	PCA : M.E. Computer Aided Design

Semester I

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 107	COMPUTER AIDED ANALYSIS LABORATORY I (PED, PCA)	0	0	3	2	50	50	100

Objective(s)	To develop the students to perform Structural Analysis of beams, trusses ,plate and spring, Steady state and transient heat transfer analysis of plate and slab, fluid flow analysis in pipe using analysis software.(Ansys, Nastran etc)

1. Analysis of stepped rod with axial load.
2. Analysis of Plane truss member.
3. Analysis of cantilever beam with point load and UDL.
4. Analysis of simply supported beam with point load and UDL.
5. Analysis of I-section beam.
6. Analysis of spring system.
7. Stress analysis of corner bracket (Plane stress).
8. Analysis of circular pipe (Axi-symmetric).
9. Heat conduction in 2D plate.(steady state)
10. Heat convection in 2D plate. (steady state)
11. Transient heat transfer analysis in slab
12. Flow analysis in 2 channel pipe.

Total Hrs	45

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="3">PCA : M.E. Computer Aided Design</td></tr>
<tr><td colspan="8">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="2">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>10 PCA 201</td><td colspan="2">MECHANICAL VIBRATIONS (PED, PCA)</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">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.</td></tr>
<tr><td>1</td><td colspan="4">FUNDAMENTALS OF VIBRATION</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>2</td><td colspan="4">TWO DEGREE-OF-FREEDOM SYSTEMS</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">Free vibration of spring-coupled system – Mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation</td></tr>
<tr><td>3</td><td colspan="4">MULTI DEGREE-OF-FREEDOM SYSTEMS</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>4</td><td colspan="4">VIBRATION OF CONTINUOUS SYSTEMS</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>5</td><td colspan="4">EXPERIMENTAL METHODS IN VIBRATION ANALYSIS</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">Vibration instruments – Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.</td></tr>
<tr><td colspan="6">Total hours to be taught</td><td colspan="2">60</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Thomson, W.T., “Theory of Vibration with Applications”, CBS Publishers and Distributors, New Delhi, 1990.</td></tr>
<tr><td>2</td><td colspan="7">Rao, J.S. and Gupta, K., “Introductory Course on Theory and Practice Mechanical Vibration”, New Age International (P) Ltd., New Delhi, 1999.</td></tr>
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<tr><td>2</td><td colspan="7">Rao, S.S., “Mechanical Vibrations”, Addison Wesley Longman, New York, 1995.</td></tr>
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K.S.Rangasamy College of Technology - Autonomous Regulation			R 2010
Department	Mechanical Engineering	Programme Code & Name	32: M.E. Computer Aided Design

Semester II

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 202	PRODUCT DESIGN AND DEVELOPMENT (PED, PCA)	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on product development process and challenges in product development, product planning, product specifications, concept selection and product architecture.							

1	INTRODUCTION	Total Hrs	9

Characteristics of Successful Product Development-Interdisciplinary activity-Duration and Costs of Product Development- Challenges of Product Development –Development Processes and Organizations-A Generic Development Process-Concept Development: The Front-End Process Adapting the Generic Product Development Process- The AMF Development Process-Product Development Organizations-The AMF Organization.

2	PRODUCT PLANNING	Total Hrs	9

Product Planning Process- Identifying Opportunities- Evaluating and Prioritizing Projects- Allocating Resources and Timing- Pre-Project Planning-Reflect on the Results and the Process-Identifying Customer Needs- Raw Data from Customers- Interpreting Raw Data in Terms of Customer Needs-Organizing the Needs into a Hierarchy-Establishing the Relative Importance of the Needs-Reflecting on the Results and the Process.

3	PRODUCT SPECIFICATIONS	Total Hrs	9

Product specifications- Stages of Specifications -Establishing Target Specifications- Setting the Final Specifications-Concept Generation-The Activity of Concept Generation-The steps in concept generation method.

4	CONCEPT SELECTION	Total Hrs	9

Concept Selection- Overview of Methodology-Concept Screening-Concept Testing- Defining the Purpose of the Concept Test- Choosing a Survey Population- Choosing a Survey Format- Communicating the Concept-Measuring Customer Response- Interpreting the Results- Reflecting on the Results and the Process.

5	PRODUCT ARCHITECTURE	Total Hrs	9

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	Ulrich, Karl T. and Eppinger, Steven D., “Product Design and Development”, McGraw–Hill, New York, 1999.
2	Otto, Kevien and Wood, Kristin, “Product Design” Pearson Publication, New Delhi, 2004.

Reference(s) :

1	Rosenthal, Stephen, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992.
2	Stuart Pugh., “Tool Design – Integrated Methods for successful Product Engineering”, Addison Wesley Publishing, New York, 1991.
3	Kemnneth Crow., “Concurrent Engineering / Integrated Product Development”, DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274 (310) 377-569, Workshop Book.

K.S.Rangasamy College of Technology - Autonomous Regulation			R 2010
Department	Mechanical Engineering	Programme Code & Name	PCA : M.E. Computer Aided Design

Semester II

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 203	INTEGRATED MECHANICAL DESIGN	3	1	0	4	50	50	100

Objective(s)	(Use of Approved Data Book is Permitted) To Teach students the concepts of Integrated Mechanical Design as related to solving engineering problems.

1	INTRODUCTION	Total Hrs	12

Phases of design – Standardization and interchangeability of machine elements - Tolerances from process and function – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration.

2	SHAFTING	Total Hrs	12

Analysis and Design of shafts for different applications – detailed design – preparation of production drawings – integrated design of shaft, bearing and casing – design for rigidity.

3	GEARS AND GEAR BOXES	Total Hrs	12

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

4	CLUTCHES	Total Hrs	12

Integrated design of - Automobile clutches.

5	BRAKES	Total Hrs	12

Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, Automobiles and mechanical handling equipments.

Total hours to be taught	60

Text book (s) :

1	Shigley, J.E., “Mechanical Engineering Design”, McGraw Hill, 1986.
2	Lingaiah. K. and Narayana Iyengar, “Machine Design Data Hand Book”, Vol. 1 & 2, Suma Publishers, Bangalore, 1983.

Reference(s) :

1	Newcomb, T.P. and Spur, R.T., “- Automobile Brakes and Braking Systems”, Chapman and Hall, 2nd Edition, 1975.
2	Juvinall, RL.C., “Fundamentals of Machine Component Design”, John Wiley, 1983.
3	Maitra G.M., “Hand Book of Gear Design”, Tata McGraw Hill, 1985.
4	Prasad. L. V., “Machine Design”, Tata McGraw Hill, New Delhi, 1992.
5	Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="2">Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="3">PCA : M.E. Computer Aided Design</td></tr>
<tr><td colspan="9">Semester II</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" 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 colspan="2">10 PCA 204</td><td colspan="2">METALLIC MATERIALS AND MANUFACTURING PROCESS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To impart knowledge on types of materials, manufacturing methods& assembly of components.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Factors for mechanical, electrical and thermal properties – Dimensional geometrical tolerances – selection of materials.</td></tr>
<tr><td>2</td><td colspan="5">TYPES OF MATERIALS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Ferrous – Ferrous Alloys, steel, stainless steel, etc. – Non-ferrous, Aluminum, Copper, etc. – Non ferrous alloys, Brass, Gun Metal, etc. – Material Cost – Cost usage ratio.</td></tr>
<tr><td>3</td><td colspan="5">MANUFACTURING METHODS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Metal extrusion, metal stamping, fine blanking, four slide metal parts, cold headed parts, extruded parts, tube and section bends, rolled formed parts, power metal parts forging electro forming parts specialized forming methods, turned parts, machined round holes, drilled parts, milled parts, planned shaped and slotted parts, screw threaded contoured and internal ground parts, center less ground, electrical discharged, roller furnished parts, electro chemical and advanced machined parts. Sand cast, die cast, investment cast and other cast products.– HERF Process – Machined components – conventional, non-conventional.</td></tr>
<tr><td>4</td><td colspan="5">ASSEMBLY OF COMPONENTS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Press fitting – riveting – screwing – flanged connections - welded parts – electric arc – gas welding – brazing – soldering – advanced techniques – PCB.</td></tr>
<tr><td>5</td><td colspan="5">CAST STUDIES</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Design for minimum cost, material and process</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Dieter G.E., “Mechanical Metallurgy”, McGraw Hill, 1987.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Kenneth G. Budingski, “Surface Engineering for wear Resistance”, Prentice Hall, 1988.</td></tr>
<tr><td>2</td><td colspan="8">Zakharove B., “Heat Treatment of Metals”, Peace Publications, 1962.</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation			R 2010
Department	Mechanical Engineering	Programme Code & Name	PCA : M.E. Computer Aided Design
Semester II			

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 205	COMPUTER AIDED ANALYSIS LABORATORY II (PED, PCA)	0	0	3	2	50	50	100
Objective(s)	To develop the students to perform Design optimization, Buckling, Modal, Transient and Harmonic, Explicit, Non linear analysis, Heat transfer analysis of composite wall and fin, Fluid flow analysis in duct and flat plate using analysis software. .(Ansys, Nastran etc)							

1. Design optimization of cantilever beam.
2. Solid model creation.
3. Buckling analysis of gear shift rod.
4. Modal analysis of cantilever beam.
5. Transient analysis of cantilever beam.
6. Harmonic analysis of cantilever beam.
7. Drop test analysis of Aluminum container on steel plate.
8. Non linear contact analysis
9. Heat transfer analysis in composite wall
10. Heat transfer analysis in automobile fin.
11. Air flow in 2D duct.
12. Flow over a flat plate.

Total Hrs	45

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<tr><td colspan="8">Semester II</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>10 PCA 206</td><td>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="7">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="7">• 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="10">Execution</td><td>Week</td><td colspan="6">Activity</td></tr>
<tr><td>I</td><td colspan="6">Allotment of Faculty Guide by the HoD</td></tr>
<tr><td>II</td><td colspan="6">Finalizing the topic with the approval of Faculty Guide</td></tr>
<tr><td>III-IV</td><td colspan="6">Collection of Technical papers</td></tr>
<tr><td>V-VI</td><td colspan="6">Mid semester presentation</td></tr>
<tr><td>VII-VIII</td><td colspan="6">Report writing</td></tr>
<tr><td>IX</td><td colspan="6">Report submission</td></tr>
<tr><td>X-XI</td><td colspan="6">Final presentation</td></tr>
<tr><td rowspan="7">Evaluation</td><td colspan="7">❖ 100% by Continuous Assessment
❖ 2 Hrs/week</td></tr>
<tr><td colspan="5">Component</td><td colspan="2">Weightage</td></tr>
<tr><td colspan="5">Phase -I Presentation</td><td colspan="2">25 %</td></tr>
<tr><td colspan="5">Phase - II Presentation</td><td colspan="2">25 %</td></tr>
<tr><td colspan="5">Report Preparation and Submission</td><td colspan="2">30 %</td></tr>
<tr><td colspan="5">Final Presentation</td><td colspan="2">20 %</td></tr>
<tr><td colspan="5">Total</td><td colspan="2">100 %</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation			R 2010
Department	Mechanical Engineering	Programme Code & Name	PCA : M.E. Computer Aided Design

Semester III

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA 301	PROJECT WORK - PHASE I	0	0	12	2	100	00	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 as given below • Preliminary implementation can be done if possible • Internal evaluation has to be done for 100marks

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<tr><td colspan="9">Semester IV</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>10 PCA 401</td><td>PROJECT WORK - PHASE II</td><td>0</td><td>0</td><td>40</td><td>10</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">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.</td></tr>
<tr><td>Methodology</td><td colspan="8">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 fro 100 marks
Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or more chance may be given
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 with in the college)
The report should be submitted by the students around at the end of may</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E01	ADVANCED FINITE ELEMENT ANALYSIS	3	0	0	3	50	50	100
Objective(s)	To Teach students the concepts in finite element method as related to solving engineering problems involving fluid mechanics, linear and non-linear. To provide students with a working knowledge of computer-aided engineering analysis tools and their use in design.							

1	BENDING OF PLATES AND SHELLS	Total Hrs	9
Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non Conforming Elements – C_0 and C_1 Continuity Elements – Application and Examples.			
2	NON-LINEAR PROBLEMS	Total Hrs	9
Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity –Visco Plasticity – Geometric Non linearity – large displacement Formulation – Application in Metal Forming Process and Contact Problems.			
3	DYNAMIC PROBLEM	Total Hrs	9
Direct Formulation – Free, Transient and Forced Response – Solution Procedures –Subspace Iterative Technique – Houbolt, Wilson, Newmark – Methods – Examples.			
4	FLUID MECHANICS AND HEAT TRANSFER	Total Hrs	9
Governing Equations of Fluid Mechanics – Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming – Navier Stokes Equation – Steady and Transient Solution.			
5	ERROR ESTIMATES AND ADAPTIVE REFINEMENT	Total Hrs	9
Error norms and Convergence rates – h-refinement with adaptivity – Adaptive refinement.			
Total hours to be taught			45

Text book (s) :

1	Cook, R.D., “Concepts and Applications of Finite Element Analysis”, Wiley India Pvt Ltd., Fourth Edition, 2007.
2	Tirupathi R Chandrupatla, T R Chandrupatla, Ashok D Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall, Third Edition, 2002

Reference(s) :

1	Bathe, K.J., “Finite Element Procedures in Engineering Analysis”, Prentice Hall, New Jersey, 1990.
2	S.S.Rao, “Finite Element Analysis”, Elesevier, Fourth Edition, 2005.
3	Logan D.L, “A First Course in the Finite Element Method”, Third Edition, Thomson Learning, 2002.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E02	OPTIMIZATION TECHNIQUES IN DESIGN	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on static, dynamic constrained and unconstrained optimization techniques in design.							

1	INTRODUCTION	Total Hrs	9
General Characteristics of mechanical elements - Adequate and Optimum design - Principles of optimization - Formulation of objective function - Design constraints – Classification of optimization problem.			
2	UNCONSTRAINED OPTIMIZATION	Total Hrs	9
Single variable and Multivariable optimization- Techniques of unconstrained minimization – Golden section, Pattern and Gradient search methods – Interpolation methods.			
3	CONSTRAINED OPTIMIZATION	Total Hrs	9
Optimization with equality and inequality constraints - Indirect methods using penalty functions - Lagrange multipliers - Geometric programming - Constrained, mixed inequality and unconstrained minimization - Genetic algorithms.			
4	STATIC APPLICATIONS	Total Hrs	9
Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, maximum weight – Design of shafts and torsionally loaded members – Design of springs.			
5	DYNAMIC APPLICATIONS	Total Hrs	9
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	Singiresu S.Rao., “Engineering Optimization Theory and Practice”, New Age International (P) Limited, Publishers 1996.
2	Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 1990.

Reference(s) :

1	Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 1995.
2	Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison-Wesley, New York, 1989.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E03	TRIBOLOGY IN DESIGN	3	0	0	3	50	50	100
Objective(s)	To create awareness of the importance of Tribology in design and selection of machine elements.							

1	SURFACES, FRICTION AND WEAR	Total Hrs	9

Topography of surfaces – Surfaces features – Experimental Determinations of surface structure – Chemical analysis of surface – Surface effects in Tribology – Analysis of surface roughness – Measurement of surface roughness. Friction – Mechanism of friction, measuring friction, equations and models of friction – Friction.
Properties of metallic and non metallic materials- friction in extreme conditions- Wear – Types, mechanism, mapping, measurements, wear resistance materials – surface treatment, surface modifications and surface coatings- Computer Simulations of friction, Lubrication and wear.

2	LUBRICATION THEORY	Total Hrs	9

Lubricants – Selection criteria – Lubrication regimes – Hydrodynamic, elasto and plasto hydrodynamic lubrication - Basic equations - Reynold's equation - Energy equation, boundary lubrication, boundary lubricating films and its properties- Hydrostatic lubrication – Gas lubrication.

3	DESIGN OF FLUID FILM BEARINGS	Total Hrs	9

Dynamic analysis of hydrodynamic bearing performance, trust and journal bearings– Full, partial, fixed and pivoted – Mass flow rate, friction, power loss, heat and temperature difference, dynamic loads, oil film thickness, stiffness of squeeze film and dynamic co-efficient – Hydrostatic bearing design.

4	INDUSTRIAL COMPONENTS AND SYSTEMS	Total Hrs	9

Slider bearings – Self acting finite bearings, failure modes, materials rolling element bearings – Types, contact mechanics, bearing internal load distribution, lubrication – Bearing geometry and kinematics, load ratings and life prediction, torque calculation, temperature analysis, endurance testing and failure analysis.

5	SPACE AND AUTOMOTIVE TRIBOLOGY	Total Hrs	9

Introduction – Mechanism, components, liquid and solid lubricants, accelerated testing and life testing of space mechanism. Principles of Aerospace eccentric bearing test mechanism. Engine Tribology –Importance, lubrication regimes, engine bearings, wheel bearings, tire- Mechanics of load transfer – Contact area and normal pressure distribution, brakes, effects of service on engine oil properties. Tribology in manufacturing – Macro and micro tribology of MEMS materials - Technologies for machinery diagnosis and prognosis.

Total hours to be taught	45

Text book (s) :

1	Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981.
2	Hulling, J.(Editor) – " Principles of Tribology", MacMillan, 1984.

Reference(s) :

1	Williams, J.A. "Engineering Tribology", Oxford University Press, 1994.
2	Neale, M.J. "Tribology Handbook", Butterworth Heinemann, 1995.
3	Bharat Bhushan, "Modern Tribology Handbook" Vol. – I & II.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E04	ADVANCED STRENGTH OF MATERIALS	3	0	0	3	50	50	100
Objective(s)	To Analyze, understand and predict the mechanical behavior of deformable solid bodies using techniques from engineering mechanics and applied mathematics, basic concepts in mechanics of materials to more advanced topics and advanced mechanics of materials topics such as unsymmetrical beam bending.							

1	ELASTICITY	Total Hrs	9
Stress – Strain relation and General equation of elasticity in Cartesian, Polar and Spherical coordinates- Differential equation of equilibrium – Compact ability – Boundary conditions - Representations of three dimensional stress of a tension – Generalized Hooke's law – St.Vennant's principle – Plane strain - Plane stress –-Shear Centre - Location of shear centre for various sections – Shear flow.			
2	UNSYMMETRICAL BENDING	Total Hrs	9
Stresses and Deflection in beams subjected to unsymmetrical loading – Kern of a section - Curved flexural members - Circumferential and Radial stresses – Deflection and radial curved beam with re-strained ends – Closed ring subjected to concentrated load and uniform load – Chain link and crane hooks.			
3	THICK CYLINDERS AND ROTATING DISKS	Total Hrs	9
Thick walled cylinder subjected to internal and external pressures – Shrink fit joints – Stresses due to rotation – Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – Allowable speed. – Rotating shafts and cylinders.			
4	TORSION OF NON CIRCULAR SECTIONS	Total Hrs	9
Torsion of rectangular cross section – St.Vennant Theory – Elastic membrane analogy – Prandtl's stress function – Torsional stresses in hollow thin walled tubes.			
5	STRESSES IN FLAT PLATES	Total Hrs	9
Stresses in circular and rectangular plates due to various types of loading and end conditions – Buckling of plates - Theory of contact stresses – Methods of computing contact stresses – Deflection of bodies in point and line contact – Applications.			
Total hours to be taught			45

Text book (s) :

1	Arthur P.Boresi and Richard J.Schmidt, "Advanced Mechanics of Materials", John, Willey &Sons, Inc., 2003.
2	Robert,D.Cook, Wareen.C.Yound, "Advanced Mechanics of Materials", Macmillan Publishers Company, 1985.

Reference(s) :

1	Srinath.L.S., Advanced Mechanics of Solids, Tata McGraw Hill Publishing Company Limited, 2003.
2	KrishnaRaju, N., Gururaja,D.R., Advanced Mechanics of Solids and Structures, Narosa Publishing House, 1997.
3	U.C.Jindal, "Advanced Topics of Strength of materials", Galgotia Publications, First edition, 1997.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E05	PRODUCT DATA MANAGEMENT	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on change management, configuration management, components on product data, projects and variants.							

1	INTRODUCTION	Total Hrs	9
Introduction to PDM - Present market constraints - Need for collaboration - Internet and developments in server - Client computing.			
2	COMPONENTS OF PDM	Total Hrs	9
Components of a typical PDM setup - Hardware and software-document management - Creation and viewing of documents - Creating parts - Versions and version control of parts and documents - Case studies.			
3	CONFIGURATION MANAGEMENT	Total Hrs	9
Base lines - Product structure - Configuration management - Case studies.			
4	PROJECTS AND ROLES & CHANGE MANAGEMENT	Total Hrs	9
Creation of projects and roles - Life cycle of a product - Life cycle management automating information flow -Work flows - Creation of work flow templates - Life cycle work flow integration - Case studies. Change issue - Change request - Change investigation - Change proposal – Change activity - Case studies.			
5	GENERIC PRODUCTS AND VARIANTS	Total Hrs	9
Data Management Systems for FEA data - Product configuration – Comparison between sales configuration and product configuration - Generic product modeling in configuration modeler - Use of order generator for variant creation - Registering of variants in product register - Case studies.			
Total hours to be taught			45

Text book (s) :

1	Kevin Otto, Kristin Wood, “Product Design”, Pearson, 2001.
2	Daniel Amor, “The E-Business Revolution”, Prentice-Hall, 2000.

Reference(s) :

1	David Bed worth. Mark Henderson & Phillip Wolfe. “Computer Integrated Design and Manufacturing “. McGraw Hill Inc...1991.
2	Terry Quatrain. “Visual Modeling with Rational Rose and UML “. Addison Wesley...1998.
3	Wind-Chill R5.0 Reference Manuals 2000.

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<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 colspan="2">10 PCA E06</td><td colspan="2">DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To Impart knowledge on design of Hydraulic and pneumatic systems, oil hydraulic systems, Hydraulic & pneumatic actuators, their control and regulation elements, hydraulic & pneumatic circuits and their installation and maintenance.</td></tr>
<tr><td>1</td><td colspan="5">OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS</td><td>Total Hrs</td><td colspan="3">9</td></tr>
<tr><td colspan="9">Hydraulic Power Generators – Selection and specification of pumps - Pump characteristics - Determination of volumetric, mechanical and overall efficiencies of positive displacement pumps - Linear and Rotary Actuators – Selection, specification and characteristics.</td></tr>
<tr><td>2</td><td colspan="5">CONTROL AND REGULATION ELEMENTS</td><td>Total Hrs</td><td colspan="3">9</td></tr>
<tr><td colspan="9">Pressure - Direction and flow control valves - Relief valves, non-return and safety valves - Actuation systems. Electrical control solenoid valves, relays - Electro hydraulic servo valves.</td></tr>
<tr><td>3</td><td colspan="5">HYDRAULIC CIRCUITS</td><td>Total Hrs</td><td colspan="3">9</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>4</td><td colspan="5">PNEUMATIC SYSTEMS AND CIRCUITS</td><td>Total Hrs</td><td colspan="3">9</td></tr>
<tr><td colspan="9">Pneumatic fundamentals - Control elements, position and pressure sensing - Logic circuits - Switching circuits - Fringe conditions modules and these integration - Sequential circuits -Cascade methods - Mapping methods - Step counter method - Compound circuit design -Combination circuit design.</td></tr>
<tr><td>5</td><td colspan="5">INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS</td><td>Total Hrs</td><td colspan="3">9</td></tr>
<tr><td colspan="9">Pneumatic equipments - Selection of components - Design calculations – Application –Fault finding - Hydro pneumatic circuits - Use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="3">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Espossito, Antony., “Fluid Power with Applications”, Prentice Hall, New York, 1980.</td></tr>
<tr><td>2</td><td colspan="8">Pease, Dudleyt, A. and Pippenger, John J., “Industrial Hydraulics”, Tata McGraw-Hill, New Delhi, 1985.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Parr, Andrew, “Hydraulic and Pneumatics”, Jaico Publishing House, New Delhi, 2004.</td></tr>
<tr><td>2</td><td colspan="8">Bolton. W., “Pneumatic and Hydraulic Systems”, Butterworth –Heinemann, 1997.</td></tr>
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K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E07	APPLIED ENGINEERING ACOUSTICS	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on basic concepts of acoustics, characterization of sound and their transmission phenomena and concepts of noise control							

1	BASIC CONCEPTS OF ACOUSTICS	Total Hrs	9

Scope of Acoustics – Sound pressure – Sound intensity – Sound power level Sound power– Wave motion – Alteration of wave paths –Measurement of sound waves – sound spectra– Sound fields – Interference – Standing waves – Acoustic energy density and intensity –Specific acoustic impedance.

2	CHARACTERISTICS OF SOUND	Total Hrs	9

The one dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimension.

3	TRANSMISSION PHENOMENA	Total Hrs	9

Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence– Standing wave pattern – Transmission through three media.

4	AN INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND	Total Hrs	9

Introduction – The decibel scale for the measurement of sound power – Sound level meter – Weighted sound pressure level – Equal Loudness contours – Perceived noisiness –Loudness, Loudness level, perceived noise, perceived noise level – Equivalent sound level– Identified level – Frequency and Amplitude measurement.

5	BASIC CONCEPTS OF NOISE CONTROL	Total Hrs	9

Noise Control at source, path, and receiver – Noise control by acoustical treatment – Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.

Total hours to be taught	45

Text book (s) :

1	Kinsler, Lawrence E. and Frey, Austin R., “Fundamentals of Acoustics”, John Wiley & Sons New York, 1986.
2	Bies, David A. and Hansen, Colin H., “Engineering Noise Control: Theory and Practice”, Second Edition, Chapman-Hall, London, 1996.

Reference(s) :

1	Hansen, C.H. and Snyder, S.D., “Active Control of Sound and Vibration”, E and FN Spon, London, 1996.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E08	ADVANCED TOOL DESIGN	3	0	0	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.							

1	TOOL-DESIGN METHODS	Total Hrs	9

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

2	TOOLING MATERIALS AND HEAT TREATMENT	Total Hrs	9

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

3	DESIGN OF DRILL JIGS	Total Hrs	9

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

4	DESIGN OF FIXTURES AND DIES	Total Hrs	9

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

5	TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE	Total Hrs	9

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

Total hours to be taught	45

Text book (s) :

1	Donaldson, Cyrll., LeCain, George H. and Goold, V.C., “Tool Design”, Tata McGraw- Hill, New York, 2000.
2	Joshi, Prakash Hiralal., “Tooling Data”, Wheeler Publishing, Allagabad, 2000.

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
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<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 colspan="2">10 PCA E09</td><td colspan="2">MICRO ELECTRO MECHANICAL SYSTEMS DESIGN</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To Impart knowledge on micro actuation techniques, scaling laws and scaling in mechanical applications, materials and fabrication process, micro mechanics, micro system manufacturing and micro system design.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Overview-Microsystems and microelectronics - Working principle of Microsystems -Micro actuation techniques-Micro sensors-Types-microactuators-Types-Micropumpmicromotors-Micro-Valves-Microgrippers-Scaling laws-Scaling in geometry-Scaling in rigid body dynamics- Scaling in electrostatic forces- Scaling in electricity- Scaling in fluid mechanics- Scaling in heat transfer.</td></tr>
<tr><td>2</td><td colspan="5">MATERIALS AND FABRICATION PROCESS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Substrates and wafer-single crystal silicon wafer formation-ideal substrates mechanical properties-silicon compounds - Sio2, SiC, Si3N4 and polycrystalline silicon - Silicon piezo resistors - Gallium are senside, Quartz-piezoelectric crystals polymers for MEMS -conductive polymers – Photolithography - Ion implantation -Diffusion – Oxidation –CVD - Physical vapor deposition - Deposition by epitaxy - Etching process.</td></tr>
<tr><td>3</td><td colspan="5">MICROMECHANICS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Introduction-static bending of thin plates-circular plates with edge fixed – Rectangular plate with all edges fixed and square plate with all edges fixed – Mechanical vibration-resonant vibration- Micro accelerometers-design theory and damping coefficients- Thermo mechanics-Thermal stresses-fracture mechanics-Stress intensity factors, Fracture toughness and interfacial fracture mechanics.</td></tr>
<tr><td>4</td><td colspan="5">MICRO SYSTEM MANUFACTURING</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Clean room technology-Bulk Micro manufacturing- Surface micro machining –LIGASLIGA-Micro system packaging-materials-Die level-device level-System level packaging techniques-Die preparation-Surface bonding-Wire bonding-sealing.</td></tr>
<tr><td>5</td><td colspan="5">MICRO SYSTEM DESIGN</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Design considerations-Process design-Mask layout design- Mechanical design applications of micro system in -Automotive industry-Bio medical –Aero space telecommunications.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Mohamed Gad-el-Hak, The MEMS Hand book, CRC press 2002.</td></tr>
<tr><td>2</td><td colspan="7">Julian W.Gardner,Vijay K.Varadan, Osama O.Awadel Karim, Microsensors MEMS and Smart Devices, John Wiby & sons Ltd.,2001.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">S.Fatikow, U.Rembold, Microsystem Technology and Microrobotics, Springer-Verlag Berlin Heidelberg, 1997.</td></tr>
<tr><td>2</td><td colspan="7">Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture, Tata McGraw-Hill, 2006.</td></tr>
<tr><td>3</td><td colspan="7">Francis E.H Tay and W.O Choong, Microfludics and BioMEMS Applications, Springer, 2002.</td></tr>
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<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>10 PCA E10</td><td>MECHANICS OF COMPOSITE MATERIALS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">To Impart knowledge on Principles of Composite Material Mechanics, mechanics of composite materials their design structure and its manufacturing.</td></tr>
<tr><td>1</td><td colspan="4">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Definition – Need – General Characteristics - Applications - Fibers – Glass, Carbon, Ceramic and Aramid fibers - Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices - Fiber surface treatments - Fillers and additives - Fiber content, density and void content.</td></tr>
<tr><td>2</td><td colspan="4">MECHANICS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Rule of mixture - Volume and mass fractions – Density - Void content - Evaluation of four elastic moduli based on strength of materials approach and Semi - Empirical model - Longitudinal Young’s modulus - transverse Young’s modulus – major Poisson’s ratio - In-plane shear modulus, Ultimate strengths of a unidirectional lamina - Characteristics of Fiber -Reinforced lamina – Laminates –Lamination theory, Interlaminar stresses</td></tr>
<tr><td>3</td><td colspan="4">PERFORMANCE</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Long term properties, Fracture Behavior and Damage Tolerance.</td></tr>
<tr><td>4</td><td colspan="4">MANUFACTURING</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes – Quality Inspection methods - Processing of MMC – Diffusion bonding – Stir casting – Squeeze casting.</td></tr>
<tr><td>5</td><td colspan="4">DESIGN OF STRUCTURES</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Failure Predictions - Laminate Design Consideration -Design criteria - Design allowable - Design guidelines - Joint design-Bolted and Bonded Joints - Design Examples - Design of a tension member – Design of a compression member – Design of a beam-design of a torsional member - Application of FEM for design and analysis of laminated composites.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Mallick, P.K., “Fiber Reinforced Composites: Materials, Manufacturing and Design”, Marcel Dekker Inc, 1993.</td></tr>
<tr><td>2</td><td colspan="7">Autar K. Kaw, “Mechanics of Composite Materials” CRC Press, 2006.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, New York, 1990.</td></tr>
<tr><td>2</td><td colspan="7">Ronald Gibson, “Principles of Composite Material Mechanics", Tata McGraw Hill, 1994.</td></tr>
<tr><td>3</td><td colspan="7">Chawla K.K., “Composite materials”, Springer – Verlag, 1987.</td></tr>
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<tr><td colspan="2">10 PCA E11</td><td colspan="2">RAPID PROTOTYPING AND TOOLING</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To understand the rapid tooling software for rapid prototyping and rapid prototyping in manufacturing industries.</td></tr>
<tr><td>1</td><td colspan="4">INTRODUCTION AND STEREOLITHOGRAPHY SYSTEMS</td><td colspan="2">Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="9">Need for the compression in product development - History of RP systems - Survey of applications - Growth of RP industry and classification of RP systems. Stereolithography Systems: Principle - Process parameters - Process details - Data preparation - Data files and Machine details - Applications. Selective Laser Sintering - Types of machines - Principle of operation - Process parameters - Data preparation for SLS - Applications.</td></tr>
<tr><td>2</td><td colspan="4">FUSION DEPOSITION MODELING</td><td colspan="2">Total Hrs</td><td colspan="3">6</td></tr>
<tr><td colspan="9">Principle - Process parameters - Path generation - Applications. Solid Ground Curing - Principle of operation - Machine details - Applications.</td></tr>
<tr><td>3</td><td colspan="4">LAMINATED OBJECT MANUFACTURING</td><td colspan="2">Total Hrs</td><td colspan="3">8</td></tr>
<tr><td colspan="9">Principle of operation - LOM materials - Process details - Applications. Concept Modelers – Principle - Thermo jet printer - Sander’s model market - 3-D printer - Genisys Xs printer - JP system 5 - Object Quadra System. Laser Engineered Net Shaping (LENS) – Principle – Applications.</td></tr>
<tr><td>4</td><td colspan="4">RAPID TOOLING</td><td colspan="2">Total Hrs</td><td colspan="3">7</td></tr>
<tr><td colspan="9">Indirect Rapid Tooling - Silicone rubber tooling - Aluminum filled epoxy tooling - Spray metal tooling etc. Direct Rapid Tooling - Direct AIM - Quick cast process - Copper polyamide - Rapid Tool – DMILS – ProMetal - Sand casting tooling - Laminate tooling - Soft tooling Vs Hard tooling.</td></tr>
<tr><td>5</td><td colspan="4">SOFTWARE FOR RAPID PROTOTYPING</td><td colspan="2">Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="9">STL files - Overview of Solid view - Magics, mimics, magics communicator, etc.- Internet based soft wares - Collaboration tools - Rapid Manufacturing Process Optimization - Factors influencing accuracy - Data preparation errors - Part building errors - Errors in finishing - Influence of part build orientation. Allied
Processes - Vacuum Casting - Surface Digitizing - Surface Generation from point cloud -Surface modification and data transfer to solid models.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Paul. F. Jacobs, "Stereo lithography and other RP & M Technologies", SME, NY, 1996.</td></tr>
<tr><td>2</td><td colspan="8">Pham. D. T. & Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2001.</td></tr>
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<tr><td>1</td><td colspan="8">Terry Wohlers, "Wohlers Report 2006", Wohlers Associates, 2006.</td></tr>
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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E12	MECHANICS OF FRACTURE	3	0	0	3	50	50	100
Objective(s)	To prove in depth study on stationary crack, crack growth and Fatigue crack growth. To Analyse crack Growth for cyclic loading and crack initiation under large scale.							
1	ELEMENTS OF SOLID MECHANICS				Total Hrs	9		
The geometry of stress and strain - Elastic deformation - Plastic and elasto-plastic deformation - Limit analysis.								
2	STATIONARY CRACK UNDER STATIC LOADING				Total Hrs	9		
Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - Plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement.								
3	ENERGY BALANCE AND CRACK GROWTH				Total Hrs	9		
Griffith analysis – Linear Fracture Mechanics - Crack Opening displacement – Dynamic energy balance – Crack arrest.								
4	FATIGUE CRACK GROWTH CURVE				Total Hrs	9		
Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – Effects of changing the load spectrum – Effects of Environment.								
5	ELEMENTS OF APPLIED FRACTURE MECHANICS				Total Hrs	9		
Examples of crack-growth Analysis for cyclic loading - Leak before break – Crack Initiation under large scale yielding – Thickness as a Design parameter – Crack instability in Thermal or Residual – Stress fields.								
Total hours to be taught						45		
Text book (s) :								
1	Broek, David. "Elementary Engineering Fracture Mechanics", Fifthoff & Noerdhoff International Publisher, 1978.							
2	Hellan, Kare., "Introduction of Fracture Mechanics", McGraw-Hill, New York, 1985.							
Reference(s) :								
1	Preshant Kumar., "Elements of Fracture Mechanics", Wheeler Publishing, Allahabad, 1999.							

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E13	APPLIED OBJECT ORIENTED PROGRAMMING	3	0	0	3	50	50	100
Objective(s)	To Impart some fundamentals of object oriented programming, C++ data types, C++ classes, class derivation and applications of all							

1	FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING	Total Hrs	9
Elements of OOP, classes, subjects, messaging, inheritance, polymorphism, OOP paradigm versus Procedural paradigm, object-oriented design.			
2	C++ DATA TYPES	Total Hrs	9
Expression and statements, operators, precedence, type conversion, flow control, Arrays structures, argument passing, reference argument, overloaded function.			
3	C++ CLASS	Total Hrs	9
Definition, class objects, member functions, pointer friends, class member pointer, scope, unions, bit-fields, class argument and ellises - Class member functions, initialization, operator overloading, user defined conversions.			
4	CLASS DERIVATION	Total Hrs	9
Derivation specification, Information hiding under derivation public and private base classes, standard conventions under derivation, class scope, Initialization and assignment under derivation.			
5	APPLICATION	Total Hrs	9
OOP's applications in linear programming, integer programming, simulation, etc.			
Total hours to be taught			45

Text book (s) :

1	Wiener, Richard, S. and Pinson, Lewis, J. "An introduction to objective oriented programming and C++ ", 1999.
2	Stanley B.Lippman, "C++ primer ", Addison - Wesley Pub. Co., 1989.

Reference(s) :

1	Robert Lafore, "Object Oriented programming in Turbo C++ ", Galgotia Publication, 1992.
2	Strousstrup, Bjarne, The "C++ programming languages ", Addison Wesley, 1986.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E14	DESIGN OF MATERIAL HANDLING EQUIPMENTS	3	0	0	3	50	50	100
Objective(s)	To give a comprehensive insight on design of hoists, Hoisting gear, conveyors and Elevators.							

1	MATERIALS HANDLING EQUIPMENT	Total Hrs	6
Types of material handling equipments - Selection and applications.			
2	DESIGN OF HOISTS	Total Hrs	12
Design of hoisting elements - Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments - Design of forged hooks and eye hooks - Crane grabs - Lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types			
3	DRIVES OF HOISTING GEAR	Total Hrs	9
Hand and power drives - Traveling gear - Rail traveling mechanism - Cantilever and monorail cranes - Slewing, jib and luffing gear - Cogwheel drive - Selecting the motor ratings.			
4	CONVEYORS	Total Hrs	12
Types - Description - Design and applications of Belt conveyors, apron conveyors and escalators - Pneumatic conveyors - Screw conveyors - Vibratory conveyors.			
5	ELEVATORS	Total Hrs	9
Bucket elevators: design - Loading and bucket arrangements - Cage elevators - Shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.			
Total hours to be taught			45

Text book (s) :

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

Reference(s) :

1	Alexandrov M., “Materials Handling Equipments”, MIR Publishers, 1981.
2	Boltzharol A., “Materials Handling Handbook”, The Ronald Press Company, 1958.
3	P.S.G. Tech “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.
4	Lingaiah K. and Narayana Iyengar, “Machine Design Data Hand Book”, Vol. 1 & 2, Suma Publishers, Bangalore, 1983.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E15	MEASUREMENT TECHNIQUES	3	0	0	3	50	50	100
Objective(s)	To prove in depth study on forces and strain measurement and vibration measurements, principles of Acoustics and distress measurements and non-destructive testing methods.							

1	FORCES AND STRAIN MEASUREMENT	Total Hrs	9
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			
2	VIBRATION MEASUREMENTS	Total Hrs	9
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.			
3	ACOUSTICS AND WIND FLOW MEASURES	Total Hrs	9
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.			
4	DISTRESS MEASUREMENTS	Total Hrs	9
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.			
5	NON DESTRUCTIVE TESTING METHODS	Total Hrs	9
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.

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="2">Mechanical Engineering</td><td colspan="3">Programme Code & Name</td><td colspan="3">PCA : M.E. Computer Aided Design</td></tr>
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<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 colspan="2">10 PCA E16</td><td colspan="2">VIBRATION CONDITION MONITORING</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">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.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>7</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>2</td><td colspan="5">PASSIVE VIBRATION CONTROL</td><td colspan="2">Total Hrs</td><td>11</td></tr>
<tr><td colspan="8">Introduction – Reduction of Vibration at the Source – Control of Vibration – by Structural design – Material Selection – Localized additions – Artificial damping – Different types of Isolation Dampers - Resilient isolation – Vibration isolation – MR Dampers – Constrained layer damping - Advanced vibration absorbers.</td></tr>
<tr><td>3</td><td colspan="5">ACTIVE VIBRATION CONTROL</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Introduction – Concepts and applications – Review of smart materials – Types and Characteristics – Review of smart structures – Characteristics Active vibration control in smart structures.</td></tr>
<tr><td>4</td><td colspan="5">CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>5</td><td colspan="5">DYNAMIC BALANCING AND ALIGNMENT OF MACHINERY</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Bathe K.J. and Wilson, F.I., “Numerical Methods in Finite Element Analysis”, Prentice Hall of India, New Delhi, 1978.</td></tr>
<tr><td>2</td><td colspan="7">Hartog J.O. Den., “Mechanical Vibrations”, McGraw-Hill, New York, 1985.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Rao J.S., “Vibratory Condition Monitoring of Machines”, CRC Press, London, 2000.</td></tr>
<tr><td>2</td><td colspan="7">“Hand Book of Condition Monitoring”, Elsevier Science, Amsterdam, 1996.</td></tr>
<tr><td>3</td><td colspan="7">Collacott R.A., “Mechanical Fault Diagnosis and Condition Monitoring”, Chapman & Hall, London, 1982.</td></tr>
<tr><td>4</td><td colspan="7">John S. Mitchell, “Introduction to Machinery Analysis and Monitoring”, Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma, 1993</td></tr>
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<tr><td>10 PCA E17</td><td>COMPOSITE MATERIALS AND ITS MECHANICS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">To understand the fundamentals of composite material strength and its mechanical behavior. Understanding the analysis of fiber reinforced Laminate design for different Combinations of plies with different orientations of the fiber. Thermo-mechanical behavior and study of residual stresses in Laminates during processing</td></tr>
<tr><td>1</td><td colspan="4">LAMINA CONSTITUTIVE RELATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="8">Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke’s Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes.</td></tr>
<tr><td>2</td><td colspan="4">FLAT PLATE LAMINATE CONSTITUTIVE RELATIONS</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.</td></tr>
<tr><td>3</td><td colspan="4">LAMINA STRENGTH ANALYSIS</td><td colspan="2">Total Hrs</td><td>5</td></tr>
<tr><td colspan="8">Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill’s Criterion for Anisotropic materials. Tsai-Hill’s Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure.</td></tr>
<tr><td>4</td><td colspan="4">ANALYSIS OF LAMINATED FLAT PLATES</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.</td></tr>
<tr><td>5</td><td colspan="4">EFFECT OF THERMAL PROPERTIES</td><td colspan="2">Total Hrs</td><td>8</td></tr>
<tr><td colspan="8">Modification of Hooke’s Law due to thermal properties - Modification of Laminate Constitutive Equations. Orthotropic Lamina - special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates - Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.</td></tr>
<tr><td colspan="6">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Gibson R.F., “Principles of Composite Material Mechanics”, McGraw-Hill, 1994, Second Edition - CRC press.</td></tr>
<tr><td>2</td><td colspan="7">Hyer M.W., “Stress Analysis of Fiber – Reinforced Composite Materials”, McGraw-Hill, 1998.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, Oxford University Press-2006, First Indian Edition - 2007.</td></tr>
<tr><td>2</td><td colspan="7">Mallick P.K.,”Fiber–Reinforced Composites: Materials, Manufacturing and Design”, Maneel Dekker Inc, 1993</td></tr>
<tr><td>3</td><td colspan="7">Halpin J.C., “Primer on Composite Materials, Analysis”, Techomic Publishing Co., 1984</td></tr>
<tr><td>4</td><td colspan="7">Mallick P.K. and Newman, S., (edition), “Composite Materials Technology: Processes and Properties”, Hansen Publisher, Munish, 1990</td></tr>
<tr><td>5</td><td colspan="7">Madhujit Mukhopadhyay, “Mechanics of Composite Materials and Structures”, University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)</td></tr>
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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E18	MODAL ANALYSIS OF MECHANICAL SYSTEMS	3	0	0	3	50	50	100
Objective(s)	To understand the concept of modal analysis, to learn the measurement techniques, to know the extraction methods and to create the mathematical model.							

1	OVERVIEW	Total Hrs	6
Introduction to Modal Testing – Applications of Modal Testing – Philosophy of Modal Testing – Summary of Theory – Summary of Measurement Methods – Summary of Analysis – Review of Test Procedure.			
2	THEORETICAL BASIS	Total Hrs	12
Introduction – Single Degree of Freedom (SDOF) System Theory – Presentation and Properties of FRF Data for SDOP System – Undamped Multi-degree of freedom (MDOF) system – Proportional Damping – Hysteretic Damping – General Case – Viscous Damping – General Case – Characteristics and presentation of MDOF – FRF Data – Complete and incomplete models - Non-sinusoidal vibration and FRF Properties			
3	MOBILITY MEASUREMENT TECHNIQUES	Total Hrs	10
Introduction – Basic Measurement System – Structure preparation – Excitation of the Structure – Transducers and Amplifiers – Analyzers – Digital Signal Processing – Use of Different Excitation types – Calibration – Mass Cancellation – Rotational Mobility Measurement – Multi point excitation methods.			
4	MODAL PARAMETER EXTRACTION METHODS	Total Hrs	11
Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.			
5	DERIVATION OF MATHEMATICAL MODELS	Total Hrs	6
Introduction – Modal Models – Display of Modal Model – Response Models – Spatial Models – Mobility Skeletons and System Models.			
Total hours to be taught			45

Reference(s) :

1	Ewins D J “Modal Testing: Theory and Practice “, John Wiley & Sons Inc., 1988.
2	Nuno Manuel Mendes Maia et al,” Theoretical and Experimental Modal Analysis”, Wiley John & sons, 1997.

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		L	T	P	C	CA	ES	Total
10 PCA E19	INTEGRATED MANUFACTURING SYSTEMS	3	0	0	3	50	50	100
Objective(s)	To enlighten the basic concepts of group technology and computer aided process planning, computer aided planning and control, ways and means of computer monitoring and integrated manufacturing system.							
1	INTRODUCTION				Total Hrs	6		
Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems analysis of manufacturing operations.								
2	GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING				Total Hrs	9		
Introduction-part families-parts classification and cooling - group technology machine cells-benefits of group technology. Process planning function CAPP - Computer generated time standards.								
3	COMPUTER AIDED PLANNING AND CONTROL				Total Hrs	9		
Production planning and control-cost planning and control-inventory management-Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology- automated data collection system.								
4	COMPUTER MONITORING				Total Hrs	9		
Types of production monitoring systems-structure model of manufacturing process-process control & strategies- direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.								
5	INTEGRATED MANUFACTURING SYSTEM				Total Hrs	12		
Definition - application - features - types of manufacturing systems-machine tools-materials handling system- computer control system – Introduction to CNC Programming, DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS - variable mission manufacturing system - CAD/CAM system - human labor in the manufacturing system-computer integrated manufacturing system benefits. Artificial Intelligence and Expert system in CIM.								
Total hours to be taught						45		
Text book (s) :								
1	Groover M.P., "Automation, Production System and CIM", Prentice-Hall of India, 2005.							
2	David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998							
Reference(s) :								
1	Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.							
2	Ranky Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1986.							
3	Yeomamas R.W., Choudry A. and Ten Hagen P.J.W., "Design Rules for a CIM system", North Holland Amsterdam, 1985.							

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10 PCA E20	THEORY OF PLATES AND SHELLS	3	0	0	3	50	50	100
Objective(s)	To Impart some fundamentals knowledge on thin plates and governing differential equations, Energy methods, finite difference and finite element methods, shells and space frames.							

1	THIN PLATES & GOVERNING DIFFERENTIAL EQUATION	Total Hrs	9
Thin Plates with small deflection - Laterally loaded thin plates - Governing differential equation - Various boundary conditions.			
2	BENDING OF RECTANGULAR & CIRCULAR PLATES	Total Hrs	9
Rectangular plates - Simply supported rectangular plates - Navier solution and Levy's method - Rectangular plates with various edge conditions - Plates on elastic foundation - Symmetrical bending of circular plates.			
3	ANALYSIS OF PLATES	Total Hrs	9
Energy methods - Finite difference and Finite element methods.			
4	SHELLS & FOLDED PLATES STRUCTURE	Total Hrs	9
Classification of shells - Types of shells, structural action - Membrane theory - Shells of revolution and shells of translation, examples, and limitations of membrane theory - Folded Plate structures - Structural behavior, types, design by ACI - ASCE Task Committee method			
5	SPACE FRAMES	Total Hrs	9
Space frames - Configuration - Types of nodes - General principles of design Philosophy - Behavior.			
Total hours to be taught			45

Text book (s) :

1	Szilard, R., Theory and Analysis of Plates, Prentice Hall Inc., 1995.
2	Timoshenko, S. and Krieger S.W. Theory of Plates and Shells, McGraw Hill Book Company, New York 1990.

Reference(s) :

1	Wilhelm Flügge,"Stresses in shells", Springer – Verlag.
2	Timoshenko S., "Theory of Plates and Shells", 4th Edition, McGraw Hill, 1990.
3	Subramanian N., "Principles of Space Structures", Wheeler Publishing Co. 1999.

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10 PCA E21	DESIGN OF HEAT EXCHANGERS	3	0	0	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.							

1	CONSTRUCTIONAL DETAILS AND HEAT TRANSFER	Total Hrs	9
Types - Shell and Tube Heat Exchangers - Regenerators and Recuperates Industrial Applications Temperature Distribution and its Implications - LMTD - Effectiveness			
2	FLOW DISTRIBUTION AND STRESS ANALYSIS	Total Hrs	9
Effect of Turbulence - Friction Factor - Pressure Loss - Channel Divergence Stresses in Tubes - Heater sheets and Pressure Vessels - Thermal Stresses - Shear Stresses - Types of Failures			
3	DESIGN ASPECTS	Total Hrs	9
Heat Transfer and Pressure Loss - Flow Configuration - Effect of Baffles - Effect of Deviations from Ideality – Design of Typical Liquid - Gas-Gas-Liquid Heat Exchangers			
4	CONDENSERS AND EVAPORATORS DESIGN	Total Hrs	9
Design of Surface and Evaporative Condensers - Design of Shell and Tube - Plate Type Evaporators			
5	COOLING TOWERS	Total Hrs	9
Packing - Spray Design - Selection of Pumps - Fans and Pipes - Testing and Maintenance – Experimental Methods.			
Total hours to be taught			45

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., 1980.

Reference(s) :

1	Nicholas Cheremisioff “Cooling Tower”, Ann Arbor Science Publishers, 1981.
2	Arthur P. Fraas “Heat Exchanger Design”, John Wiley & Sons, 1988.

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<tr><td>10 PCA E22</td><td>BEARING DESIGN AND ROTOR DYNAMICS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">To study the selection and design of different bearings and to analyze the bearings under dynamic conditions.</td></tr>
<tr><td>1</td><td colspan="4">CLASSIFICATION AND SELECTION OF BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">6</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td>2</td><td colspan="4">DESIGN OF FLUID FILM BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td>3</td><td colspan="4">SELECTION AND DESIGN OF ROLLING BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td>4</td><td colspan="4">DYNAMICS OF HYDRODYNAMIC BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td>5</td><td colspan="4">ROTOR DYNAMICS</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Rotor vibration and Rotor critical speeds- support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip-Design configurations of stable journal bearings</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text Book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Neale M.J. “Tribology Hand Book”, Butterworth Heinemann, United Kingdom 2001.</td></tr>
<tr><td>2</td><td colspan="8">Halling J. (Editor) – “Principles of Tribology “, Macmillian – 1984.</td></tr>
<tr><td>3</td><td colspan="8">Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.</td></tr>
<tr><td>4</td><td colspan="8">Basu S.K., Sengupta, S.N. and Ahuja, B.B.,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005.</td></tr>
<tr><td>5</td><td colspan="8">Stachowiak G.W. and Batchelor, A.W., Engineering Tribology, Butterworth-Heinemann, UK, 2005.</td></tr>
<tr><td>6</td><td colspan="8">SKF, “SKF Bearing Maintenance Hand Book”, SKF Publishers, 1996</td></tr>
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<tr><td colspan="2">10 PCA E23</td><td colspan="2">COMPUTATIONAL FLUID DYNAMICS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="8">To understand the concept of boundary conditions and to study the fluid flow and heat transfer problems.</td></tr>
<tr><td>1</td><td colspan="5">GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>2</td><td colspan="5">CONDUCTION HEAT TRANSFER</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.</td></tr>
<tr><td>3</td><td colspan="5">INCOMPRESSIBLE FLUID FLOW</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, Computation of Boundary layer flow, finite difference approach.</td></tr>
<tr><td>4</td><td colspan="5">CONVECTION HEAT TRANSFER AND FEM</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">Steady One-Dimensional and Two-Dimensional Convection – diffusion, Unsteady one-dimensional convection – diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – solution of steady heat conduction by FEM – Incompressible flow – simulation by FEM.</td></tr>
<tr><td>5</td><td colspan="5">TURBULENCE MODELS</td><td colspan="2">Total Hrs</td><td>5</td></tr>
<tr><td colspan="8">Algebraic Models – One equation model, K – ϵ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text Book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Ghoshdasdidar P.S.,“Computer Simulation of Flow and Heat Transfer”, Tata McGraw-Hill Publishing Company Ltd., 1998.</td></tr>
<tr><td>2</td><td colspan="7">Subas V.Patankar “Numerical Heat Transfer Fluid Flow”, Hemisphere Publishing Corporation, 1980.</td></tr>
<tr><td>3</td><td colspan="7">Taylor, C and Hughes, J.B. “Finite Element Programming of the Navier-Stokes Equation”, Pineridge Press Limited, U.K., 1981.</td></tr>
<tr><td>4</td><td colspan="7">Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., “Computational Fluid Mechanics and Heat Transfer “, Hemisphere Publishing Corporation, New York, USA, 1984.</td></tr>
<tr><td>5</td><td colspan="7">Fletcher C.A.J. “Computational Techniques for Fluid Dynamics 1” Fundamental and General Techniques, Springer – Verlag, 1987.</td></tr>
<tr><td>6</td><td colspan="7">Fletcher C.A.J. “Computational Techniques for fluid Dynamics 2” Specific Techniques for Different Flow Categories Springer – Verlag, 1987.</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E24	PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING	3	0	0	3	50	50	100
Objective(s)	To Integrate the concepts of productivity models, organizational transformation, Re-engineering process, Re-engineering tools and Implementation.							

1	INTRODUCTION	Total Hrs	9
Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle.			
2	PRODUCTIVITY MODELS	Total Hrs	9
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.			
3	ORGANIZATIONAL TRANSFORMATION	Total Hrs	9
Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the workforce for transformation and reengineering, methodology, guidelines, DSMCQ and PMP model			
4	RE-ENGINEERING PROCESS IMPROVEMENT MODELS	Total Hrs	9
PMI models, Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model.			
5	RE-ENGINEERING TOOLS AND IMPLEMENTATION	Total Hrs	9
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			
Total hours to be taught			45

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 cataloging in pub. Data, 1996.

Reference(s) :

1	Rastogi P.N. “Re-Engineering and Re-inventing the Enterprise ", Wheeler pub. New Delhi, 1995.
2	Premvrat Sardana G.D. and Sahay B.S, “Productivity Management - A Systems Approach", Narosa Publishers, New Delhi, 1998.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E25	MECHATRONICS IN MANUFACTURING SYSTEMS	3	0	0	3	50	50	100
Objective(s)	To understand the functions of mechatronic systems, sensors and transducers, microprocessor in mechatronics, programmable logic controllers and design.							

1	INTRODUCTION	Total Hrs	9
Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.			
2	SENSORS AND TRANSDUCERS	Total Hrs	9
Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion - Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems.			
3	MICROPROCESSORS IN MECHATRONICS	Total Hrs	9
Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8105 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters –Applications - Temperature control - Stepper motor control - Traffic light controller.			
4	PROGRAMMABLE LOGIC CONTROLLERS	Total Hrs	9
Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC			
5	DESIGN AND MECHATRONICS	Total Hrs	9
Designing - Possible design solutions - Case studies of Mechatronics systems.			
Total hours to be taught			45

Text book (s) :

1	Michael B.Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.
2	Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ., " Mechatronics ", Chapman and Hall, 1993.

Reference(s) :

1	Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications", Wiley Eastern, 1998.
2	Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering:An Introduction to Mechatronics ", Prentice-Hall, 2000.
3	Ghosh P.K. and Sridhar, P.R., “Introduction to Microprocessors for Engineers and Scientists ", 2nd Edition, Prentice Hall, 1995.
4	Bolton W., “Mechatronics: A Multidisciplinary Approach”, 4th Edition, Prentice Hall, 2008

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E26	INDUSTRIAL ROBOTICS	3	0	0	3	50	50	100
Objective(s)	To understand the functions of Robot Drives and Control, Cell Design and Application							

1	INTRODUCTION AND ROBOT KINEMATICS	Total Hrs	10

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

2	ROBOT DRIVES AND CONTROL	Total Hrs	9

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

3	ROBOT SENSORS	Total Hrs	9

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

4	ROBOT CELL DESIGN AND APPLICATION	Total Hrs	9

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

5	ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Total Hrs	8

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

Total hours to be taught	45

Text book (s) :

1	Fu, K.C., Gonzalez, R.C. and Lee, C.S.G., "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987
2	Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.

Reference(s) :

1	Yoram Koren, "Robotics for Engineers" Mc Graw-Hill, 1987.
2	Kozyrey Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
3	Deb S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
4	Timothy Jordanides, "Expert Systems and Robotic", Springer –Verlag,New York, May 1991.

K.S.Rangasamy College of Technology - Autonomous Regulation							R 2010	
Department	Mechanical Engineering	Programme Code & Name			PCA : M.E. Computer Aided Design			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E27	CREATIVITY IN DESIGN	3	0	0	3	50	50	100
Objective(s)	This course will provide students with a solid foundation in innovation, design, and creativity. Additionally, students will be prepared to apply relevant principles, tools, and techniques to promote and sustain organizational innovation for competitive advantage.							

1	INTRODUCTION	Total Hrs	4
Need for design creativity – creative thinking for quality – essential theory about directed creativity.			
2	MECHANISM OF THINKING AND VISUALIZATION	Total Hrs	11
Definitions and theory of mechanisms of mind heuristics and models : attitudes, Approaches and Actions that support creative thinking - Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, color symmmetry.Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking.			
3	CREATIVITY	Total Hrs	11
Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management.			
4	DESIGN	Total Hrs	9
Process Design, Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective-Recycling and availability-Creativity and customer needs analysis – Innovative product and service designs, future directions in this application of creativity thinking in quality management.			
5	INNOVATION	Total Hrs	10
Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator's solution – creating and sustaining successful growth – Disruptive Innovation model – Segmentive Models – New market disruption - Commoditation and DE-commoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton.			
Total hours to be taught			45

Reference(s) :

1	Rousing Creativity: Think New NowFloyd Hurr, Crisp Publications Inc. 1999.
2	Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999.
3	Donald A. Norman," Emotional Design", Perseus Books Group New York, 2004.
4	Clayton M. Christensen Michael E. Raynor," The Innovator's Solution", Harvard Business School Press Boston, USA, 2003.
5	Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New York USA," 2000.

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="2">Mechanical Engineering</td><td colspan="3">Programme Code & Name</td><td colspan="3">PCA : M.E. Computer Aided Design</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" 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 colspan="2">10 PCA E28</td><td colspan="2">ENTERPRISE RESOURCE PLANNING</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="8">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.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>2</td><td colspan="5">TECHNOLOGY AND ARCHITECTURE</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="9">Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.</td></tr>
<tr><td>3</td><td colspan="5">ERP SYSTEM PACKAGES</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>4</td><td colspan="5">APPLICATION AND TRAINING</td><td colspan="2">Total Hrs</td><td colspan="2">7</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>5</td><td colspan="5">ERP PROCUREMENT ISSUES</td><td colspan="2">Total Hrs</td><td colspan="2">8</td></tr>
<tr><td colspan="9">Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Sadagopan.S , “ERP-A Managerial Perspective”, Tata Mcgraw Hill, 1999.</td></tr>
<tr><td>2</td><td colspan="8">Jose Antonio Fernandez, “The SAP R/3 Handbook”, Tata Mcgraw Hill, 1998.</td></tr>
<tr><td>3</td><td colspan="8">Vinod Kumar Crag and Venkitakrishnan N.K., “Enterprise Resource Planning – Concepts and Practice”, Prentice Hall of India, 1998.</td></tr>
<tr><td>4</td><td colspan="8">Garg & Venkitakrishnan “ERPWARE ERP Implementation Framework”, , Prentice Hall, 1999.</td></tr>
<tr><td>5</td><td colspan="8">Thomas E Vollmann and Bery Whybark , “Manufacturing and Control Systems”, Galgothia Publications, 1998.</td></tr>
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K.S.Rangasamy College of Technology, Tiruchengode - 637 215								
Curriculum for the Programmes under Autonomous Scheme								
Regulation	R 2010							
Department	Department of Mechanical Engineering							
Program 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
	THEORY							
10 PED 101	Advanced Mathematics (PED, PCA)	3	1	0	4	50	50	100
10 PED102	Computer Applications in Design (PED, PCA)	3	0	0	3	50	50	100
10 PED 103	Finite Element Analysis (PED, PCA)	3	1	0	4	50	50	100
10 PED 104	Concepts of Engineering Design (PED, PCA)	3	0	0	3	50	50	100
10 PED 105	Advanced Material Technology	3	0	0	3	50	50	100
10 PED E**	Elective I	3	0	0	3	50	50	100
	PRACTICAL							
10 PED 106	CAD Laboratory (PED, PCA)	0	0	3	2	50	50	100
10 PED 107	Computer Aided Analysis Laboratory I PED, PCA)	0	0	3	2	50	50	100
	Total	18	2	6	24	800		
Semester II								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
	THEORY							
10 PED 201	Mechanical Vibrations (PED, PCA)	3	1	0	4	50	50	100
10 PED 202	Product Design and Development (PED, PCA)	3	0	0	3	50	50	100
10 PED 203	Advanced Mechanisms and Synthesis	3	1	0	4	50	50	100
10 PED 204	Design for Manufacture and Assembly	3	0	0	3	50	50	100
10 PED E**	Elective II	3	0	0	3	50	50	100
10 PED E**	Elective III	3	0	0	3	50	50	100
	PRACTICAL							
10 PED 205	Computer Aided Analysis Laboratory II (PED, PCA)	0	0	3	2	50	50	100
10 PED 206	Technical Report Preparation and Presentation	0	0	2	0	100	00	100
	Total	18	2	5	22	800		

K.S.Rangasamy College of Technology, Tiruchengode - 637 215								
Curriculum for the Programmes under Autonomous Scheme								
Regulation	R 2010							
Department	Department of Mechanical Engineering							
Program Code & Name	PED : M.E. Engineering Design							
Semester III								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
	THEORY							
10 PED E**	Elective IV	3	0	0	3	50	50	100
10 PED E**	Elective V	3	0	0	3	50	50	100
10 PED E**	Elective VI	3	0	0	3	50	50	100
	PRACTICAL							
10 PED 301	Project Work - Phase I	0	0	12	2	100	00	100
	Total	9	0	12	11	400		
Semester IV								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED 401	Project Work - Phase II	0	0	40	10	50	50	100
	Total	0	0	40	10	100		

K.S.Rangasamy College of Technology, Tiruchengode - 637 215								
Curriculum for the programmes under Autonomous Scheme								
Regulation	R 2010							
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
10 PED E01	Advanced Finite Element Analysis	3	0	0	3	50	50	100
10 PED E02	Optimization Techniques in Design	3	0	0	3	50	50	100
10 PED E03	Tribology in Design	3	0	0	3	50	50	100
10 PED E04	Advanced Strength of Materials	3	0	0	3	50	50	100
10 PED E05	Product Data Management	3	0	0	3	50	50	100
10 PED E06	Design of Hydraulic and Pneumatic Systems	3	0	0	3	50	50	100
10 PED E07	Applied Engineering Acoustics	3	0	0	3	50	50	100
10 PED E08	Advanced Tool Design	3	0	0	3	50	50	100
10 PED E09	Micro Electro Mechanical Systems Design	3	0	0	3	50	50	100
10 PED E10	Mechanics of Composite Materials	3	0	0	3	50	50	100
10 PED E11	Rapid Prototyping and Tooling	3	0	0	3	50	50	100
10 PED E12	Mechanics of Fracture	3	0	0	3	50	50	100
10 PED E13	Applied Object Oriented Programming	3	0	0	3	50	50	100
10 PED E14	Design of Material Handling Equipments	3	0	0	3	50	50	100
10 PED E15	Measurement Techniques	3	0	0	3	50	50	100
10 PED E16	Vibration Condition Monitoring	3	0	0	3	50	50	100
10 PED E17	Composite Materials and its Mechanics	3	0	0	3	50	50	100
10 PED E18	Modal Analysis of Mechanical Systems	3	0	0	3	50	50	100
10 PED E19	Integrated Manufacturing Systems	3	0	0	3	50	50	100
10 PED E20	Theory of Plates and Shells	3	0	0	3	50	50	100
10 PED E21	Design of Heat Exchangers	3	0	0	3	50	50	100
10 PED E22	Bearing Design and Rotor Dynamics	3	0	0	3	50	50	100
10 PED E23	Computational Fluid Dynamics	3	0	0	3	50	50	100
10 PED E24	Productivity Management and Re-Engineering	3	0	0	3	50	50	100
10 PED E25	Mechatronics in Manufacturing Systems	3	0	0	3	50	50	100
10 PED E26	Industrial Robotics	3	0	0	3	50	50	100
10 PED E27	Creativity in Design	3	0	0	3	50	50	100
10 PED E28	Enterprise Resource Planning	3	0	0	3	50	50	100
10 PED E29	Advanced Materials and their processing	3	0	0	3	50	50	100
10 PED E30	Special experimental techniques	3	0	0	3	50	50	100

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Curriculum for the programmes under Autonomous Scheme								
Regulation	R 2010							
Department	Department of Mechanical Engineering							
Program Code & Name	PED : M.E. Engineering Design							
List of Electives								
10 PED E31	Measurements and control	3	0	0	3	50	50	100
10 PED E32	Microcontroller system design and applications	3	0	0	3	50	50	100
10 PED E33	Advanced internal combustion engines	3	0	0	3	50	50	100
10 PED E34	Advanced heat and mass transfer	3	0	0	3	50	50	100
10 PED E35	Research Methodology - Engineering and Management Studies	3	0	0	3	50	50	100
10 PED E36	Experimental stress analysis	3	0	0	3	50	50	100
10 PED E37	Fuels and combustion	3	0	0	3	50	50	100
10 PED E38	Advances in casting and welding processes	3	0	0	3	50	50	100
10 PED E39	Quality concepts in design	3	0	0	3	50	50	100
10 PED E40	Maintenance Management	3	0	0	3	50	50	100
10 PED E41	Special Optimization	3	0	0	3	50	50	100

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<tr><td colspan="2">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 colspan="2">Course Code</td><td colspan="3">Course Name</td><td colspan="2">Hours / Week</td><td>Credit</td><td>Maximum Marks</td></tr>
<tr><td colspan="2"></td><td colspan="3"></td><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 PED 101</td><td colspan="3">ADVANCED MATHEMATICS (PED, PCA)</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">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.</td></tr>
<tr><td>1</td><td colspan="5">SIMULTANEOUS EQUATIONS AND NUMERICAL INTEGRATION</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>2</td><td colspan="5">BOUNDARY & CHARACTERISTIC VALUE PROBLEMS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>3</td><td colspan="5">CALCULUS OF VARIATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Extremum of functional involving one unknown function- Several unknown functions-Functional dependant on higher order derivatives- Several independent variables- Isoperimetric problems-Rayleigh Ritz method.</td></tr>
<tr><td>4</td><td colspan="5">ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Finite difference expressions for partial derivatives – Laplace’s equation – Liebmann method – Derivative boundary conditions- Poisson equation.</td></tr>
<tr><td>5</td><td colspan="5">PARABOLIC AND HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td>60</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Rajasekaran.S “Numerical method in Science and Engineering” – Wheeler Publishing, 1999, Second edition.</td></tr>
<tr><td>2</td><td colspan="8">M.K.Venkatraman, Higher mathematics for engineering and Science; National Publishing company, 2000</td></tr>
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<tr><td>1</td><td colspan="8">Douglas J Faires and Riched Burden, “Numerical Methods” Brooks / Cole Publishing Company, 1998, second edition.</td></tr>
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<tr><td>3</td><td colspan="8">Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Brooks/Cole Publishing Company, Fourth Edition, 1999.</td></tr>
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<tr><td colspan="9">Semester I</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" 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 colspan="2">10 PED 102</td><td colspan="2">COMPUTER APPLICATIONS IN DESIGN (PED, PCA)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To Impart knowledge on parametric sketching, data exchange formats, use of computers in design, to learn softwares like Lisp, visual basic in designing mechanical components and to develop the students ability to utilize the computers for managing product design data.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION TO COMPUTER APPLICATIONS IN NEW PRODUCT DESIGN</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Concept design – Parametric sketching – Constraints – Computer graphics principles-2D transformation, Scaling, Rotation – Windowing, View ports – Clipping – Data exchange formats.</td></tr>
<tr><td>2</td><td colspan="5">COMPUTERS IN DESIGN</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Solid modeling of Mechanical components – Associative features – Sheet metal components, Nesting and development – Plastic parts with draft and shrinkage allowance – Reverse engineering of components – Assembly of parts – Tolerance analysis – Mass property calculations.</td></tr>
<tr><td>3</td><td colspan="5">COMPUTERS IN TOOLING DESIGN</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Mould design – Jigs and fixtures design – Check for interferences – Mechanism design and analysis – Rapid tooling</td></tr>
<tr><td>4</td><td colspan="5">COMPUTERS IN DESIGN PRODUCTIVITY</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Customizing various software by using visual basic, pro/program, script, LISP etc to write applications like design of shafts, gears etc.,</td></tr>
<tr><td>5</td><td colspan="5">MANAGING PRODUCT DESIGN DATA</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="8">Version control – Library creation – Catalog making – Standardization for design –Collaborative design among peer groups – Design optimization for geometry – Design check, approval and validation.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">William M. Neumann and Robert Sproul “Principles of Computer Graphics” McGraw Hill Book Co. Singapore, 1989.</td></tr>
<tr><td>2</td><td colspan="8">Ibrahim Zeid, “CAD/CAM – Theory and Practice” – McGraw Hill, International Edition 1998.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">P N Rao “CAD/CAM: Principles and Applications” Tata McGraw Hill, Second Edition. 2004.</td></tr>
<tr><td>2</td><td colspan="8">Schlechtendahl, E. G, CAD – Data transfer for Solid Models, Springer Verlag,Berlin, 1989.</td></tr>
<tr><td>3</td><td colspan="8">Donald Hearn and M Pauline Baker “Computer Graphics” Prentice Hall Inc1992.</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
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
10 PED 103	FINITE ELEMENT ANALYSIS (PED, PCA)	3	1	0	4	50	50	100
Objective(s)	To teach students the concepts in finite element method as related to solving engineering problems and working knowledge of computer-aided engineering analysis tools and their use in design.							

1	INTRODUCTION & ONE-DIMENSIONAL PROBLEMS	Total Hrs	12
Relevance of finite element analysis in design - Variational principles and methods –Weighted-Integral statements – Weak formulations – Ritz method – Method of weighted residuals Applications of FEA - Finite element modeling – Co-ordinates and shape functions - Potential energy approach – Galerkin's approach – One-dimensional finite element models in Solid mechanics and Heat transfer – Finite element model for beams			
2	TWO-DIMENSIONAL PROBLEMS	Total Hrs	12
Poisson equation – Laplace equation – Weak form – Element matrices for triangular and rectangular elements – Evaluation of integrals – Assembly – Axi-symmetric problems – Applications – Conduction and convection heat transfer – Torsional cylindrical member – Transient analysis - Theory of elasticity – Plane strain – Plane stress – Axi-symmetric problems – Principle of virtual displacement			
3	ISOPARAMETRIC ELEMENTS	Total Hrs	12
Introduction – Bilinear quadrilateral elements – Quadratic quadrilaterals –Hexahedral elements - Numerical integration – Gauss quadrature – Static condensation – Load considerations – Stress calculations – Examples of 2D and 3D applications			
4	STRUCTURAL DYNAMICS APPLICATIONS	Total Hrs	12
Dynamic equations – Mass and damping matrices – Natural frequencies and modes– Reduction of number of DOF-response history – Model methods – Ritz vectors –Component mode synthesis – Harmonic response – Direct integration techniques –Explicit and implicit methods – Analysis by response spectra – Example problems			
5	NON-LINEAR PROBLEMS & ERROR ESTIMATES	Total Hrs	12
Introduction – Material non-linearity – Elasto Plasticity – Plasticity – Visco plasticity –Geometric non-linearity – Large displacement – Error norms and convergence rates– H-refinement with adaptivity – adaptive refinement			
Total hours to be taught			60

Text book (s) :

1	Reddy J.N., "An Introduction to the Finite Element Method", McGraw Hill, International Edition, 1993.
2	Logan D.L, "A First Course in the Finite Element Method", Third Edition, Thomson Learning, 2002.

Reference(s) :

1	Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis", Wiley, John & Sons, 1999.
2	Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984.
3	S.S.Rao, "Finite Element Analysis", 2002 Edition.
4	Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics Services, 1991.
5	Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1990.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
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
10 PED 104	CONCEPTS OF ENGINEERING DESIGN (PED, PCA)	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.							

1	THE DESIGN PROCESS	Total Hrs	9
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.			
2	TOOLS IN ENGINEERING DESIGN	Total Hrs	9
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.			
3	MATERIAL SELECTION AND MATERIALS IN DESIGN	Total Hrs	9
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.			
4	MATERIAL PROCESSING AND DESIGN	Total Hrs	9
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.			
5	LEGAL, ETHICAL ENVIRONMENTAL AND SAFETY ISSUES IN DESIGN AND QUALITY ENGINEERING	Total Hrs	9
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	Dieter, George E, Engineering Design –“A materials and processing Approach,”.Mc Graw Hill, International Edition, Singapore 2000.
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 2010
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
10 PED 105	ADVANCED MATERIAL TECHNOLOGY	3	0	0	3	50	50	100
Objective(s)	To understand the interdisciplinary applications of materials in the industry.							

1	ADVANCED FERROUS ALLOYS AND CONDUCTIVE POLYMERS	Total Hrs	10

Maraging steel, TRIP steels, HSLA Steels, Stainless steels, Conductive polymers and applications

2	ADVANCED NON FERROUS ALLOYS	Total Hrs	8

Al, Ti alloys; metallurgical aspects, properties, heat treatment and application

3	HIGH TEMPERATURE ALLOYS AND COATING, MESOPOROUS MATERIALS	Total Hrs	9

Iron base, nickel base and cobalt base super alloys, properties, strengthening mechanism and application Thermal barrier coating for high temperature application, Mesoporous materials system: Silica and Alumina, properties and applications.

4	ALLOYS AND MATERIALS FOR SPECIAL APPLICATIONS	Total Hrs	9

Overview of Shape memory alloys, Functionally gradient materials, high temperature super conductors, Smart materials.

5	NANO MATERIALS & NANO COMPOSITES	Total Hrs	9

Concept of nanomaterials – scale / dimensional aspects, nano and nature, effect of size reduction on various properties, advantages and limitations at the nano level and types of carbon nano tubes and Polymer based CNT composites

Total hours to be taught	45

Text book (s) :

1	Vijendra Singh ,Physical Metallurgy, Standard Publishers Distributors, 2005. For Advanced Ferrous Alloys and Conductive polymers chapter
2	Introduction to physical metallurgy, Avner, McGraw-Hill Education (India) Pvt Ltd, 1997. For Advanced Ferrous Alloys and Conductive polymers chapter
3	Polmear .I.J, Light alloys: metallurgy of the light metals, J. Wiley & Sons, 1995. For Advanced Non Ferrous Alloys chapter
4	Roger C. Reed, The super alloys: fundamentals and applications, Cambridge University Press. For High temperature Alloys and coating, Mesoporous materials chapter

Reference(s) :

1	Information regarding “Chapters for “Alloys and Materials for special applications, Nano materials & Nano composites” and Topics “Conductive polymers and applications, Mesoporous materials” are available in various books and research journals publications. There is no specific books which covers all aspects since all are in current research

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Semester I

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED 106	CAD LABORATORY (PED, PCA)	0	0	3	2	50	50	100

Objective(s)	To develop the students in solid modeling, sheet metal and mechanism design of mechanical components and to develop the students in feature based packages like pro-E, solid works etc..

15. Part diagrams of Mechanical parts
16. Part diagram of screw threads.
17. Part and Assembly of Flange Coupling
18. Part and Assembly of Universal Coupling
19. Part and Assembly of Bushed Bearing
20. Part and Assembly of Knuckle Joint
21. Part and Assembly of Plummer Block
22. Part and Assembly of Connecting rod
23. Part and Assembly of Screw Jack
24. Part and Assembly of Pipe Vice
25. Part and Assembly of Piston
26. Part and Assembly of Stuffing box
27. Part and Assembly of Machine Vice
28. Part and Assembly of Swivel bearing

Total Hrs	45

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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
10 PED 107	COMPUTER AIDED ANALYSIS LABORATORY I (PED, PCA)	0	0	3	2	50	50	100
Objective(s)	To develop the students to perform Structural Analysis of beams, trusses ,plate and spring, Steady state and transient heat transfer analysis of plate and slab, fluid flow analysis in pipe using analysis software.(Ansys, Nastran etc)							

13. Analysis of stepped rod with axial load.
14. Analysis of Plane truss member.
15. Analysis of cantilever beam with point load and UDL.
16. Analysis of simply supported beam with point load and UDL.
17. Analysis of I-section beam.
18. Analysis of spring system.
19. Stress analysis of corner bracket (Plane stress).
20. Analysis of circular pipe (Axi-symmetric).
21. Heat conduction in 2D plate.(steady state)
22. Heat convection in 2D plate. (steady state)
23. Transient heat transfer analysis in slab
24. Flow analysis in 2 channel pipe.

Total Hrs	45

<table>
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<tr><td colspan="8">Semester II</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">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 colspan="2">10 PED 201</td><td>MECHANICAL VIBRATIONS (PED, PCA)</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">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.</td></tr>
<tr><td>1</td><td colspan="4">FUNDAMENTALS OF VIBRATION</td><td colspan="2">Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>2</td><td colspan="4">TWO DEGREE-OF-FREEDOM SYSTEMS</td><td colspan="2">Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="8">Free vibration of spring-coupled system – Mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation</td></tr>
<tr><td>3</td><td colspan="4">MULTI DEGREE-OF-FREEDOM SYSTEMS</td><td colspan="2">Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>4</td><td colspan="4">VIBRATION OF CONTINUOUS SYSTEMS</td><td colspan="2">Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>5</td><td colspan="4">EXPERIMENTAL METHODS IN VIBRATION ANALYSIS</td><td colspan="2">Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="8">Vibration instruments – Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">60</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Thomson, W.T., “Theory of Vibration with Applications”, CBS Publishers and Distributors, New Delhi, 1990.</td></tr>
<tr><td>2</td><td colspan="7">Rao, J.S. and Gupta, K., “Introductory Course on Theory and Practice Mechanical Vibration”, New Age International (P) Ltd., New Delhi, 1999.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Den Hartog, J.P, “Mechanical Vibrations,” Dover Publications, New York, 1990.</td></tr>
<tr><td>2</td><td colspan="7">Rao, S.S., “Mechanical Vibrations”, Addison Wesley Longman, New York, 1995.</td></tr>
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<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="2">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>10 PED 202</td><td colspan="2">PRODUCT DESIGN AND DEVELOPMENT (PED, PCA)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">To Impart knowledge on product development process and challenges in product development, product planning, product specifications, concept selection and product architecture.</td></tr>
<tr><td>1</td><td colspan="4">INTRODUCTION</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Characteristics of Successful Product Development-Interdisciplinary activity-Duration and Costs of Product Development- Challenges of Product Development –Development Processes and Organizations-A Generic Development Process-Concept Development: The Front-End Process Adapting the Generic Product Development Process- The AMF Development Process-Product Development Organizations-The AMF Organization.</td></tr>
<tr><td>2</td><td colspan="4">PRODUCT PLANNING</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Product Planning Process- Identifying Opportunities- Evaluating and Prioritizing Projects- Allocating Resources and Timing- Pre-Project Planning-Reflect on the Results and the Process- Identifying Customer Needs- Raw Data from Customers- Interpreting Raw Data in Terms of Customer Needs-Organizing the Needs into a Hierarchy- Establishing the Relative Importance of the Needs-Reflecting on the Results and the Process.</td></tr>
<tr><td>3</td><td colspan="4">PRODUCT SPECIFICATIONS</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Product specifications- Stages of Specifications -Establishing Target Specifications- Setting the Final Specifications-Concept Generation-The Activity of Concept Generation-The steps in concept generation method.</td></tr>
<tr><td>4</td><td colspan="4">CONCEPT SELECTION</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Concept Selection- Overview of Methodology-Concept Screening-Concept Testing- Defining the Purpose of the Concept Test- Choosing a Survey Population- Choosing a Survey Format- Communicating the Concept- Measuring Customer Response- Interpreting the Results- Reflecting on the Results and the Process.</td></tr>
<tr><td>5</td><td colspan="4">PRODUCT ARCHITECTURE</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Product Architecture-Implications of the Architecture-Establishing the Architecture- Delayed Differentiation-Platform Planning-Related System-Level Design Issues.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Ulrich, Karl T. and Eppinger, Steven D., “Product Design and Development”, McGraw–Hill, New York, 1999.</td></tr>
<tr><td>2</td><td colspan="8">Otto, Kevien and Wood, Kristin, “Product Design” Pearson Publication, New Delhi, 2004.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Rosenthal, Stephen, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992.</td></tr>
<tr><td>2</td><td colspan="8">Stuart Pugh., “Tool Design – Integrated Methods for successful Product Engineering”, Addison Wesley Publishing, New York, 1991.</td></tr>
<tr><td>3</td><td colspan="8">Kemnneth Crow., “Concurrent Engineering / Integrated Product Development”, DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274 (310) 377-569, Workshop Book.</td></tr>
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<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>10 PED 203</td><td>ADVANCED MECHANISMS AND SYNTHESIS</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">To Impart knowledge on kinematics analysis path curvature theory, synthesis of mechanisms, static force analysis, dynamic force analysis and robot kinematics.</td></tr>
<tr><td>1</td><td colspan="4">INTRODUCTION</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">Review of fundamentals of kinematics – Mobility analysis – Formation of one D.O.F. Multi loop kinematic chains, Network formula – Gross motion concepts.</td></tr>
<tr><td>2</td><td colspan="4">KINEMATIC ANALYSIS</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">Displacement- Velocity and acceleration analysis of simple mechanisms- Instant centers kinematics analysis of complex mechanisms- Goodman analysis- Auxiliary point method.</td></tr>
<tr><td>3</td><td colspan="4">PATH CURVATURE THEORY</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">Inflection point and inflection circles. Euler – Savary equation- Bobilliers constructions- Hartmann’s construction-The cubic of stationary curvature or Burmester’s circle point and center point curves for four infinitesimally close positions of the moving plane.</td></tr>
<tr><td>4</td><td colspan="4">SYNTHESIS OF MECHANISMS</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – Function generation- Path generation- Motion generation- Graphical methods- Cognate linkages - Coupler curve synthesis- Design of six-bar mechanisms- Algebraic methods- Application of instant center in linkage design- Cam Mechanisms – Determination of optimum size of Cams.</td></tr>
<tr><td>5</td><td colspan="4">DYNAMICS OF MECHANISMS AND SPATIAL MECHANISMS AND ROBOTICS</td><td>Total Hrs</td><td colspan="3">12</td></tr>
<tr><td colspan="8">Static force analysis with friction – Inertia force analysis – Combined static and inertia force analysis- Shaking force- Kinetostatic analysis- Introduction to force and moment balancing of linkages- Kinematic Analysis of Spatial RSSR mechanism – Denavit – Hartenberg Parameters- Forward and inverse Kinematics of Robotic Manipulators- Study and use of Mechanism using Simulation Software packages.</td></tr>
<tr><td colspan="6">Total hours to be taught</td><td colspan="3">60</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Sandor G.N., and Erdman A.G., “Advanced Mechanism Design Analysis and Synthesis”, Prentice Hall, 1984.</td></tr>
<tr><td>2</td><td colspan="7">Shigley, J.E., and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw Hill, 1995.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Ghosh, Amitabha and Mallik, Asok Kumar., “Theory of Mechanism and Machines”, EWLP, Delhi, 1999.</td></tr>
<tr><td>2</td><td colspan="7">Nortron, R.L., “Design of Machinery”, Tata McGraw-Hill, New Delhi, 2005.</td></tr>
<tr><td>3</td><td colspan="7">Waldron, Kenneth J, and Kinzel, Gary L., “Kinematics, Dynamics and Design of Machinery”, John Wiley & Sons, New York. 1999.</td></tr>
</table>

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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
10 PED 204	DESIGN FOR MANUFACTURE AND ASSEMBLY	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on process capability and tolerances, form design, component design machining consideration, casting consideration in component design and design for the environment.							

1	PROCESS CAPABILITY AND TOLERANCES	Total Hrs	9
General design principles for manufacturability - Strength and mechanical factors- Mechanisms selection- Evaluation method - Process capability - Feature tolerances - Geometric tolerances – Worst case method - Assembly limits -Datum features – Tolerance stacks.			
2	FACTORS INFLUENCING FORM DESIGN	Total Hrs	9
Influence of materials on form design - Form design of grey iron- Malleable iron-Steel and Aluminum castings - Form design of welded members and forgings.			
3	COMPONENT DESIGN - MACHINING CONSIDERATION	Total Hrs	9
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.			
4	COMPONENT DESIGN - CASTING CONSIDERATION	Total Hrs	9
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			
5	DESIGN FOR THE ENVIRONMENT	Total Hrs	9
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.			
Total hours to be taught			45

Text book (s) :

1	Peck, Harry, "Designing for Manufacture", Pitman Publications, 1983.
2	Bralla., "Design for Manufacture Handbook", McGraw-Hill, New York, 1999.

Reference(s) :

1	Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Second Edition, Marcel Dekker Inc., London, 2002.
2	Otto, Kevien and Wood, Kristin, "Product Design", Pearson Publication, New Delhi, 2004.
3	Matousek, "Engineering Design- A Systematic Approach", Blackie & Son Ltd., London, 1974.
4	Allen, Graedel T., "Design for the Environment", Prentice Hall, New Jersey, 1996.
5	Fixel, J., "Design for the Environment", McGraw-Hill, New Delhi, 1996.

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
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
10 PED 205	COMPUTER AIDED ANALYSIS LABORATORY II (PED, PCA)	0	0	3	2	50	50	100
Objective(s)	To develop the students to perform Design optimization, Buckling, Modal, Transient and Harmonic, Explicit, Non linear analysis ,Heat transfer analysis of composite wall and fin, Fluid flow analysis in duct and flat plate using analysis software. .(Ansys, Nastran etc)							

13. Design optimization of cantilever beam.
14. Solid model creation.
15. Buckling analysis of gear shift rod.
16. Modal analysis of cantilever beam.
17. Transient analysis of cantilever beam.
18. Harmonic analysis of cantilever beam.
19. Drop test analysis of Aluminum container on steel plate.
20. Non linear contact analysis
21. Heat transfer analysis in composite wall
22. Heat transfer analysis in automobile fin.
23. Air flow in 2D duct.
24. Flow over a flat plate.

Total Hrs	45

<table>
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<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="8">Semester II</td></tr>
<tr><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">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>10 PED 206</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="8">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="8">• 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="7">Activity</td></tr>
<tr><td>I</td><td colspan="7">Allotment of Faculty Guide by the HoD</td></tr>
<tr><td>II</td><td colspan="7">Finalizing the topic with the approval of Faculty Guide</td></tr>
<tr><td>III-IV</td><td colspan="7">Collection of Technical papers</td></tr>
<tr><td>V-VI</td><td colspan="7">Mid semester presentation</td></tr>
<tr><td>VII-VIII</td><td colspan="7">Report writing</td></tr>
<tr><td>IX</td><td colspan="7">Report submission</td></tr>
<tr><td>X-XI</td><td colspan="7">Final presentation</td></tr>
<tr><td rowspan="6">Evaluation</td><td colspan="8">❖ 100% by Continuous Assessment
❖ 2 Hrs/week</td></tr>
<tr><td colspan="6">Component</td><td colspan="2">Weightage</td></tr>
<tr><td colspan="6">Phase -I Presentation</td><td colspan="2">25 %</td></tr>
<tr><td colspan="6">Phase - II Presentation</td><td colspan="2">25 %</td></tr>
<tr><td colspan="6">Report Preparation and Submission</td><td colspan="2">30 %</td></tr>
<tr><td colspan="6">Final Presentation</td><td colspan="2">20 %</td></tr>
<tr><td colspan="6">Total</td><td colspan="2">100 %</td></tr>
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<table>
<tr><td colspan="7">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="4">PED : M.E. Engineering Design</td></tr>
<tr><td colspan="10">Semester III</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="4">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>10 PED 301</td><td>PROJECT WORK - PHASE I</td><td>0</td><td>0</td><td>12</td><td>2</td><td>100</td><td>00</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="9">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.</td></tr>
<tr><td>Methodology</td><td colspan="9">• 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 as given below
• Preliminary implementation can be done if possible
• Internal evaluation has to be done for 100marks</td></tr>
</table>

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<tr><td>Department</td><td colspan="2">Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="4">PED : M.E. Engineering Design</td></tr>
<tr><td colspan="10">Semester IV</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>10 PED 401</td><td>PROJECT WORK - PHASE II</td><td>0</td><td>0</td><td>40</td><td>10</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="9">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.</td></tr>
<tr><td>Methodology</td><td colspan="9">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 fro 100 marks
Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or more chance may be given
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 with in the college)
The report should be submitted by the students around at the end of may</td></tr>
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<tr><td colspan="9">Elective</td></tr>
<tr><td colspan="2" 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 colspan="2">10 PED E01</td><td>ADVANCED FINITE ELEMENT ANALYSIS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To teach students the concepts in finite element method as related to solving engineering problems involving fluid mechanics, linear and non-linear and to provide students with a working knowledge of computer-aided engineering analysis tools and their use in design.</td></tr>
<tr><td>1</td><td colspan="5">BENDING OF PLATES AND SHELLS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non Conforming Elements – C_0 and C_1 Continuity Elements – Application and Examples.</td></tr>
<tr><td>2</td><td colspan="5">NON-LINEAR PROBLEMS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity –Visco Plasticity – Geometric Non linearity – large displacement Formulation – Application in Metal Forming Process and Contact Problems.</td></tr>
<tr><td>3</td><td colspan="5">DYNAMIC PROBLEM</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Direct Formulation – Free, Transient and Forced Response – Solution Procedures –Subspace Iterative Technique – Houbolt, Wilson, Newmark – Methods – Examples.</td></tr>
<tr><td>4</td><td colspan="5">FLUID MECHANICS AND HEAT TRANSFER</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Governing Equations of Fluid Mechanics – Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming – Navier Stokes Equation – Steady and Transient Solution.</td></tr>
<tr><td>5</td><td colspan="5">ERROR ESTIMATES AND ADAPTIVE REFINEMENT</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Error norms and Convergence rates – h-refinement with adaptivity – Adaptive refinement.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Cook, R.D., “Concepts and Applications of Finite Element Analysis”, Wiley India Pvt Ltd., Fourth Edition, 2007.</td></tr>
<tr><td>2</td><td colspan="8">Tirupathi R Chandrupatla, T R Chandrupatla, Ashok D Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall, Third Edition, 2002</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Bathe, K.J., “Finite Element Procedures in Engineering Analysis”, Prentice Hall, New Jersey, 1990.</td></tr>
<tr><td>2</td><td colspan="8">S.S.Rao, “Finite Element Analysis”, Elesevier, Fourth Edition, 2005.</td></tr>
<tr><td>3</td><td colspan="8">Logan D.L, “A First Course in the Finite Element Method”, Third Edition, Thomson Learning, 2002.</td></tr>
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K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name		PED : M.E. Engineering Design				
Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E02	OPTIMIZATION TECHNIQUES IN DESIGN	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on static, dynamic constrained and unconstrained optimization techniques in design.							

1	INTRODUCTION	Total Hrs	9
General Characteristics of mechanical elements - Adequate and Optimum design - Principles of optimization - Formulation of objective function - Design constraints – Classification of optimization problem.			
2	UNCONSTRAINED OPTIMIZATION	Total Hrs	9
Single variable and Multivariable optimization- Techniques of unconstrained minimization – Golden section, Pattern and Gradient search methods – Interpolation methods.			
3	CONSTRAINED OPTIMIZATION	Total Hrs	9
Optimization with equality and inequality constraints - Indirect methods using penalty functions - Lagrange multipliers - Geometric programming - Constrained, mixed inequality and unconstrained minimization - Genetic algorithms.			
4	STATIC APPLICATIONS	Total Hrs	9
Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, maximum weight – Design of shafts and torsionally loaded members – Design of springs.			
5	DYNAMIC APPLICATIONS	Total Hrs	9
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	Singiresu S.Rao., “Engineering Optimization Theory and Practice”, New Age International (P) Limited, Publishers 1996.
2	Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 1990.

Reference(s) :

1	Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 1995.
2	Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison-Wesley, New York, 1989.

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<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 colspan="2">10 PED E03</td><td colspan="2">TRIBOLOGY IN DESIGN</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To create awareness of the importance of Tribology in design and selection of machine elements.</td></tr>
<tr><td>1</td><td colspan="5">SURFACES, FRICTION AND WEAR</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Topography of surfaces – Surfaces features – Experimental Determinations of surface structure – Chemical analysis of surface – Surface effects in Tribology – Analysis of surface roughness – Measurement of surface roughness. Friction – Mechanism of friction, measuring friction, equations and models of friction – Friction.
Properties of metallic and non metallic materials- friction in extreme conditions- Wear – Types, mechanism, mapping, measurements, wear resistance materials – surface treatment, surface modifications and surface coatings- Computer Simulations of friction, Lubrication and wear.</td></tr>
<tr><td>2</td><td colspan="5">LUBRICATION THEORY</td><td>Total Hrs</td><td colspan="2">7</td></tr>
<tr><td colspan="9">Lubricants – Selection criteria – Lubrication regimes – Hydrodynamic, elasto and plasto hydrodynamic lubrication - Basic equations - Reynold’s equation - Energy equation, boundary lubrication, boundary lubricating films and its properties- Hydrostatic lubrication – Gas lubrication</td></tr>
<tr><td>3</td><td colspan="5">DESIGN OF FLUID FILM BEARINGS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Dynamic analysis of hydrodynamic bearing performance, trust and journal bearings– Full, partial, fixed and pivoted – Mass flow rate, friction, power loss, heat and temperature difference, dynamic loads, oil film thickness, stiffness of squeeze film and dynamic co-efficient – Hydrostatic bearing design.</td></tr>
<tr><td>4</td><td colspan="5">INDUSTRIAL COMPONENTS AND SYSTEMS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Slider bearings – Self acting finite bearings, failure modes, materials rolling element bearings – Types, contact mechanics, bearing internal load distribution, lubrication – Bearing geometry and kinematics, load ratings and life prediction, torque calculation, temperature analysis, endurance testing and failure analysis.</td></tr>
<tr><td>5</td><td colspan="5">SPACE AND AUTOMOTIVE TRIBOLOGY</td><td>Total Hrs</td><td colspan="2">11</td></tr>
<tr><td colspan="9">Introduction – Mechanism, components, liquid and solid lubricants, accelerated testing and life testing of space mechanism. Principles of Aerospace eccentric bearing test mechanism. Engine Tribology –Importance, lubrication regimes, engine bearings, wheel bearings, tire- Mechanics of load transfer – Contact area and normal pressure distribution, brakes, effects of service on engine oil properties. Tribology in manufacturing – Macro and micro tribology of MEMS materials - Technologies for machinery diagnosis and prognosis.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981.</td></tr>
<tr><td>2</td><td colspan="8">Hulling, J.(Editor) – “ Principles of Tribology”, MacMillan, 1984.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Williams, J.A. “Engineering Tribology”, Oxford University Press, 1994.</td></tr>
<tr><td>2</td><td colspan="8">Neale, M.J. “Tribology Handbook”, Butterworth Heinemann, 1995.</td></tr>
<tr><td>3</td><td colspan="8">Bharat Bhushan, “Modern Tribology Handbook” Vol. – I & II.</td></tr>
</table>

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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E04	ADVANCED STRENGTH OF MATERIALS	3	0	0	3	50	50	100
Objective(s)	To Analyze, understand and predict the mechanical behavior of deformable solid bodies using techniques from engineering mechanics and applied mathematics, basic concepts in mechanics of materials to more advanced topics and advanced mechanics of materials topics such as unsymmetrical beam bending.							

1	ELASTICITY	Total Hrs	9
Stress – Strain relation and General equation of elasticity in Cartesian, Polar and Spherical coordinates- Differential equation of equilibrium – Compact ability – Boundary conditions - Representations of three dimensional stress of a tension – Generalized Hooke's law – St.Vennant's principle – Plane strain - Plane stress –-Shear Centre - Location of shear centre for various sections – Shear flow.			
2	UNSYMMETRICAL BENDING	Total Hrs	9
Stresses and Deflection in beams subjected to unsymmetrical loading – Kern of a section - Curved flexural members - Circumferential and Radial stresses – Deflection and radial curved beam with re-strained ends – Closed ring subjected to concentrated load and uniform load – Chain link and crane hooks.			
3	THICK CYLINDERS AND ROTATING DISKS	Total Hrs	9
Thick walled cylinder subjected to internal and external pressures – Shrink fit joints – Stresses due to rotation – Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – Allowable speed. – Rotating shafts and cylinders.			
4	TORSION OF NON CIRCULAR SECTIONS	Total Hrs	9
Torsion of rectangular cross section – St.Vennant Theory – Elastic membrane analogy – Prandtl's stress function – Torsional stresses in hollow thin walled tubes.			
5	STRESSES IN FLAT PLATES	Total Hrs	9
Stresses in circular and rectangular plates due to various types of loading and end conditions – Buckling of plates - Theory of contact stresses – Methods of computing contact stresses – Deflection of bodies in point and line contact – Applications.			
Total hours to be taught			45

Text book (s) :

1	Arthur P.Boresi and Omar M.Siseborttom, "Advanced Mechanics of Materials", John, Willey International Education, 1985.
2	Robert,D.Cook, Wareen.C.Yound, "Advanced Mechanics of Materials", Macmillan Publishers Company, 1985.

Reference(s) :

1	Srinath.L.S., Advanced Mechanics of Solids, Tata McGraw Hill Publishing Company Limited, 2003
2	KrishnaRaju, N., Gururaja,D.R., Advanced Mechanics of Solids and Structures, Narosa Publishing House, 1997.
3	U.C.Jindal, "Advanced Topics of Strength of materials", Galgotia Publications, First edition, 1997.

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Elective								
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		L	T	P	C	CA	ES	Total
10 PED E05	PRODUCT DATA MANAGEMENT	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on change management, configuration management, components on product data, projects and variants.							

1	INTRODUCTION	Total Hrs	9
Introduction to PDM - Present market constraints - Need for collaboration - Internet and developments in server - Client computing.			
2	COMPONENTS OF PDM	Total Hrs	9
Components of a typical PDM setup - Hardware and software-document management - Creation and viewing of documents - Creating parts - Versions and version control of parts and documents - Case studies.			
3	CONFIGURATION MANAGEMENT	Total Hrs	9
Base lines - Product structure - Configuration management - Case studies.			
4	PROJECTS AND ROLES & CHANGE MANAGEMENT	Total Hrs	9
Creation of projects and roles - Life cycle of a product - Life cycle management automating information flow -Work flows - Creation of work flow templates - Life cycle work flow integration - Case studies. Change issue - Change request - Change investigation - Change proposal – Change activity - Case studies.			
5	GENERIC PRODUCTS AND VARIANTS	Total Hrs	9
Data Management Systems for FEA data - Product configuration – Comparison between sales configuration and product configuration - Generic product modeling in configuration modeler - Use of order generator for variant creation - Registering of variants in product register - Case studies.			
Total hours to be taught			45

Text book (s) :

1	Kevin Otto, Kristin Wood, “Product Design”, Pearson, 2001.
2	Daniel Amor, “The E-Business Revolution”, Prentice-Hall, 2000.

Reference(s) :

1	David Bed worth. Mark Henderson & Phillip Wolfe. “Computer Integrated Design and Manufacturing “. McGraw Hill Inc...1991.
2	Terry Quatrain. “Visual Modeling with Rational Rose and UML “. Addison Wesley...1998.
3	Wind-Chill R5.0 Reference Manuals 2000.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E06	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on design of Hydraulic and pneumatic systems, oil hydraulic systems, Hydraulic & pneumatic actuators, their control and regulation elements, hydraulic & pneumatic circuits and their installation and maintenance.							
1	OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS				Total Hrs	9		
Hydraulic Power Generators – Selection and specification of pumps - Pump characteristics - Determination of volumetric, mechanical and overall efficiencies of positive displacement pumps - Linear and Rotary Actuators – Selection, specification and characteristics.								
2	CONTROL AND REGULATION ELEMENTS				Total Hrs	9		
Pressure - Direction and flow control valves - Relief valves, non-return and safety valves - Actuation systems. Electrical control solenoid valves, relays - Electro hydraulic servo valves.								
3	HYDRAULIC CIRCUITS				Total Hrs	9		
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.								
4	PNEUMATIC SYSTEMS AND CIRCUITS				Total Hrs	9		
Pneumatic fundamentals - Control elements, position and pressure sensing - Logic circuits - Switching circuits - Fringe conditions modules and these integration - Sequential circuits -Cascade methods - Mapping methods - Step counter method - Compound circuit design -Combination circuit design.								
5	INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS				Total Hrs	9		
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	Espossito, Antony., “Fluid Power with Applications”, Prentice Hall, New York, 1980.							
2	Pease, Dudleyt, A. and Pippenger, John J., “Industrial Hydraulics”, Tata McGraw-Hill, New Delhi, 1985.							
Reference(s) :								
1	Parr, Andrew, “Hydraulic and Pneumatics”, Jaico Publishing House, New Delhi, 2004.							
2	Bolton. W., “Pneumatic and Hydraulic Systems”, Butterworth –Heinemann, 1997.							

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<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" 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 colspan="2">10 PED E07</td><td colspan="2">APPLIED ENGINEERING ACOUSTICS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="8">To Impart knowledge on basic concepts of acoustics, characterization of sound and their transmission phenomena and concepts of noise control</td></tr>
<tr><td>1</td><td colspan="5">BASIC CONCEPTS OF ACOUSTICS</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">Scope of Acoustics – Sound pressure – Sound intensity – Sound power level Sound power– Wave motion – Alteration of wave paths –Measurement of sound waves – sound spectra– Sound fields – Interference – Standing waves – Acoustic energy density and intensity –Specific acoustic impedance.</td></tr>
<tr><td>2</td><td colspan="5">CHARACTERISTICS OF SOUND</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">The one dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimension.</td></tr>
<tr><td>3</td><td colspan="5">TRANSMISSION PHENOMENA</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence– Standing wave pattern – Transmission through three media.</td></tr>
<tr><td>4</td><td colspan="5">AN INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">Introduction – The decibel scale for the measurement of sound power – Sound level meter – Weighted sound pressure level – Equal Loudness contours – Perceived noisiness –Loudness, Loudness level, perceived noise, perceived noise level – Equivalent sound level– Identified level – Frequency and Amplitude measurement.</td></tr>
<tr><td>5</td><td colspan="5">BASIC CONCEPTS OF NOISE CONTROL</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">Noise Control at source, path, and receiver – Noise control by acoustical treatment – Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="10">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="9">Kinsler, Lawrence E. and Frey, Austin R., “Fundamentals of Acoustics”, John Wiley & Sons New York, 1986.</td></tr>
<tr><td>2</td><td colspan="9">Bies, David A. and Hansen, Colin H., “Engineering Noise Control: Theory and Practice”, Second Edition, Chapman-Hall, London, 1996.</td></tr>
<tr><td colspan="10">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="9">Hansen, C.H. and Snyder, S.D., “Active Control of Sound and Vibration”, E and FN Spon, London, 1996.</td></tr>
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<tr><td colspan="7">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td colspan="2">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="10">Elective</td></tr>
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<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 colspan="2">10 PED E08</td><td colspan="2">ADVANCED TOOL DESIGN</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="8">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.</td></tr>
<tr><td>1</td><td colspan="5">TOOL-DESIGN METHODS</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">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.</td></tr>
<tr><td>2</td><td colspan="5">TOOLING MATERIALS AND HEAT TREATMENT</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td>3</td><td colspan="5">DESIGN OF DRILL JIGS</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td>4</td><td colspan="5">DESIGN OF FIXTURES AND DIES</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">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.</td></tr>
<tr><td>5</td><td colspan="5">TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="10">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="9">Donaldson, Cyrll., LeCain, George H. and Goold, V.C., “Tool Design”, Tata McGraw- Hill, New York, 2000.</td></tr>
<tr><td>2</td><td colspan="9">Joshi, Prakash Hiralal., “Tooling Data”, Wheeler Publishing, Allagabad, 2000.</td></tr>
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K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
Department	Mechanical Engineering	Programme Code & Name		PED : M.E. Engineering Design				
Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E09	MICRO ELECTRO MECHANICAL SYSTEMS DESIGN	3	0	0	3	50	50	100
Objective(s)	To Impart knowledge on micro actuation techniques, scaling laws and scaling in mechanical applications, materials and fabrication process, micro mechanics, micro system manufacturing and micro system design.							
1	INTRODUCTION				Total Hrs	9		
Overview-Microsystems and microelectronics - Working principle of Microsystems -Micro actuation techniques-Micro sensors-Types-microactuators-Types-Micropumpmicromotors-Micro-Valves-Microgrippers-Scaling laws-Scaling in geometry-Scaling in rigid body dynamics- Scaling in electrostatic forces- Scaling in electricity- Scaling in fluid mechanics- Scaling in heat transfer.								
2	MATERIALS AND FABRICATION PROCESS				Total Hrs	9		
Substrates and wafer-single crystal silicon wafer formation-ideal substrates mechanical properties-silicon compounds - Sio2, SiC, Si3N4 and polycrystalline silicon - Silicon piezo resistors - Gallium are senside, Quartz-piezoelectric crystals polymers for MEMS -conductive polymers – Photolithography - Ion implantation -Diffusion – Oxidation –CVD - Physical vapor deposition - Deposition by epitaxy - Etching process.								
3	MICROMECHANICS				Total Hrs	9		
Introduction-static bending of thin plates-circular plates with edge fixed – Rectangular plate with all edges fixed and square plate with all edges fixed – Mechanical vibration-resonant vibration- Micro accelerometers-design theory and damping coefficients- Thermo mechanics-Thermal stresses-fracture mechanics-Stress intensity factors, Fracture toughness and interfacial fracture mechanics.								
4	MICRO SYSTEM MANUFACTURING				Total Hrs	9		
Clean room technology-Bulk Micro manufacturing- Surface micro machining –LIGASLIGA-Micro system packaging-materials-Die level-device level-System level packaging techniques-Die preparation-Surface bonding-Wire bonding-sealing.								
5	MICRO SYSTEM DESIGN				Total Hrs	9		
Design considerations-Process design-Mask layout design- Mechanical design applications of micro system in -Automotive industry-Bio medical –Aero space telecommunications.								
Total hours to be taught						45		
Text book (s) :								
1	Mohamed Gad-el-Hak, The MEMS Hand book, CRC press 2002.							
2	Julian W.Gardner,Vijay K.Varadan, Osama O.Awadel Karim, Microsensors MEMS and Smart Devices, John Wiby & sons Ltd.,2001.							
Reference(s) :								
1	S.Fatikow, U.Rembold, Microsystem Technology and Microrobotics, Springer-Verlag Berlin Heidelberg, 1997.							
2	Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture, Tata McGraw-Hill, 2006.							
3	Francis E.H Tay and W.O Choong, Microfludics and BioMEMS Applications, Springer, 2002.							

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<tr><td colspan="2">Department</td><td>Mechanical Engineering</td><td colspan="2">Programme Code & Name</td><td colspan="3">PED : M.E. Engineering Design</td></tr>
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<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 colspan="2">10 PED E10</td><td>MECHANICS OF COMPOSITE MATERIALS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To Impart knowledge on Principles of Composite Material Mechanics, mechanics of composite materials their design structure and its manufacturing.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td>Total Hrs</td><td colspan="2">8</td></tr>
<tr><td colspan="9">Definition – Need – General Characteristics - Applications - Fibers – Glass, Carbon, Ceramic and Aramid fibers - Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices - Fiber surface treatments - Fillers and additives - Fiber content, density and void content.</td></tr>
<tr><td>2</td><td colspan="5">MECHANICS</td><td>Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="9">Rule of mixture - Volume and mass fractions – Density - Void content - Evaluation of four elastic moduli based on strength of materials approach and Semi - Empirical model - Longitudinal Young’s modulus - transverse Young’s modulus – major Poisson’s ratio - In-plane shear modulus, Ultimate strengths of a unidirectional lamina - Characteristics of Fiber -Reinforced lamina – Laminates –Lamination theory, Interlaminar stresses</td></tr>
<tr><td>3</td><td colspan="5">PERFORMANCE</td><td>Total Hrs</td><td colspan="2">5</td></tr>
<tr><td colspan="9">Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Long term properties, Fracture Behavior and Damage Tolerance.</td></tr>
<tr><td>4</td><td colspan="5">MANUFACTURING</td><td>Total Hrs</td><td colspan="2">8</td></tr>
<tr><td colspan="9">Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes – Quality Inspection methods - Processing of MMC – Diffusion bonding – Stir casting – Squeeze casting.</td></tr>
<tr><td>5</td><td colspan="5">DESIGN OF STRUCTURES</td><td>Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="9">Failure Predictions - Laminate Design Consideration -Design criteria - Design allowable - Design guidelines - Joint design-Bolted and Bonded Joints - Design Examples - Design of a tension member – Design of a compression member – Design of a beam-design of a torsional member - Application of FEM for design and analysis of laminated composites.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Mallick, P.K., “Fiber Reinforced Composites: Materials, Manufacturing and Design”, Marcel Dekker Inc, 1993.</td></tr>
<tr><td>2</td><td colspan="8">Autar K. Kaw, “Mechanics of Composite Materials” CRC Press, 2006.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, New York, 1990.</td></tr>
<tr><td>2</td><td colspan="8">Ronald Gibson, “Principles of Composite Material Mechanics", Tata McGraw Hill, 1994.</td></tr>
<tr><td>3</td><td colspan="8">Chawla K.K., “Composite materials”, Springer – Verlag, 1987.</td></tr>
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<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>10 PED E11</td><td colspan="2">RAPID PROTOTYPING AND TOOLING</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">To understand the rapid tooling software for rapid prototyping and rapid prototyping in manufacturing industries.</td></tr>
<tr><td>1</td><td colspan="4">INTRODUCTION AND STEREOLITHOGRAPHY SYSTEMS</td><td colspan="2">Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="8">Need for the compression in product development - History of RP systems - Survey of applications - Growth of RP industry and classification of RP systems. Stereolithography Systems: Principle - Process parameters - Process details - Data preparation - Data files and Machine details - Applications. Selective Laser Sintering - Types of machines - Principle of operation - Process parameters - Data preparation for SLS - Applications.</td></tr>
<tr><td>2</td><td colspan="4">FUSION DEPOSITION MODELING</td><td colspan="2">Total Hrs</td><td colspan="2">6</td></tr>
<tr><td colspan="8">Principle - Process parameters - Path generation - Applications. Solid Ground Curing - Principle of operation - Machine details - Applications.</td></tr>
<tr><td>3</td><td colspan="4">LAMINATED OBJECT MANUFACTURING</td><td colspan="2">Total Hrs</td><td colspan="2">8</td></tr>
<tr><td colspan="8">Principle of operation - LOM materials - Process details - Applications. Concept Modelers – Principle - Thermo jet printer - Sander’s model market - 3-D printer - Genisys Xs printer - JP system 5 - Object Quadra System. Laser Engineered Net Shaping (LENS) – Principle – Applications.</td></tr>
<tr><td>4</td><td colspan="4">RAPID TOOLING</td><td colspan="2">Total Hrs</td><td colspan="2">7</td></tr>
<tr><td colspan="8">Indirect Rapid Tooling - Silicone rubber tooling - Aluminum filled epoxy tooling - Spray metal tooling etc. Direct Rapid Tooling - Direct AIM - Quick cast process - Copper polyamide - Rapid Tool – DMILS – ProMetal - Sand casting tooling - Laminate tooling - Soft tooling Vs Hard tooling.</td></tr>
<tr><td>5</td><td colspan="4">SOFTWARE FOR RAPID PROTOTYPING</td><td colspan="2">Total Hrs</td><td colspan="2">12</td></tr>
<tr><td colspan="8">STL files - Overview of Solid view - Magics, mimics, magics communicator, etc.- Internet based soft wares - Collaboration tools - Rapid Manufacturing Process Optimization - Factors influencing accuracy - Data preparation errors - Part building errors - Errors in finishing - Influence of part build orientation. Allied
Processes - Vacuum Casting - Surface Digitizing - Surface Generation from point cloud -Surface modification and data transfer to solid models.</td></tr>
<tr><td colspan="6">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Paul. F. Jacobs, "Stereo lithography and other RP & M Technologies", SME, NY, 1996.</td></tr>
<tr><td>2</td><td colspan="7">Pham. D. T. & Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2001.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Terry Wohlers, "Wohlers Report 2006", Wohlers Associates, 2006.</td></tr>
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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E12	MECHANICS OF FRACTURE	3	0	0	3	50	50	100
Objective(s)	To prove in depth study on stationary crack, crack growth and fatigue crack growth and to analyze crack Growth for cyclic loading and crack initiation under large scale.							
1	ELEMENTS OF SOLID MECHANICS				Total Hrs	9		
The geometry of stress and strain - Elastic deformation - Plastic and elasto-plastic deformation - Limit analysis.								
2	STATIONARY CRACK UNDER STATIC LOADING				Total Hrs	9		
Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - Plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement.								
3	ENERGY BALANCE AND CRACK GROWTH				Total Hrs	9		
Griffith analysis – Linear Fracture Mechanics - Crack Opening displacement – Dynamic energy balance – Crack arrest.								
4	FATIGUE CRACK GROWTH CURVE				Total Hrs	9		
Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – Effects of changing the load spectrum – Effects of Environment.								
5	ELEMENTS OF APPLIED FRACTURE MECHANICS				Total Hrs	9		
Examples of crack-growth Analysis for cyclic loading - Leak before break – Crack Initiation under large scale yielding – Thickness as a Design parameter – Crack instability in Thermal or Residual – Stress fields.								
Total hours to be taught						45		
Text book (s) :								
1	Broek, David. "Elementary Engineering Fracture Mechanics", Fifthoff & Noerdhoff International Publisher, 1978.							
2	Hellan, Kare., "Introduction of Fracture Mechanics", McGraw-Hill, New York, 1985.							
Reference(s) :								
1	Preshant Kumar., "Elements of Fracture Mechanics", Wheeler Publishing, Allahabad, 1999.							

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<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>10 PED E13</td><td colspan="2">APPLIED OBJECT ORIENTED PROGRAMMING</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">To Impart some fundamentals of object oriented programming, C++ data types, C++ classes, class derivation and applications of all</td></tr>
<tr><td>1</td><td colspan="4">FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING</td><td colspan="2">Total Hrs</td><td>5</td></tr>
<tr><td colspan="8">Elements of OOP, classes, subjects, messaging, inheritance, polymorphism, OOP paradigm versus Procedural paradigm, object-oriented design.</td></tr>
<tr><td>2</td><td colspan="4">C++ DATA TYPES</td><td colspan="2">Total Hrs</td><td>15</td></tr>
<tr><td colspan="8">Expression and statements, operators, precedence, type conversion, flow control, Arrays structures, argument passing, reference argument, overloaded function.</td></tr>
<tr><td>3</td><td colspan="4">C++ CLASS</td><td colspan="2">Total Hrs</td><td>5</td></tr>
<tr><td colspan="8">Definition, class objects, member functions, pointer friends, class member pointer, scope, unions, bit-fields, class argument and ellises - Class member functions, initialization, operator overloading, user defined conversions.</td></tr>
<tr><td>4</td><td colspan="4">CLASS DERIVATION</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">Derivation specification, Information hiding under derivation public and private base classes, standard conventions under derivation, class scope, Initialization and assignment under derivation.</td></tr>
<tr><td>5</td><td colspan="4">APPLICATION</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">OOP’s applications in linear programming, integer programming, simulation, etc.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Wiener, Richard, S. and Pinson, Lewis, J. “An introduction to objective oriented programming and C++ ", 1999.</td></tr>
<tr><td>2</td><td colspan="7">Stanley B.Lippman, “C++ primer ", Addison - Wesley Pub. Co., 1989.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Robert Lafore, “Object Oriented programming in Turbo C++ ", Galgotia Publication, 1992.</td></tr>
<tr><td>2</td><td colspan="7">Strousstrup, Bjarne, The “C++ programming languages ", Addison Wesley, 1986.</td></tr>
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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E14	DESIGN OF MATERIAL HANDLING EQUIPMENTS	3	0	0	3	50	50	100
Objective(s)	To give a comprehensive insight on design of hoists, Hoisting gear, conveyors and Elevators.							

1	MATERIALS HANDLING EQUIPMENT	Total Hrs	6
Types of material handling equipments - Selection and applications.			
2	DESIGN OF HOISTS	Total Hrs	12
Design of hoisting elements - Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments - Design of forged hooks and eye hooks - Crane grabs - Lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types			
3	DRIVES OF HOISTING GEAR	Total Hrs	9
Hand and power drives - Traveling gear - Rail traveling mechanism - Cantilever and monorail cranes - Slewing, jib and luffing gear - Cogwheel drive - Selecting the motor ratings.			
4	CONVEYORS	Total Hrs	12
Types - Description - Design and applications of Belt conveyors, apron conveyors and escalators - Pneumatic conveyors - Screw conveyors - Vibratory conveyors.			
5	ELEVATORS	Total Hrs	9
Bucket elevators: design - Loading and bucket arrangements - Cage elevators - Shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.			
Total hours to be taught			45

Text book (s) :

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

Reference(s) :

1	Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, 1981.
2	Boltzharol, A., “Materials Handling Handbook”, The Ronald Press Company, 1958.
3	P.S.G. Tech, “Design Data Book”, Kalaikathir Achchagam, Coimbatore, 2003.
4	Lingaiah. K. and Narayana Iyengar, “Machine Design Data Hand Book”, Vol. 1 & 2, Suma Publishers, Bangalore, 1983.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E15	MEASUREMENT TECHNIQUES	3	0	0	3	50	50	100
Objective(s)	To prove in depth study on forces and strain measurement and vibration measurements, principles of Acoustics and distress measurements and non-destructive testing methods.							
1	FORCES AND STRAIN MEASUREMENT				Total Hrs	9		
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								
2	VIBRATION MEASUREMENTS				Total Hrs	9		
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.								
3	ACOUSTICS AND WIND FLOW MEASURES				Total Hrs	9		
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.								
4	DISTRESS MEASUREMENTS				Total Hrs	9		
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.								
5	NON DESTRUCTIVE TESTING METHODS				Total Hrs	9		
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.							

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		L	T	P	C	CA	ES	Total
10 PED E16	VIBRATION CONDITION MONITORING	3	0	0	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.							
1	INTRODUCTION				Total Hrs	9		
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.								
2	VIBRATION CONTROL				Total Hrs	9		
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.								
3	ACTIVE VIBRATION CONTROL				Total Hrs	9		
Introduction – Concepts and applications - Review of smart materials – Types and Characteristics - Review of smart structures – Characteristics Active vibration control in smart structures.								
4	CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS				Total Hrs	9		
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.								
5	DYNAMIC BALANCING AND ALIGNMENT OF MACHINERY				Total Hrs	9		
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.								
Total hours to be taught						45		
Text book (s) :								
1	Bathe K.J. and Wilson, F.I., “Numerical Methods in Finite Element Analysis”, Prentice Hall of India, New Delhi, 1978.							
2	Hartog, J.O. Den., “Mechanical Vibrations”, McGraw-Hill, New York, 1985.							
Reference(s) :								
1	Rao, J.S., “Vibratory Condition Monitoring of Machines”, CRC Press, London, 2000.							
2	“Hand Book of Condition Monitoring”, Elsevier Science, Amsterdam, 1996.							

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10 PED E17	COMPOSITE MATERIALS AND ITS MECHANICS	3	0	0	3	50	50	100
Objective(s)	To understand the fundamentals of composite material strength and its mechanical behavior. Understanding the analysis of fiber reinforced Laminate design for different Combinations of plies with different orientations of the fiber. Thermo-mechanical behavior and study of residual stresses in Laminates during processing							

1	LAMINA CONSTITUTIVE RELATIONS	Total Hrs	12
Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes.			
2	FLAT PLATE LAMINATE CONSTITUTIVE RELATIONS	Total Hrs	10
Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.			
3	LAMINA STRENGTH ANALYSIS	Total Hrs	5
Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure.			
4	ANALYSIS OF LAMINATED FLAT PLATES	Total Hrs	10
Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.			
5	EFFECT OF THERMAL PROPERTIES	Total Hrs	8
Modification of Hooke's Law due to thermal properties - Modification of Laminate Constitutive Equations. Orthotropic Lamina - special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates - Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.			
Total hours to be taught			45

Text book (s) :

1	Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, 1994, Second Edition - CRC press.
2	Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.

Reference(s) :

1	Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007.
2	Mallick,P.K.,"Fiber–Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993
3	Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984
4	Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990
5	Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)

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10 PED E18	MODAL ANALYSIS OF MECHANICAL SYSTEMS	3	0	0	3	50	50	100
Objective(s)	To understand the concept of modal analysis, to learn the measurement techniques, to know the extraction methods and to create the mathematical model.							

1	OVERVIEW	Total Hrs	6
Introduction to Modal Testing – Applications of Modal Testing – Philosophy of Modal Testing – Summary of Theory – Summary of Measurement Methods – Summary of Analysis – Review of Test Procedure.			
2	THEORETICAL BASIS	Total Hrs	12
Introduction – Single Degree of Freedom (SDOF) System Theory – Presentation and Properties of FRF Data for SDOP System – Undamped Multi-degree of freedom (MDOF) system – Proportional Damping – Hysteretic Damping – General Case – Viscous Damping – General Case – Characteristics and presentation of MDOF – FRF Data – Complete and incomplete models - Non-sinusoidal vibration and FRF Properties			
3	MOBILITY MEASUREMENT TECHNIQUES	Total Hrs	10
Introduction – Basic Measurement System – Structure preparation – Excitation of the Structure – Transducers and Amplifiers – Analyzers – Digital Signal Processing – Use of Different Excitation types – Calibration – Mass Cancellation – Rotational Mobility Measurement – Multi point excitation methods.			
4	MODAL PARAMETER EXTRACTION METHODS	Total Hrs	11
Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.			
5	DERIVATION OF MATHEMATICAL MODELS	Total Hrs	6
Introduction – Modal Models – Display of Modal Model – Response Models – Spatial Models – Mobility Skeletons and System Models.			
Total hours to be taught			45

Reference(s) :

1	Ewins D J, “Modal Testing: Theory and Practice “, John Wiley & Sons Inc., 1988.
2	Nuno Manuel Mendes Maia et al,” Theoretical and Experimental Modal Analysis”, Wiley John & sons, 1997.

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10 PED E19	INTEGRATED MANUFACTURING SYSTEMS	3	0	0	3	50	50	100
Objective(s)	To enlighten the basic concepts of group technology and computer aided process planning, computer aided planning and control, ways and means of computer monitoring and integrated manufacturing system.							

1	INTRODUCTION	Total Hrs	6
Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems analysis of manufacturing operations.			
2	GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING	Total Hrs	9
Introduction-part families-parts classification and cooling - group technology machine cells-benefits of group technology. Process planning function CAPP - Computer generated time standards.			
3	COMPUTER AIDED PLANNING AND CONTROL	Total Hrs	9
Production planning and control-cost planning and control-inventory management-Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology- automated data collection system.			
4	COMPUTER MONITORING	Total Hrs	9
Types of production monitoring systems-structure model of manufacturing process-process control & strategies- direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.			
5	INTEGRATED MANUFACTURING SYSTEM	Total Hrs	12
Definition - application - features - types of manufacturing systems-machine tools-materials handling system- computer control system – Introduction to CNC Programming, DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS - variable mission manufacturing system - CAD/CAM system - human labor in the manufacturing system-computer integrated manufacturing system benefits. Artificial Intelligence and Expert system in CIM.			
Total hours to be taught			45

Text book (s) :	
1	Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India, 2005.
2	David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998
Reference(s) :	
1	Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
2	Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1986.
3	R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design Rules for a CIM system", North Holland Amsterdam, 1985.

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10 PED E20	THEORY OF PLATES AND SHELLS	3	0	0	3	50	50	100
Objective(s)	To Impart some fundamentals knowledge on thin plates and governing differential equations, Energy methods, finite difference and finite element methods, shells and space frames.							
1	THIN PLATES & GOVERNING DIFFERENTIAL EQUATION				Total Hrs	9		
Thin Plates with small deflection - Laterally loaded thin plates - Governing differential equation - Various boundary conditions.								
2	BENDING OF RECTANGULAR & CIRCULAR PLATES				Total Hrs	9		
Rectangular plates - Simply supported rectangular plates - Navier solution and Levy's method - Rectangular plates with various edge conditions - Plates on elastic foundation - Symmetrical bending of circular plates.								
3	ANALYSIS OF PLATES				Total Hrs	9		
Energy methods - Finite difference and Finite element methods.								
4	SHELLS & FOLDED PLATES STRUCTURE				Total Hrs	9		
Classification of shells - Types of shells, structural action - Membrane theory - Shells of revolution and shells of translation, examples, and limitations of membrane theory - Folded Plate structures - Structural behavior, types, design by ACI - ASCE Task Committee method								
5	SPACE FRAMES				Total Hrs	9		
Space frames - Configuration - Types of nodes - General principles of design Philosophy - Behavior.								
Total hours to be taught						45		
Text book (s) :								
1	Szilard, R., Theory and Analysis of Plates, Prentice Hall Inc., 1995.							
2	Timoshenko, S. and Krieger S.W. Theory of Plates and Shells, McGraw Hill Book Company, New York 1990.							
Reference(s) :								
1	Wilhelm Flügge,"Stresses in shells", Springer – Verlag.							
2	Timoshenko, S., "Theory of Plates and Shells", 4th Edition, McGraw Hill, 1990.							
3	Subramanian.N, "Principles of Space Structures", Wheeler Publishing Co. 1999.							

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10 PED E21	DESIGN OF HEAT EXCHANGERS	3	0	0	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.							
1	CONSTRUCTIONAL DETAILS AND HEAT TRANSFER				Total Hrs	9		
Types - Shell and Tube Heat Exchangers - Regenerators and Recuperates Industrial Applications Temperature Distribution and its Implications - LMTD - Effectiveness								
2	FLOW DISTRIBUTION AND STRESS ANALYSIS				Total Hrs	9		
Effect of Turbulence - Friction Factor - Pressure Loss - Channel Divergence Stresses in Tubes - Heater sheets and Pressure Vessels - Thermal Stresses - Shear Stresses - Types of Failures								
3	DESIGN ASPECTS				Total Hrs	9		
Heat Transfer and Pressure Loss - Flow Configuration - Effect of Baffles - Effect of Deviations from Ideality – Design of Typical Liquid - Gas-Gas-Liquid Heat Exchangers								
4	CONDENSERS AND EVAPORATORS DESIGN				Total Hrs	9		
Design of Surface and Evaporative Condensers - Design of Shell and Tube - Plate Type Evaporators								
5	COOLING TOWERS				Total Hrs	9		
Packing - Spray Design - Selection of Pumps - Fans and Pipes - Testing and Maintenance – Experimental Methods.								
Total hours to be taught						45		
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., 1980.							
Reference(s) :								
1	Nicholas Cheremisioff, “Cooling Tower”, Ann Arbor Science Publishers, 1981.							
2	Arthur P. Fraas, “Heat Exchanger Design”, John Wiley & Sons, 1988.							

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<tr><td colspan="2">10 PED E22</td><td colspan="2">BEARING DESIGN AND ROTOR DYNAMICS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="8">To study the selection and design of different bearings and to analyze the bearings under dynamic conditions.</td></tr>
<tr><td>1</td><td colspan="5">CLASSIFICATION AND SELECTION OF BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">6</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td>2</td><td colspan="5">DESIGN OF FLUID FILM BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="10">Design and performance analysis of Thrust and Journal bearings – Full, partial, fixed and pivoted journal bearings design procedure-Minimum film thickness – lubricant flow and delivery – power loss, Heat and temperature distribution calculations- Design based on Charts & Tables and Experimental curves-Design of Foil bearings-Air Bearings- Design of Hydrostatic bearings-Thrust and Journal bearings- Stiffness consideration - flow regulators and pump design</td></tr>
<tr><td>3</td><td colspan="5">SELECTION AND DESIGN OF ROLLING BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="10">Contact Stresses in Rolling bearings- Centrifugal stresses-Elasto hydrodynamic lubrication-Fatique life calculations- Bearing operating temperature- Lubrication- Selection of lubricants-Internal clearance – Shaft and housing fit- -Mounting arrangements-Materials for rolling bearings-Manufacturing methods- Ceramic bearings-Rolling bearing cages-bearing seals selection</td></tr>
<tr><td>4</td><td colspan="5">DYNAMICS OF HYDRODYNAMIC BEARINGS</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="10">Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads , alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions</td></tr>
<tr><td>5</td><td colspan="5">ROTOR DYNAMICS</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="10">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</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="10">Text Book (s) :</td></tr>
<tr><td>1</td><td colspan="9">Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981.</td></tr>
<tr><td colspan="10">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="9">Neale, M.J. “Tribology Hand Book”, Butterworth Heinemann, United Kingdom 2001.</td></tr>
<tr><td>2</td><td colspan="9">Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.</td></tr>
<tr><td>3</td><td colspan="9">Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.</td></tr>
<tr><td>4</td><td colspan="9">Basu S.K., Sengupta, S.N. and Ahuja, B.B.,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd, New Delhi, 2005.</td></tr>
<tr><td>5</td><td colspan="9">Stachowiak, G.W. and Batchelor, A.W., Engineering Tribology, Butterworth-Heinemann, UK, 2005.</td></tr>
<tr><td>6</td><td colspan="9">SKF, “SKF Bearing Maintenance Hand Book”, SKF Publishers, 1996</td></tr>
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<tr><td colspan="2">10 PED E23</td><td>COMPUTATIONAL FLUID DYNAMICS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="6">To understand the concept of boundary conditions and to study the fluid flow and heat transfer problems.</td></tr>
<tr><td>1</td><td colspan="4">GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>2</td><td colspan="4">CONDUCTION HEAT TRANSFER</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="8">Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.</td></tr>
<tr><td>3</td><td colspan="4">INCOMPRESSIBLE FLUID FLOW</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="8">Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, Computation of Boundary layer flow, finite difference approach.</td></tr>
<tr><td>4</td><td colspan="4">CONVECTION HEAT TRANSFER AND FEM</td><td colspan="2">Total Hrs</td><td colspan="2">10</td></tr>
<tr><td colspan="8">Steady One-Dimensional and Two-Dimensional Convection – diffusion, Unsteady one-dimensional convection – diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – solution of steady heat conduction by FEM – Incompressible flow – simulation by FEM.</td></tr>
<tr><td>5</td><td colspan="4">TURBULENCE MODELS</td><td colspan="2">Total Hrs</td><td colspan="2">5</td></tr>
<tr><td colspan="8">Algebraic Models – One equation model, K – ϵ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.</td></tr>
<tr><td colspan="6">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="8">Text Book (s) :</td></tr>
<tr><td>1</td><td colspan="7">Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.</td></tr>
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<tr><td>1</td><td colspan="7">Ghoshdasdidar, P.S.,“Computer Simulation of Flow and Heat Transfer”, Tata McGraw-Hill Publishing Company Ltd., 1998.</td></tr>
<tr><td>2</td><td colspan="7">Subas, V.Patankar “Numerical Heat Transfer Fluid Flow”, Hemisphere Publishing Corporation, 1980.</td></tr>
<tr><td>3</td><td colspan="7">Taylor, C and Hughes, J.B. “Finite Element Programming of the Navier-Stokes Equation”, Pineridge Press Limited, U.K., 1981.</td></tr>
<tr><td>4</td><td colspan="7">Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., “Computational Fluid Mechanics and Heat Transfer “, Hemisphere Publishing Corporation, New York, USA, 1984.</td></tr>
<tr><td>5</td><td colspan="7">Fletcher, C.A.J. “Computational Techniques for Fluid Dynamics 1” Fundamental and General Techniques, Springer – Verlag, 1987.</td></tr>
<tr><td>6</td><td colspan="7">Fletcher, C.A.J. “Computational Techniques for fluid Dynamics 2” Specific Techniques for Different Flow Categories, Springer – Verlag, 1987.</td></tr>
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<tr><td colspan="2">10 PED E24</td><td colspan="2">PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To Integrate the concepts of productivity models, organizational transformation, Re-engineering process, Re-engineering tools and Implementation.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle.</td></tr>
<tr><td>2</td><td colspan="5">PRODUCTIVITY MODELS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>3</td><td colspan="5">ORGANIZATIONAL TRANSFORMATION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the workforce for transformation and reengineering, methodology, guidelines, DSMCQ and PMP model</td></tr>
<tr><td>4</td><td colspan="5">RE-ENGINEERING PROCESS IMPROVEMENT MODELS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">PMI models, Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model.</td></tr>
<tr><td>5</td><td colspan="5">RE-ENGINEERING TOOLS AND IMPLEMENTATION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Sumanth, D.J., "Productivity Engineering and Management", Tata Mc Graw Hill, New Delhi, 1990.</td></tr>
<tr><td>2</td><td colspan="8">Edosomwan, J.A.,“Organizational Transformation and Process Re-Engineering", British Library cataloging in pub. Data, 1996.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Rastogi, P.N. “Re-Engineering and Re-inventing the Enterprise ", Wheeler pub. New Delhi, 1995.</td></tr>
<tr><td>2</td><td colspan="8">Premvrat, Sardana, G.D. and Sahay, B.S, “Productivity Management - A Systems Approach", Narosa Publishers, New Delhi, 1998.</td></tr>
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<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">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">Elective</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" 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 colspan="2">10 PED E25</td><td colspan="2">MECHATRONICS IN MANUFACTURING SYSTEMS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To understand the functions of Mechatronics systems, sensors and transducers, microprocessor in Mechatronics, programmable logic controllers and design.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.</td></tr>
<tr><td>2</td><td colspan="5">SENSORS AND TRANSDUCERS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion - Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems.</td></tr>
<tr><td>3</td><td colspan="5">MICROPROCESSORS IN MECHATRONICS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8105 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters –Applications - Temperature control - Stepper motor control - Traffic light controller.</td></tr>
<tr><td>4</td><td colspan="5">PROGRAMMABLE LOGIC CONTROLLERS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC</td></tr>
<tr><td>5</td><td colspan="5">DESIGN AND MECHATRONICS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Designing - Possible design solutions - Case studies of Mechatronics systems.</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Michael B.Histand and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.</td></tr>
<tr><td>2</td><td colspan="8">Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ., " Mechatronics ", Chapman and Hall, 1993.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications", Wiley Eastern, 1998.</td></tr>
<tr><td>2</td><td colspan="8">Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering:An Introduction to Mechatronics ", Prentice-Hall, 2000.</td></tr>
<tr><td>3</td><td colspan="8">Ghosh, P.K. and Sridhar, P.R., “Introduction to Microprocessors for Engineers and Scientists ", 2nd Edition, Prentice Hall, 1995.</td></tr>
<tr><td>4</td><td colspan="8">Bolton, W., “Mechatronics: A Multidisciplinary Approach”, 4th Edition, Prentice Hall, 2008</td></tr>
</table>

K.S.Rangasamy College of Technology - Autonomous Regulation								R 2010
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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PCA E26	INDUSTRIAL ROBOTICS	3	0	0	3	50	50	100
Objective(s)	To understand the functions of Robot Drives and Control, Cell Design and Application							

1	INTRODUCTION AND ROBOT KINEMATICS	Total Hrs	10

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

2	ROBOT DRIVES AND CONTROL	Total Hrs	9

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

3	ROBOT SENSORS	Total Hrs	9

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

4	ROBOT CELL DESIGN AND APPLICATION	Total Hrs	9

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

5	ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Total Hrs	8

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

Total hours to be taught	45

Text book (s) :

1	Fu, K.C., Gonzalez, R.C. and Lee, C.S.G., "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987
2	Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.

Reference(s) :

1	Yoram Koren, "Robotics for Engineers" Mc Graw-Hill, 1987.
2	Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
3	Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
4	Timothy Jordanides, "Expert Systems and Robotic", Springer –Verlag,New York, May 1991.

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<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
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<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 colspan="2">10 PED E27</td><td colspan="2">CREATIVITY IN DESIGN</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">This course will provide students with a solid foundation in innovation, design, and creativity. Additionally, students will be prepared to apply relevant principles, tools, and techniques to promote and sustain organizational innovation for competitive advantage.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>4</td></tr>
<tr><td colspan="8">Need for design creativity – creative thinking for quality – essential theory about directed creativity.</td></tr>
<tr><td>2</td><td colspan="5">MECHANISM OF THINKING AND VISUALIZATION</td><td colspan="2">Total Hrs</td><td>11</td></tr>
<tr><td colspan="8">Definitions and theory of mechanisms of mind heuristics and models : attitudes, Approaches and Actions that support creative thinking - Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, color symmmetry.Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking.</td></tr>
<tr><td>3</td><td colspan="5">CREATIVITY</td><td colspan="2">Total Hrs</td><td>11</td></tr>
<tr><td colspan="8">Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management.</td></tr>
<tr><td>4</td><td colspan="5">DESIGN</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Process Design, Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective-Recycling and availability-Creativity and customer needs analysis – Innovative product and service designs, future directions in this application of creativity thinking in quality management.</td></tr>
<tr><td>5</td><td colspan="5">INNOVATION</td><td colspan="2">Total Hrs</td><td>10</td></tr>
<tr><td colspan="8">Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator’s solution – creating and sustaining successful growth – Disruptive Innovation model – Segmentive Models – New market disruption - Commoditation and DE-commoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">Rousing Creativity: Think New NowFloyd Hurr, Crisp Publications Inc. 1999.</td></tr>
<tr><td>2</td><td colspan="7">Geoffrey Petty,” how to be better at Creativity”, The Industrial Society 1999.</td></tr>
<tr><td>3</td><td colspan="7">Donald A. Norman,” Emotional Design”, Perseus Books Group New York, 2004.</td></tr>
<tr><td>4</td><td colspan="7">Clayton M. Christensen Michael E. Raynor,” The Innovator’s Solution”, Harvard Business School Press Boston, USA, 2003.</td></tr>
<tr><td>5</td><td colspan="7">Semyon D. Savransky,” Engineering of Creativity – TRIZ”, CRC Press New York USA,” 2000.</td></tr>
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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E28	ENTERPRISE RESOURCE PLANNING	3	0	0	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.							

1	INTRODUCTION	Total Hrs	10
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.			
2	TECHNOLOGY AND ARCHITECTURE	Total Hrs	10
Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.			
3	ERP SYSTEM PACKAGES	Total Hrs	10
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.			
4	APPLICATION AND TRAINING	Total Hrs	7
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.			
5	ERP PROCUREMENT ISSUES	Total Hrs	8
Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.			
Total hours to be taught			45

Reference(s) :

1	Sadagopan.S , “ERP-A Managerial Perspective”, Tata Mcgraw Hill, 1999.
2	Jose Antonio Fernandez, “The SAP R/3 Handbook”, Tata Mcgraw Hill, 1998.
3	Vinod Kumar Crag and Venkitakrishnan N.K. , “Enterprise Resource Planning – Concepts and Practice”, Prentice Hall of India, 1998.
4	Garg & Venkitakrishnan “ERPWARE ERP Implementation Framework”, , Prentice Hall, 1999.
5	Thomas E Vollmann and Bery Whybark , “Manufacturing and Control Systems”, Galgothia Publications, 1998.

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		L	T	P	C	CA	ES	Total
10 PED E29	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.							

1	BEHAVIOUR OF MATERIALS	Total Hrs	10

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.

2	FRACTURE BEHAVIOUR	Total Hrs	10

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.

3	SELECTION OF MATERIALS	Total Hrs	10

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.

4	MODERN METALLIC MATERIALS	Total Hrs	7

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.

5	NON METALLIC MATERIALS	Total Hrs	8

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, AI2O3, SiC, Si3N4, 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, 2000..
2	Charles J.A., Crane, F.A.A and Furness, J.A.G., " Selection and use of Engineering Materials" (3rd Edition), Butterworth- Heiremann, 1977.
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), 1994.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E30	SPECIAL EXPERIMENTAL TECHNIQUES	3	0	0	3	50	50	100
Objective(s)	To impart knowledge on principles of metallographic, X-ray diffraction techniques and to know about advanced chemical and thermal analysis.							
1	METALLOGRAPHIC TECHNIQUES				Total Hrs	10		
Resolution, depth of focus and components of microscope, polarized light, plane contrast, interference, hot stage and quantitative metallographic techniques – in situ techniques, specimen preparation techniques.								
2	X-RAY DIFFRACTION TECHNIQUES				Total Hrs	10		
Characteristic spectrum – Bragg's law – Diffraction methods – Laue, rotating crystal and powder methods. Intensity of diffracted beams – structure factor calculations.								
3	STEREOGRAPHIC PROJECTION AND RECIPROCAL LATTICE				Total Hrs	10		
Diffractometer – general feature and optics – proportional scintillating and Geiger counters. X-ray diffraction application in determination of crystal structure, lattice parameter and residual stress – quantitative phase estimation.								
4	ELECTRON MICROSCOPY (9)				Total Hrs	7		
Construction and operation of TEM – Diffraction effects and image formation, specimen preparation techniques, elemental analysis by wavelength dispersive and energy dispersive systems – construction and operation of SEM – atomic force microscopy - analysis of fractured surfaces.								
5	ADVANCED CHEMICAL AND THERMAL ANALYSIS METHODS				Total Hrs	8		
X-ray fluoroscopy, spectrometry, Auger spectroscopy, DTA, DSC and TGA. Stress analysis by strain gauging, high temperature strain gauge technique, Photo elasticity and holography.								
Total hours to be taught						45		
Reference(s) :								
1	Philips V.A. "Modern Metallographic Techniques and their Applications", Wiley Interscience, 1971.							
2	Cullity B.D. "Elements of X- ray Diffraction", 4th Edition, Addison Wiley, 1978.							
3	Thomas. G. "Transmission Electron Microscopy of Metals". John Wiley. 1961.							
4	Smallman R.E. "Modern Physical Metallurgy", 4th Edition, Butterworths. 1985.							
5	Loretto. M.H. "Electron Beam Analysis of Materials", Chapman and Hall, 1984.							

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Elective									
Course Code	Course Name	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	ES	Total	
10 PED E31	MEASUREMENTS AND CONTROL	3	0	0	3	50	50	100	
Objective(s)	To provide sound knowledge in the basic concepts Measurements and Control								

1	FUNDAMENTALS OF INSTRUMENTATION	Total Hrs.	9
Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments Reliability of instruments			
2	INTELLIGENT INSTRUMENTATION	Total Hrs.	9
Data logging and acquisition, use of intelligent instrument for error reduction, elements of micro-computer interfacing, intelligent instruments in use.			
3	APPLICATION OF INTELLIGENT INSTRUMENTS	Total Hrs.	9
Measurement of thermo-physical properties, instruments for measuring temperature pressure and flow, use of intelligent instruments for the physical variables. Chemical. Thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas chromatography, spectrometry, measurement pf pH, Review of basic measurement techniques.			
4	AIR FLOW, HEAT FLUX MEASUREMENT	Total Hrs.	9
Techniques, shadow graph, Schileren, interferometer, Laser Doppler anemometer, hear flux measurement, Telemetry in engines.			
5	DATA ACQUISITION SYSTEM	Total Hrs.	9
Digital Transducers – Interface system and Standards – Computer automated measurements and controls (CAMAC) standards – IEEE 488 standard interface – Remote monitoring and control of boiler houses – D-DAC (Distributed Data acquisition and Control Systems) – Microprocessor based temperature control system – Introduction to Microcontrollers – Process control system – Pneumatic control systems			
Total hours to be taught			45

Reference(s):

1.	Holman, J.P., Experimental methods for engineers, McGraw-Hill, 1958
2.	Barney, Intelligent Instrumentation, Prentice Hall of India, 1988
3.	Prebrashensky. V., Measurement and Instrumentation in Heat Engineering, Vol.1 and 2 MIR Publishers, 1980
4.	Raman, C.S. Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw-Hill, New Delhi, 1983.
5.	Doeblin, Measurement System Application and Design, McGraw-Hill, 1978.
6.	Morris. A.S, Principles of Measurements and Instrumentation Prentice Hall of India, 1998.
7.	George C barney, Intelligent Instrumentation Microprocessor and Applications in Measurements and Control, Prentice Hall, New Delhi, 1995

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E32	MICROCONTROLLER SYSTEM DESIGN AND APPLICATIONS	3	0	0	3	50	50	100
Objective(s)	To provide sound knowledge in the basic concepts of microcontroller and design and applications.							

1	8051 ARCHITECTURE	Total Hrs.	9
Basic organization – 8051 CPU structure – Register file – Interrupts – Timers – Port circuits – Instruction set – Timing diagram – Addressing modes – Simple Program and Applications			
2	PERIPHERALS AND INTERFACING	Total Hrs.	9
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.			
3	8096 ARCHITECTURE	Total Hrs.	9
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.			
4	PERIPHERALS AND INTERFACING	Total Hrs.	9
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			
5	CASE STUDY FOR 8051 AND 8096	Total Hrs.	9
Real Time clock – DC Motor Speed Control – Generation of Gating Signals for Converters and Inverters – Frequency Measurement – Temperature Control			
Total hours to be taught			45

Reference(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, 1989
3.	Ayala, Kenneth, “The 8051 Microcontroller” Upper Saddle River, New Jersey Prentice Hall, 2000.
4.	Intel Manual on 16 bit embedded controllers, Santa Clara, 1991.
5.	Muhammad Ali Mazidi, Janice Gillispie mazidi. “The 8051 Microcontroller and Embedded systems”, Person Education, 2004.

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E33	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							

1	FUNDAMENTALS OF I.C ENGINE	Total Hrs.	9

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

2	COMBUSTION TECHNIQUES IN CI ENGINE	Total Hrs.	9

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.

3	CONCEPTS OF ENGINE SIMULATION	Total Hrs.	9

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.

4	ALTERNATIVE FUELS	Total Hrs.	9

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.

5	RECENT TRENDS IN IC ENGINE	Total Hrs.	9

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

Reference(s):

1.	K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.
2.	John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, 1988.
3.	M.L. Mathur and R.P.Sharma, A course in internal Combustion Engines, Dhanapat Rai Publications, New Delhi.
4.	R.B.Mathur and R.P. Sharma, Internal combustion Engines. Dhanpat Rai and Sons, 1998.
5.	V. Ganesan, Int. Combustion Engines, II Edition, TMH, 2002.
6.	Duffy Smith, Auto fuel Systems, The Good Heart Willox Company, Inc. 1987.
7.	Ganesan V. Computer simulation of spark ignition process: University process. Hyderabad, 1993.
8.	Ganesan V. Computer simulation of compression ignition engine. Orient Long man, 2000.

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		L	T	P	C	CA	ES	Total
10 PED E34	ADVANCED HEAT AND MASS TRANSFER	3	0	0	3	50	50	100
Objective(s)	To provide sound knowledge in the basic concepts Advanced Heat and Mass Transfer.							

1	FUNDAMENTALS OF CONDUCTION HEAT TRANSFER	Total Hrs.	9
One dimensional study and transient heat transfer equations and boundary conditions, 2D, 3D heat conduction equations-varying thermal conductivity-Analytical and semi-analytical solutions, - Lumped Analysis-Heisler's chart, extended surface-geometric non linear heat transfer-Bessel function.			
2	RADIATION HEAT TRANFER	Total Hrs.	9
Conduction with moving boundaries, Radiation in gases and vapour. Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection.			
3	MOMENTUM AND TURBULENT BOUNDARY LAYER HEAT TRANSFER	Total Hrs.	9
Momentum and Energy Equations, Turbulent Boundary Layer Heat Transfer, Mixing length concept, Turbulence Model – K Є Model, Analogy between Heat and Momentum Transfer – Reynolds, Colburn, Prandtl Turbulent flow in a Tube, High speed flows.			
4	HEAT EXCHANGER AND ITS TYPES	Total Hrs.	9
Condensation with shear edge on bank of tubes, Boiling – pool and flow boiling, Heat exchanger, Є – NTU approach and design procedure, compact heat exchangers.			
5	MASS TRANSFER	Total Hrs.	9
Mass Transfer, Vaporization of droplets, combined heat and mass transfer, Heat Transfer Correlations in various applications like I.C. Engines, Compressors & turbines.			
Total hours to be taught			45

Reference(s):

1.	Incropera F.P. and DeWitt. D.P., Fundamentals of Heat & Mass Transfer, John Wiley & Sons, 1996.
2.	Ozisik. M.N., Heat Transfer – Basic Approach, McGraw-Hill Co., 1985
3.	Schlichting, Gersten, Boundary layer Theory, Springer, 2000
4.	P.K. Nag, Heat Transfer, Tata McGraw-Hill, 2002
5.	Rohsenow. W.M., Harnett. J.P. and Ganic. E.N., Handbook of Heat Transfer Applications, McGraw-Hill, NY1985
6.	Anthony F. Mills, Basic Heat and Mass Transfer, Prentice Hall, 1999.

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Department	Mechanical Engineering	Programme Code & Name	PED : M.E. Engineering Design

Elective

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E35	RESEARCH METHODOLOGY - ENGINEERING AND MANAGEMENT STUDIES	3	0	0	3	50	50	100

1	RESEARCH METHODOLOGY	Total Hrs.	9

Research methodology – definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modeling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data- internal sources of data, external sources of data.

2	SCALES AND MEASUREMENTS	Total Hrs.	9

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

3	HYPOTHESES TESTING	Total Hrs.	9

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

4	SAMPLE TESTS	Total Hrs.	9

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

5	ANALYSIS AND REPORT	Total Hrs.	9

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

Total hours to be taught	45

Reference(s):

1.	Kothari, C.R., Research Methodology –Methods and techniques, New Age Publications, New Delhi, 2009.
2.	Panneerselvam, R., Research Methodology, Prentice-Hall of India, New Delhi, 2004.

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Department	Mechanical Engineering	Programme Code & Name			PED : M.E. Engineering Design			
Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E36	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.							

1	FORCES AND STRAIN MEASUREMENT	Total Hrs	9

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.

2	VIBRATION MEASUREMENTS	Total Hrs	9

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.

3	ACOUSTICS AND WIND FLOW MEASURES	Total Hrs	9

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.

4	DISTRESS MEASUREMENTS	Total Hrs	9

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.

5	NON DESTRUCTIVE TESTING METHODS	Total Hrs	9

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	Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 1996.
4	R.S.Sirohi and HC Radhakrishna, “Mechanical Measurements”, New Age International (P) Ltd. 1997

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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E37	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.							

1	INTRODUCTION	Total Hrs	9
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.			
2	SOLID AND LIQUID FUELS	Total Hrs	9
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.			
3	GASEOUS FUELS	Total Hrs	9
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.			
4	COMBUSTION	Total Hrs	9
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.			
5	COAL PREPARATION SYSTEM	Total Hrs	9
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

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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E38	ADVANCES IN CASTING AND WELDING PROCESSES	3	0	0	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.							

1	CASTING DESIGN	Total Hrs	8
Heat transfer between metal and mould –Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering			
2	CASTING METALLURGY	Total Hrs.	8
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.			
3	RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT	Total Hrs.	8
Shell moulding, precision investment casting, CO_2 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.			
4	WELDING METALLURGY AND DESIGN	Total Hrs.	10
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.			
5	RECENT TRENDS IN WELDING	Total Hrs.	11
Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow 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.			
Total hours to be taught			45
Text book(s) :			
1.	Parmer R.S., Welding Engineering and Technology, Khanna Publishers, 2002.		
2.	Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002.		
3.	CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.		
Reference (s):			
1.	ASM Handbook, Vol 15, Casting, 2004.		
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, 2000.		
5.	Jain P.L., Principles of Foundry Technology,Tata McGrawHill Publishers, 2003.		
6.	Iotrowski – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.		
7.	Schwariz, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981.		

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Elective									
Course Code	Course Name	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	ES	Total	
10 PED E39	QUALITY CONCEPTS IN DESIGN	3	0	0	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.								

1	DESIGN FOR QUALITY	Total Hrs	8

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.

2	FAILURE MODE EFFECT ANALYSIS	Total Hrs.	9

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

3	DESIGN OF EXPERIMENTS	Total Hrs.	9

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

4	STATISTICAL CONSIDERATION AND RELIABILITY	Total Hrs.	9

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

5	DESIGN FOR SIX SIGMA	Total Hrs.	9

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

Total hours to be taught	45
Text book(s) :	

1.	Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.
2.	Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA Mc GRAW-HILL- 3rd Edition, 2003.

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-6th edition-James R. Evens, William M Lindsay Pub:son south-western www.swlearning.com

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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E40	MAINTENANCE MANAGEMENT	3	0	0	3	50	50	100
Objective(s)	The objectives of the course are to teach the students the contemporary maintenance management methods and techniques.							

1	INTRODUCTION	Total Hrs	9
Maintenance functions – Tero technology – Maintenance costs – Organization for maintenance – Japanese concept.			
2	RELIABILITY ANALYSIS	Total Hrs	9
Reliability function – useful life – repair time distribution – Weibull application – Standby systems – Maintainability and availability – RCM			
3	MAINTENANCE POLICIES	Total Hrs	9
Maintenance types – Preventive maintenance – PM for functional characteristics and large scale systems – repair policy – PM and break down maintenance – Statistical applications – replacement models.			
4	LOGISTICS	Total Hrs	9
Spare parts control – overall/optimum availability – Maintenance planning – priority rules – Maintenance staffing – UMS –Maintenance manual.			
5	ADVANCED TECHNIQUES	Total Hrs	9
Condition monitoring – WDM, SPM, Vibration monitoring – Maintenance information system – TPM – Maximize equipment effectiveness			
Total hours to be taught			45

Text book (s) :

1	Edward Hartman, “Maintenance Management”, Productivity and Quality Publishing Pvt. Ltd., 1995

Reference(s) :

1	Smith D.J. “Reliability and Maintainability in perspective”, Mac Millan Ltd., 1985
2	Seiichi Nakagrima, “Introduction to Total Productive Maintenance”, Productivity press Pvt. Ltd., 1993

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Elective								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
10 PED E41	SPECIAL OPTIMIZATION	3	0	0	3	50	50	100
Objective(s)	To provide knowledge about Optimization Techniques and their applications.							

1	OPTIMIZATION PROBLEMS	Total Hrs	9
Classification of Optimization problems, Classical optimization techniques for continuous and differentiable functions.			
2	NON-LINEAR PROGRAMMING	Total Hrs	9
Introduction to non-linear programming-One dimensional minimization methods, constrained and unconstrained optimization; multi-objective optimization method.			
3	PROGRAMMING IN OPTIMIZATION	Total Hrs	9
Integer programming methods, Dynamic programming in Markov Decision Processes, Introduction to Geometric and Stochastic Programming.			
4	GENETIC ALGORITHM AND THEIR APPLICATIONS	Total Hrs	9
Genetic Algorithm, Simulated Annealing, Tabu Search, and Ant-Colony algorithms and their applications.			
5	ARTIFICIAL NEURAL NETWORKS AND THEIR APPLICATIONS	Total Hrs	9
Artificial Neural networks and their applications in Engineering, Fuzzy logic as an optimization tool.			
Total hours to be taught			45

Text book (s) :

1. Deb. Kalyanmoy, Optimization for Engineering Design, Prentice Hall of India, New Delhi, 1998.
2. Goldberg, D.E. Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley, 1989.

Reference(s) :

1. Engineering Optimization, Theory and Practice, John Wiley, 1996.
2. Robert .J. Schalkoff, Artificial Neural Networks, McGraw-Hill companies Inc., 1997.
3. Yegnanarayanan. B, Artificial Neural networks, Prentice Hall of India, New Delhi, 1999.