Kerala Technological University

Cluster 4: Kottayam

M. Tech Program in Mechanical Engineering
(Machine Design)

Scheme of Instruction & Syllabus: 2015 Admissions

Compiled By
Rajiv Gandhi Institute of Technology, Kottayam
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Kerala Technological University

Cluster 4: Kottayam

M. Tech Program in Machine Design

Scheme of Instruction

Credit requirements **:** 67 credits (22+19+14+12)
Normal Duration : Regular: 4 semesters; External Registration: 6 semesters;
Maximum duration : Regular: 6 semesters; External Registration: 7 semesters.

Courses: Core Courses: Either 4 or 3 credit courses; Elective courses: All of 3 credits

Semester 1 (Credits: 22)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Hours	
A	04 ME 6501	Advanced Engineering Mathematics	3-0-0	40	60	3	3
B	04 ME 6503	Theory of Vibration	3-1-0	40	60	3	4
C	04 ME 6505	Advanced Mechanics of solids	3-1-0	40	60	3	4
D	04 ME 6507	Design of Power Transmission Elements	3-0-0	40	60	3	3
E	04 ME 65XX	Elective I	3-0-0	40	60	3	3
	04 GN 6001	Research Methodology	1-1-0	100	0	0	2
	04 ME 6591	Seminar	0-0-2	100	0	0	2
	04 ME 6593	Advanced measurements laboratory	0-0-2	100	0	0	1
		Total	23				22

22

Semester 2 (Credits: 19)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Hours	
A	04 ME 6502	Finite Element Analysis	3- 1- 0	40	60	3	4
B	04 ME 6504	Design Engineering	2- 1- 0	40	60	3	3
C	04 ME 6506	Advanced Theory Of Mechanisms	2- 1- 0	40	60	3	3
D	04 ME 65XX	Elective II	3- 0- 0	40	60	3	3
E	04 ME 65XX	Elective III	3- 0- 0	40	60	3	3
	04 ME 6592	Mini Project	0-0-4	100	0	0	2
	04 ME 6594	Computer Aided Engineering Design	0-0-2	100	0	0	1
		Total	22				19

Summer Break

	04 ME 7590	Industrial Training	0-0-4				Pass/ Fail

Semester 3 (Credits: 14)

A	04 ME 75XX	Elective IV	3-0-0	40	60	3	3
B	04 ME 75XX	Elective V	3-0-0	40	60	3	3
	04 ME 7591	Seminar	0-0-2	100	0	0	2
	04 ME 7593	Project (Phase 1)	0-0-12	50	0	0	6

14

Semester 4 (Credits: 12)

	04 ME 7594	Project (Phase 2)	0-0-21	70	30	0	12

12

Total: 67

List of Electives

ELECTIVE GROUP	Course No:	Name
1	04 ME 6509	INDUSTRIAL TRIBOLOGY
	04 ME 6511	ADDITIVE MANUFACTURING
	04 ME 6513	COMPOSITE MATERIALS AND MECHANICS
	04 ME 6515	ENGINEERING OPTIMIZATION
2	04 ME 6508	INDUSTRIAL INSTRUMENTATION
	04 ME 6512	COMPUTER AIDED DESIGN IN MANUFACTURING
	04 ME 6514	PRINCIPLES OF ROBOTICS AND APPLICATIONS
	04 ME 6516	EXPERIMENTAL STRESS ANALYSIS
3	04 ME 6518	NUMERICAL METHODS
	04 ME 6522	OIL HYDRAULICS AND PNEUMATICS
	04 ME 6524	COMPUTER INTEGRATED MANUFACTURING
	04 ME 6526	FRACTURE MECHANICS AND DESIGN
4	04 ME 7501	ADVANCED MACHINE TOOL DESIGN
	04 ME 7503	SENSORS FOR INDUSTRIAL APPLICATIONS
	04 ME 7505	ACOUSTICS AND NOISE CONTROL FOR ENGINEERS
	04 ME 7507	COMPUTATIONAL FLUID DYNAMICS
5	04 ME 7509	MECHANICAL BEHAVIOUR OF MATERIALS
	04 ME 7511	ADVANCED MATERIALS AND PROCESSES
	04 ME 7513	DESIGN FOR PRODUCTION
	04 ME 7515	VIBRATION CONTOL AND CONDITION MONITORING

SEMESTER 1

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6501	Advanced Engineering Mathematics	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

To develop an understanding of the fundamental principles of higher engineering mathematics and apply these principles to a variety of physical systems mainly consisting of machines

Syllabus

Variation and its properties,Euler's equation – functionals dependent on first and higher order derivatives.Power series solutions about ordinary point, Legendre equation and Legendre polynomials, Solutions about singular points.Linear partial differential equation of second order– elliptic, parabolic, hyperbolic equations.Range and summation conventions – transformation of co-ordinates contra variant, covariant, mixed tensors.

Course Outcome:

Students shall be able to apply the knowledge of Calculus for solving problems in respective areas of specialization

TEXT BOOKS:

1. B. S. Grewal, “Higher engineering mathematics”, Khanna Publishers, 2000
2. Erwin Kreyszig, “Advanced engineering mathematics”

REFERENCES:

1. Michael E. Greenberg, “Advanced engineering mathematics”, Pearson Education
2. E. Balagurusamy, “Numerical methods”, Tata McGraw Hill, 1995
3. SokolNikof, “Tensor analysis”, John Wiley, New York, 2000
4. Richard A. Johnson, “Miller & Freund’s probability & statistics for engineers”, Prentice Hall of India, 2006
5. Jay L. Devore, “Probability and statistics for engineering and sciences”
6. B. S. Grewal, “Numerical methods in engineering and sciences”, Khanna Publications

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME 6501	ADVANCED ENGINEERING MATHEMATICS	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Functionals– Euler's equation – functional dependent on first and higher order derivatives-functionals dependent on functions of several dependent variables-Isoperimetric problem – Approximate solution of boundary value problems - Rayleigh Ritz method.	6	15
MODULE 2: Power series solutions about ordinary point-Frobenius method- Bessel equation and Bessel Functions -Legendre equation and Legendre polynomials	10	15
FIRST INTERNAL TEST		
MODULE 3: Linear partial differential equation of second order– elliptic, parabolic, hyperbolic equations –Method of separation of variables-Solution of Laplace, one-dimensional heat & one dimensional wave equations.	6	15
MODULE 4: Finite difference method – solution of Laplace equation - solution of one-dimensional heat equation – Crank Nicholson method –solution of one-dimensional wave equation	5	15
SECOND INTERNAL TEST		
MODULE 5: Range and summation conventions – transformation of coordinates contravariant, covariant, mixed tensors-Fundamental operations with tensors-Metric and Conjugate tensors-Christoffel symbols	10	20
MODULE 6: One way and two way classification (single observation per cell) – basic principles of experimentation – role of randomization, replication, local control. Basic designs –CRD, RBD, LSD	5	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6503	Theory of Vibration	3-1-0: 4	2015

Pre-requisites: Nil

Course Objectives:

To make the Student:-

- Fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.
- Develop linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF)
- To understand the principle of writing the differential equation of motion of vibratory systems
- Students should be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi-degree of freedom linear systems.;

Syllabus

Free Vibration**:** Introduction,Use of Fourier series, Single degree of freedom undamped system – Equation of motion, Response under general periodic force,The unit impulse (Dirac Delta),Eigen value problem, natural frequencies,Multi Degree of Freedom System; normal mode of vibration,flexibility matrix and stiffness matrix

Course Outcome:

The student will demonstrate the ability to

1. To learn free and forced vibration for 1 DOF, 2DOF and MDOF systems
2. To learn vibration measurement and vibration isolation techniques

To learn the analysis of vibration of continuous systems

TEXT BOOKS:

1. S. S. Rao, “Mechanical Vibrations”, Prentice Hall, 2000.
2. W. T. Thomson, M. D. Dahleh, C. Padmanabhan, “Theory of Vibration with Applications”, Pearson Education, 2008.

REFERENCES:

1. Leonard Meirovitch, “Fundamentals of Vibrations”, McGraw Hill International, 2001.
2. Den Hartog, “Mechanical Vibrations”, Dover Publishers, 1985

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME 6503	THEORY OF VIBRATION	3-1-0:4

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: **Free Vibration:** Introduction, Fundamentals of system modeling, Spring, inertia and damping elements, Harmonic motion – Representation and analysis Use of Fourier series, Single degree of freedom undamped system – Equation of motion, natural frequency, complete response, examples	9	15
MODULE 2: Single degree of freedom systems with viscous damping – response, under damping, critical damping and over damping, Logarithmic decrement. Free vibration with Coulomb Damping, Free vibration with Hysteresis damping.	9	15
FIRST INTERNAL TEST		
MODULE 3: Harmonically excited vibration – equation of motion, response of undampedsystems under harmonic force, response of damped systems to harmonic force. Frequency response plots, harmonic motion of the base, transmissibility.	9	15
MODULE 4: Response under general periodic force, Use of Fourier series Response due to square wave, triangular wave, half sine wave etc.	9	15
SECOND INTERNAL TEST		
MODULE 5: The unit impulse (Dirac Delta), Impulse response, step response, ramp response, response to arbitrary excitations. Time domain method – Convolution Integral, complete response to arbitrary excitation, response spectrum. Frequency domain method – Laplace Transforms, transfer function, general response using Laplace transforms.	10	20
MODULE 6: Introduction, Equations of motion, matrix form, coupling in mass, coupling in stiffness, free vibration analysis of 2 dof undammed system. Eigen value problem, natural frequencies, mode shapes, initial conditions to excite a specific mode, response to general initial conditions. **Multi Degree of Freedom System**; normal mode of vibration, flexibility matrix and stiffness matrix, Eigen values and vectors orthogonal properties-modal matrix analysis, matrix inversion method	10	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6505	Advanced Mechanics of Solids	3-1-0:4	2015

Pre-requisites: Nil

Course Objectives:

1. To solve advanced solid mechanics problems using classical methods.
2. To understand the theory of elasticity including strain/displacement and Hooke's law relationships;
3. To solve torsion problems in bars and thin walled members
4. To learn the importance of residual stresses.

Syllabus

Definition of Stress at a point. Shear stress distribution and Shear centre for thin walled open sections circular and semi circular.Fundamental aspects of general inelastic behaviour.Introduction to Viscoelasticity

Course Outcome:

The course aims include developing and further your skill in solving technical problems and familiarizing you with analysis: of membrane stresses in axisymmetric thin shells, stresses in long thin beams, buckling of columns, torsion of thin tubes, deflection analysis, statically indeterminate beams.

TEXT BOOKS:

1. S.P.Timoshenko, "Theory of Plates & Shells", McGraw Hill, 1958.
2. Den Hartog, "Advanced Strength of Materials", McGraw Hill, 1952.

REFERENCES:

1. S.Timoshenko&J.W.Goodier, "Theory of Elasticity", McGraw Hill, 2007.
2. Seely and Smith, "Advanced Mechanics of Materials", John Wiley, 1952.
3. Filonenko & Borodic, "Theory of Elasticity", Foreign Languages Publishing House,1965.
4. Fluggue.W, "Handbook of Engineering Mechanics", McGraw Hill, 1962.
5. Prager W., "Introduction to Plasticity", Oxford University Press, 1959.
6. Kachanov.L.M., "Foundations of Theory of Plasticity", North-Holland Publishing Co.,1971.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME6505	ADVANCED MECHANICS OF SOLIDS	3-1-0:4	
MODULES		**Contact Hours**	**Sem.Exam Marks;%**
MODULE 1: Definition of Stress at a point, Tensor representation, Stress Transformation, Concept of traction. Cauchy's stress theorem, Traction on arbitrary planes, Octahedral shear stress.		9	15
MODULE 2: Principal stresses and strains in 3D coordinates, 3D Mohr circle. Motion and Deformation. Strain Transformation, Strain Energy		9	15
FIRST INTERNAL TEST			
MODULE 3: Airy's Stress function, Biharmonic equation, Saint Venant's principle. Applications to Polynomials in rectangular coordinates.		9	15
MODULE 4: Problem of determining contact stresses, Assumptions, Expressions forprincipal stresses, cylindrical bodies in line contact and spherical bodies in point contact.		9	15
SECOND INTERNAL TEST			
MODULE 5: Shear stress distribution and Shear center for thin walled open sections circular and semicircular. Determine the shear center of a section like channel, I , L , Z . Torsion of prismatic shafts, Warping, Semi-inverse method and Stress function method - Membrane analogy,Torsion of bars with rectangular cross section. Torsion of multi celled thin wall open and closed sections.		10	20
MODULE 6: Fundamental aspects of general inelastic behaviour. Stress-strain curves – plastic flow conditions - Von Mises and Tresca , elasto-plastic analysis for bending and torsion of bars – residual stresses. Introduction to Viscoelasticity: Rheological models, Maxwell model, Kelvin model and the four-element Maxwell-Kelvin model.		10	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6507	Design of Power Transmission Elements	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

1. The fundamentals of chain drives and belt drives
2. The design fundamentals of gear box and brakes
3. The concept of design for Clutches

Syllabus

Analysis, design and selection of chain drives and belt drives, Tensioning Belt, Timer belts, Sprocket design, Design of speed gear boxes, standardization of spindle speeds, speed diagrams, design of housings, lubrication considerations, Disc brakes-Graphical and analytical analysis and design of self-actuating brakes, fixed, link and sliding anchor drum brakes, Friction Clutches, Centrifugal Clutches, Analysis, dynamics and thermal aspects of clutches.

Course Outcome:

Students will be able to understand basic design procedure for power transmission elements like gears, brakes, belt drives, clutches, chain drives, etc.

TEXT BOOKS:

1. P. Kannaiah ,Design of Machine Elements, Scitech Publications, 2006
2. Reshetov, “Design of Machine elements”, Mir Publication, 1978

REFERENCES:

1. Newcom and Spurr, “Braking of road vehicles”, Chapman and Hall, 1967.
2. Nieman, “Design of Machine elements – Vol. II”, Springer Verlag.
3. Dobrovolksy, “Design of Machine elements”, Mir Publishers, 1977.
4. Wong, “Theory of Ground Vehicles”, Wiley, 2001.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME6507	DESIGN OF POWER TRANSMISSION ELEMENTS	3-0-0: 3	
MODULES		**Contact Hours**	**Sem.Exam Marks;%**
MODULE 1: Analysis, design and selection of chain drives and belt drives, Tensioning Belt, Timer belts, Sprocket design		9	15
MODULE 2: Chordal action in Chains, Chain velocity and drive ratio, Length of chain and centre distance. Failure of the chain drives and belt drives		9	15
FIRST INTERNAL TEST			
MODULE 3: Design of speed gear boxes, standardization of spindle speeds, speed diagrams, design of housings, Step less regulation of speed		9	15
MODULE 4: Selection of servo and stepper motors, timing belts, lubrication considerations		9	15
SECOND INTERNAL TEST			
MODULE 5: Disc brakes-Graphical and analytical analysis and design of self-actuating brakes, fixed, link and sliding anchor drum brakes, Dynamics and thermal aspects of vehicle braking, Design of brakes for applications such as machine tools, modern automobiles, cranes, railway coaches and aircrafts.		10	20
MODULE 6: Friction Clutches, Centrifugal Clutches, Analysis, dynamics and thermal aspects of clutches, Design of automobile clutch: single plate, multi plate, cone clutch, overrunning clutches.		10	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6509	Industrial Tribology	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

1. To introduce the fundamentals of Friction, Wear and Lubrication.
2. To discuss the design fundamentals of hydrodynamic and hydrostatic bearings
3. To explain the basic design details of rolling contact bearings
4. To discuss the basic bearing failure modes and its remedies

Syllabus

Types of friction, effect of pressure, velocity, temperature, vibration on friction, Classification – theories of wear, Role of lubrication – Lubricants, Journal bearings, Hydrostatic lubrication, Types - bearings theory - static and dynamic capacities - bearing life - selection of bearings, Lubrication and mounting of bearings. Bearing failures.

Course Outcome:
To understand basic design procedure for different types of bearings in industrial applications.

TEXT BOOKS:

1. Radzimovsky, “Theory of lubrication of bearings”, Mir Publications, 1972.
2. Design of Machine Elements by VB Bhandari, MaGraw-Hill

REFERENCES:

1. O’Conner and Boyd, “Standard Hand Book of Lubrication Engineering”, McGraw Hill, 1968.
2. Fuller D.D., “Theory and practice of lubrication for Engineers”, John Wiley, 1973

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME6509	INDUSTRIAL TRIBOLOGY	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: **Types of friction** - dry-boundary and fluid-laws of friction and friction theories-Variables in friction – Surface cleanliness – effect of pressure, velocity, temperature, vibration, etc. Parallel plates, The continuity equation and Reynold's equation	6	15
MODULE 2: Role of lubrication – Lubricants - Importance of viscosity and methods for measuring viscosity - fundamentals of viscous flow - flow through capillary tubes	6	15
FIRST INTERNAL TEST		
MODULE 3: Journal bearings eccentricity - pressure distribution – load carrying capacity – friction and power loss - ideal and real bearings – leakage factors	6	15
MODULE 4: Sommerfield number and design charts, Petroff's Equation. Oil flow and heat dissipation in bearings	6	15
SECOND INTERNAL TEST		
MODULE 5: Hydrostatic lubrication. Analysis of hydrostatic bearings Pressure distribution calculation of flow requirements, Energy losses in hydrostatic bearings Analysis of hydrostatic bearings with multiple pads.	9	20
MODULE 6: Types - bearings theory - static and dynamic capacities - bearing life - selection of bearings, Lubrication and mounting of bearings. Bearing failures, Classification & theories of wear - stages of wear - adhesive and abrasive wear –factors affecting wear.	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6511	Additive Manufacturing	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

Engineering knowledge, techniques, skills and modern tools to analyze problems in Additive Manufacturing.

Syllabus

Definition, Different terminology, Difference b/w conventional and AM, Virtual Prototyping- Rapid Tooling –Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications.Fused deposition Modelling (FDM): Working Principles,details of processes, products, materials, advantages, limitations and applications - Case studies.Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Application. Laser Engineered Net Shaping (LENS–Case StudiesLaser Metal Deposition and other Metal AM processes.Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing,process capabilities,material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness

Course Outcome:

At the end of this programme, students will be able to, identify different industrial sectors, relevant AM processes and measurement techniques to reduce cost and time from design to manufacture.

TEXT BOOKS:

1. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.

2. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.

REFERENCES:

1.Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.

2. Liou,L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2011.

3. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.

4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME6511	ADDITIVE MANUFACTURING	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Definition, Different terminology, Difference b/w conventional and AM, Need, Development of AM systems	6	15
MODULE 2: AM process chain - Impact of AM on Product Development , Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits- Applications.	6	15
FIRST INTERNAL TEST		
MODULE 3: Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, Part quality and process planning, recoating issues, Materials, advantages, limitations and applications.	6	15
MODULE 4: Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modelling (FDM): Principle, details of processes, process variables, types, products, materials and applications, Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.	6	15
SECOND INTERNAL TEST		
MODULE 5: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Application - Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications–Case Studies Laser Metal Deposition and other Metal AM processes.	9	20
MODULE 6: Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities Material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies on Aerospace & Automotive. Deposition Manufacturing (SDM), Ballistic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6513	Composite Materials and Mechanics	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

1. Define a composite, enumerate advantages and drawbacks of composites over monolithic materials, and discuss factors which influence mechanical properties of a composite
2. Develop concepts of volume and weight fraction of fibre and matrix, density and void fraction in composites
3. Find the engineering constants of a unidirectional/bidirectional lamina in terms of the stiffness and compliance parameters of the lamina
4. To discuss about latest manufacturing methods for composite materials.

Syllabus

Fatigue and Impact Properties , Environmental effects, Long term properties,Fracture behavior and Damage Tolerance. Fibre's Glass, Carbon, Ceramic and Aramid fibers.Rule of mixture –volume and mass fractions density void content, Evaluation offour elastic moduli based on strength of materials approach and Semi empirical model.Stress Analysis of Composite Laminates

Course Outcome:
Covers strength and fracture; damage mechanics and fatigue; numerical methods and optimal design of structures and more. Experimental and theoretical research on the mechanical properties and behavior of composite materials as well as matrices and fibres.

TEXT BOOKS:

1. Autar K Kaw, "Mechanics of Composite Materials", CRC Press, 2006
2. SeropeKalpakjian, Steven Schmid, "Manufacturing engineering and technology", Prentice Hall, 2009.

REFERENCES:

1. Chawla K K, "Composite Materials", Springer – Verlag, 1987
2. Carlos A., Cristóvão M., Manuel J. M. Freitas, "Mechanics of Composite materials and Structures" Kluwer Academic, 1999.
3. Mallick, P.K., "fibre-Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME6513	COMPOSITE MATERIALS AND MECHANICS	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: **Introduction:** Definition- Need – General characteristics, Applications. Static Mechanical Properties – Fatigue and Impact Properties - Environmental effects, Long term properties,Fracture behaviour and Damage Tolerance. Fibre's- Glass, Carbon, Ceramic and Aramid fibers.	6	15
MODULE 2: Matrices – Polymer, Graphite, Ceramic and Metal matrices, Characteristics of fibers and matrices. Fibre surface treatments, fillers and additives, fibre content, density and void content	6	15
FIRST INTERNAL TEST		
MODULE 3: 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	6	15
MODULE 4: Longitudinal Young's modulus – transverse Young's modulus – major Poisson's ratio – In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fibre reinforced lamina – laminates – lamination theory. Inter laminar stresses.	6	15
SECOND INTERNAL TEST		
MODULE 5: Bag moulding – Compression moulding – Pultrusion – Filament Winding –Other manufacturing Processes,Quality Inspection Methods. Processing of MMC – diffusion bonding – stir casting – squeeze casting.	9	20
MODULE 6: Stress Analysis of Composite Laminates, Failure predictions – maximum stress theory, maximum strain theory, Tsai-Hill theory, Laminate Design considerations, Modes of Failure of composites – First Ply Failure, Partial Ply Failure, Total Ply Failure.	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6515	Engineering Optimization	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

1. To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems
2. To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology
3. To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems

Syllabus

Introduction to Optimization, Formulation and Solution methodologies, Single variable optimization, Multivariable optimization with no constraints, with equality constraints and with inequality constraints, Unrestricted search method, Interval halving method, Fibonacci method, Golden Section method, quadratic interpolation method, pattern search method,steepest descent method, quasi-Newton method, Hook &Jeeve's method,Lagrange multiplier methodConstrained non-linear optimization: Kuhn-Tucker conditions, quadratic programming, Wolfe's method, method of feasible directions, Frank-Wolf method Convex simplex method, separable programming, Kelley's cutting plane method, penalty and barrier methods, Integer and dynamic programming: Dynamic programming, principle of optimality – tabular and calculus methods of solutions, Introduction to integer programming, Gomory's cutting plane method, branch and bound method, first variation, problems with integral constraints, statement only of the corner conditions for discontinuous case, Sufficient condition for strong and weak extrema.Calculus of variations: Problems with fixed end points and moving boundaries, strong and weak variations,

Course Outcome:
At the end of this programme, students will be able to, identify and solve optimization problems.

TEXT BOOKS:

1. S.S. Rao, "Engineering Optimization", Newage, 1996.
2. N.S. Kambo, "Mathematical Programming Techniques", Affiliated East-West Press, 1984.

REFERENCES:

1. Els Golts, "Differential Equations and Calculus of Variations", Mir Publications.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME6515	ENGINEERING OPTIMIZATION	3-0-0: 3	
MODULES		**Contact Hours**	**Sem.Exam Marks;%**
MODULE 1: Introduction to Optimization, Formulation and Solution methodologies, Single variable optimization, Multivariable optimization with no constraints, with equality constraints and with inequality constraints		6	15
MODULE 2: Unrestricted search method, Interval halving method, Fibonacci method, Golden Section method, quadratic interpolation method, pattern search method, steepest descent method, quasi-Newton method, Hook & Jeeve's method, Lagrange multiplier method		6	15
FIRST INTERNAL TEST			
MODULE 3: Constrained non-linear optimization: Kuhn-Tucker conditions, quadratic programming, Wolfe's method, method of feasible directions, Frank-Wolf method Convex simplex method, separable programming, Kelley's cutting plane method, penalty and barrier methods		6	15
MODULE 4: **Integer and dynamic programming**: Dynamic programming, principle of optimality – tabular and calculus methods of solutions		6	15
SECOND INTERNAL TEST			
MODULE 5: **Calculus of variations**: Problems with fixed end points and moving boundaries, strong and weak variations,		9	20
MODULE 6: Introduction to integer programming- Gomory's cutting plane method, branch and bound method- first variation, problems with integral constraints, statement only of the corner conditions for discontinuous case, Sufficient condition for strong and weak extrema.		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 GN 6001	Research Methodology	0-2-0: 2	2015

Pre-requisites: Nil

Course Objectives:

To make the Student:-

1. Get introduced to research philosophy and processes in general.
2. Formulate the research problem and prepare research plan
3. Apply various numerical /quantitative techniques for data analysis
4. Communicate the research findings effectively

Syllabus

Introduction to Research Methodology, Concepts of Research, Meaning and Objectives of Research, Research Process, Types of Research, Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical,Criteria of Good Research, Research Problem, Selection of a problem, Techniques involved in definition of a problem, Research Proposals – Types, contents, Ethical aspects, IPR issues like patenting, copyrights.Meaning, Need and Types of research design, Literature Survey and Review, Identifying gap areas from literature review,Research Design Process, Sampling fundamentals, Measurement and scaling techniques, Data Collection – concept, types and methods, Design of Experiments.Probability distributions, Fundamentals of Statistical analysis, Data Analysis with Statistical Packages, Multivariate methods. Concepts of correlation and regression, Fundamentals of time series analysis and spectral analysis, Principles of Thesis Writing, Guidelines for writing reports & papers,Methods of giving references and appendices, Reproduction of published material, Plagiarism, Citation and acknowledgement. Documentation and presentation tools – LATEX, Microsoft Office with basic presentations skills, Use of Internet and advanced search techniques

Course Outcome:

The student will demonstrate the ability to

1. Write a technical report.
2. Identify and formulate the research problem.

TEXT BOOKS:

1. Dr. C. R. Kothari , Research Methodology: Methods and Techniques', New Age International Publisher, 2004
2. R. Paneerselvam, Research Methodology, Phi Learning, Second Edition

REFERENCES:

1. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners' by, SAGE Publications*L*td; Third Edition
2. Research Methodology: An Introduction for Science & Engineering Students', by Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004
3. Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville, Juta and Company Ltd, 2004
4. Research Methodology, G.C. Ramamurthy, Dream Tech Press, New Delhi
   Management Research Methodology' by K. N. Krishnaswamy et al, Person Education

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 GN 6001	RESEARCH METHODOLOGY	0-2-0:2

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Introduction to Research Methodology, Concepts of Research, Meaning and Objectives of Research, Research Process,	4	15
MODULE 2: Types of Research, Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical, Criteria of Good Research, Research Problem, Selection of a problem, Techniques involved in definition of a problem, Research Proposals – Types, contents, Ethical aspects, IPR issues like patenting, copyrights.	4	15
FIRST INTERNAL TEST		
MODULE 3: Meaning, Need and Types of research design, Literature Survey and Review, Identifying gap areas from literature review,	4	15
MODULE 4: Research Design Process, Sampling fundamentals, Measurement and scaling techniques, Data Collection – concept, types and methods, Design of Experiments.	4	15
SECOND INTERNAL TEST		
MODULE 5: **Quantitative techniques:** Probability distributions, Fundamentals of Statistical analysis, Data Analysis with Statistical Packages, Multivariate methods. Concepts of correlation and regression, Fundamentals of time series analysis and spectral analysis	6	20
MODULE 6: **Report Writing:** Principles of Thesis Writing, Guidelines for writing reports & papers, Methods of giving references and appendices, Reproduction of published material, Plagiarism, Citation and acknowledgement, Documentation and presentation tools – LATEX, Office Software with basic presentations skills, Use of Internet and advanced search techniques	6	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6591	Seminar	0-0-2:2	2015

Pre-requisites: Nil

Course Objectives:

1. To assess the debating capability of the student to present a technical topic.
2. To impart training to a student to face audience and present his ideas and thus creating in him self-esteem and courage that are essential for an engineer.

Syllabus

Individual students are required to choose a topic of their interest from latest design related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. The student is free to continue this as his/her project. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Course Outcome:

The student will demonstrate the ability to

1. Write a technical report.
2. Do a presentation confidently

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6593	Advanced Measurements Lab	0-0-2:1	2015

Pre-requisites: Nil

Course Objectives:

To develop measurement strategies among students for measuring parameters that can come up in the development of a machine.

Syllabus

1. Preparation and calibration of Photo elastic sheets.
2. Preparation of Photo elastic models like Discs, Beams and Columns.
3. Stress determination for different models having regular shapes, loaded conventionally, and comparison of results with theoretical values.
4. Measurement of strains for different shapes, by different arrangements of strain gauges.
5. Determination & verification of natural frequency of Transverse vibration of beams with different end conditions.
6. Determination and verification of Logarithmic Decrement of a damped system.
7. Determination and verification of Displacement, Velocity, Acceleration and phase lag of Forced vibration systems.
8. Vibration signature analysis of different existing machines such as Lathe, Grinder, Blower etc.

Course Outcome:

The student will be confident in measurement of engineering components to be used in design process

SEMESTER 2

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6502	Finite Element Analysis	3-1-0:4	2015

Pre-requisites: Nil

Course Objectives:

1. To equip the students with the Finite Element Analysis fundamentals.
2. To enable the students to formulate the design problems into FEA.
3. To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.

Syllabus

Basic concepts of FEM, Linear spring, elastic bar, flexure elements and their nodal equilibrium equations, element transformation and assembly of global stiffness matrix and element load vector, method of weighted residuals, applications in solid mechanics, finite elements in dynamics and introduction to FEA software.

Course Outcome:

Upon completing this course, the students will be able to:

1. Identify mathematical model for solution of common engineering problems.
2. Formulate simple problems into finite elements.
3. Solve structural, thermal, fluid flow problems.
4. Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer

TEXT BOOKS

1. David V Hutton, “Fundamentals of Finite Element Analysis”, McGraw Hill
2. Daryl L. Logan, “First course in Finite Element Method”, Vengage Learning, Singapore

REFERENCES

1. J. N. Reddy, “An introduction to the finite element method”, McGraw Hill
2. C. Zienkiwiez, “The finite element method”, McGraw Hill, New York.
3. K. H. Huebner, “The finite element method of engineers”, John Wiley & Sons, New York.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 6502	FINITE ELEMENT ANALYSIS	3-1-0:4	
MODULES		**Contact Hours**	**Sem.Exam Marks;%**
MODULE 1: Basic concepts of FEM - Comparison with other methods of analysis - a general procedure for finite element analysis, Discretization of domain, types of elements, interpolation polynomials, basic equations of solid mechanics.		9	15
MODULE 2: Linear spring as finite element, elastic bar, spar/link/truss element – finite element equations, solution, Strain energy, Castgliano's first theorem, Principle of minimum potential energy.		9	15
FIRST INTERNAL TEST			
MODULE 3: Truss structures: The direct stiffness method – Nodal equilibrium equation, element transformation and direct assembly of global stiffness matrix, boundary conditions, constraint forces, element strain and stress, three dimensional trusses.		9	15
MODULE 4: Flexure elements: elementary beam theory, flexure element, flexure element stiffness matrix and element load vector, work equivalence for distributed loads, flexure element with axial loading.		9	15
SECOND INTERNAL TEST			
MODULE 5: Method of weighted residuals – introduction, the Galerkin method, numerical integration – Gaussian quadrature. Applications in solid mechanics – plane stress, plane strain – triangular membrane element, isoparametric formulation of plane quadrilateral element, axisymmetric stress analysis, general three dimensional stress – finite element formulations, strain and stress computations.		10	20
MODULE 6: Finite elements in dynamics – formulation – consistent and lumped mass matrices, assembly of global mass matrix, solution of dynamic equations of motion as an eigen value problem – Free vibration analysis of one dimensional problems – bar and beam elements – evaluation of eigen values and eigen vectors, Introduction to FEA software.		10	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6504	Design Engineering	2-1-0:3	2015

Pre-requisites: Nil

Course Objectives:

1. Be able to understand, identify and quantify failure modes for mechanical parts.
2. To develop an ability to identify, formulate, and solve engineering problems.
3. Be able to approach a design problem successfully, taking decisions when there is no unique answer

Syllabus

Fundamentals of design, The design process, Design considerations, Fatigue considerations in design, Design for wear and corrosion resistance, Design consideration of rubber springs, Design for manufacture, Advanced shaft design, Design of high speed cams, Introduction to reliability in design, Industrial product design.

Course Outcome:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. An ability to function on multidisciplinary teams
4. An ability to identify, formulate, and solve engineering problems

TEXT BOOKS:

1. M.F.Spotts, “Mechanical Design Analysis”, Prentice Hall, 1964.
2. L.Sreenath, “Concepts in Reliability”, Affiliated East West Press, 2005.

REFERENCES:

1. Kare Hellan, “Introduction to Fracture Mechanics”, McGraw Hill, 1985.
2. P. Orlov, “Fundamentals of Machine Design Vol. I, II, III”, Mir publications.
3. C.O. Smith, “Introduction to Reliability in Design”, McGraw Hill, 1976.
4. Woodson T.T., “Introduction to Engineering Design” McGraw Hill, 1966.
5. W.H. Mayall, Industrial Design for Engineers, Iliffe, 1967.
6. Pahl, G, and Beitz, W.,” Engineering Design**”,** Springer – Verlag, NY. 1984.
7. Ray, M.S., “Elements of Engg. Design**”,** Prentice Hall Inc. 1985.
8. Suh, N.P., “The principles of Design”, Oxford University Press, NY.1990.
9. Dieter, George E., “Engineering Design - A Materials and Processing Approach”, McGraw Hill, International Editions, Singapore, 2000.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME 6504	DESIGN ENGINEERING	2-1-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Design Fundamentals - Importance of design- The design process-Considerations of Good Design – Morphology of Design – Organization for design, Design considerations – material selection, functional design, cost analysis.	6	15
MODULE 2: Fatigue considerations in design - fatigue in materials – fracture mechanics approach to fatigue – theories of fracture – nucleation and growth of fracture – creep in materials – laws of creep – estimated time to rupture – relaxation and creep in bending.	6	15
FIRST INTERNAL TEST		
MODULE 3: Design for wear and corrosion resistance – contact stresses – the plastic flow process – shape factor – spring back – residual stresses. Design consideration of rubber springs, air springs and Belleville springs.	6	15
MODULE 4: Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding	6	15
SECOND INTERNAL TEST		
MODULE 5: Advanced shaft design - deflection of stepped shafts – variable cross-section shafts – conjugate beam and strain energy method. Design of high speed cams – kinematic design and dynamic design – polydyne cams.	9	20
MODULE 6: Introduction to reliability in design – reliability function, failure data analysis, failure distribution functions, MTTF/MTBF, hazard rate and models, methods of improving reliability, reliability testing. Industrial product design – Creative design, ergonomics and aesthetic requirements – quality and maintainability considerations.	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6506	Advanced Theory of Mechanisms	2-1-0:3	2015

Pre-requisites: Nil

Course Objectives:

The main contents the course will teach the students the followings:

1. The classification of space mechanisms and the synthesis theory of mechanism
2. The mathematical tools for mechanism analysis and applications
3. The basic theory for motion analysis
4. The evaluation indexes for mechanism performance

Syllabus

Kinematics of links and mechanisms, Auxiliary points and special methods for velocity and acceleration determination, Euler Savary Equation, Bobilier theorem, Hartman's construction, Design of function generators, Analysis of Cams, Anlaytical and graphical methods of profile determination, Static and Dynamic Force Analysis

Course Outcome:

1. Draw inversions and determine velocity and acceleration of different mechanisms.
2. Calculate loss of power due to friction in various machine elements.
3. Solve problems on power transmission.
4. Calculate balancing mass and its position.

TEXT BOOKS:

1. Shigley, J.E, John J. Uicker, "Theory of Machines and Mechanisms", Oxford University press, 2004.
2. J.E.Shigley, "Kinematics analysis of Mechanisms", McGraw Hill, 2007.

REFERENCES:

1. Holowenko, A.R, "Dynamics of Machinery", Wiley, 2007.
2. Allen S. Hall, Jr., "Kinematics and Linkage Design", Prentice Hall, 2007.
3. Hartenberg and Denavit, "Kinematic Synthesis of Linkages", McGraw Hill, 1964.
4. Arthur G. Erdman and George N. Sandor, "Mechanisms Design Analysis and Synthesis - Vol. I and II", Prentice Hall of India.
5. Robert L. Norton, "Design of Machinery", Tata McGraw Hill, 2004.
6. Rothbart H.A., "Cams", Wiley, 1956.
7. Merit, "Gears", Pitman, 1954.
8. Pahlen R.M., "Fundamentals of Mechanical Design", McGraw Hill, 1962.

COURSE PLAN

COURSE NO	COURSE TITLE	CREDITS
04 ME 6506	ADVANCED THEORY OF MECHANISMS	2-1-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Kinematics: Review of determination of velocity and acceleration of points and links in mechanisms- Analytical and graphical methods – Use of auxiliary points and special methods for velocity and acceleration determination.	6	15
MODULE 2: Pole, polode, Polode curvature, path curvature, Inflection circle-Euler-Savary Equation -Bobiller theorem- Collineation axis-Hartman's Construction.	6	15
FIRST INTERNAL TEST		
MODULE 3: Relative poles based construction of four bar linkages and slider crank mechanisms - Geometric methods of synthesis with three accuracy points- Design of a function generators using Chebychev Spacing. Transmission angle – Angle design for optimum transmission – Coupler curves – Robert's Law – Cognate mechanisms.	6	15
MODULE 4: Analysis of Cams: Basic curves, pressure, angle-Cam size determination-Cam profile determination-Analytical and graphical. Cam dynamics: Cam force analysis-Dynamics of high speed cam system, source of vibration, Follower response. Position error-Jump and cross-over shock, Spring surge and wind up.	6	15
SECOND INTERNAL TEST		
MODULE 5: Static Force Analysis: Forces, Couples. Conditions of equilibrium- Free body diagram. Analysis of 4-bar linkage, slider crank mechanisms, cams. Force analysis using Coulomb friction and pin joint friction.	9	20
MODULE 6: Dynamic force analysis of spatial mechanism. D'alembert's principle, Motion of a rigid body, moments and products of Inertia, Translation of axes. Rotation of axes. Measuring moment of Inertia, Euler's equation of motion.	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6508	Industrial Instrumentation	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

1. Students will understand technical terms and nomenclature used in industrial measurement and industrial process control.
2. Students will demonstrate a working knowledge of the basic principles of electricity and electronics.
3. Students will understand the principles of industrial processes, process measurement, and process control.

Syllabus

Introduction to instruments and their representation, static and dynamic characteristics, steady state and transient response, Mechanical measurements, pressure, temperature and flow measurements, measurement of vibration.

Course Outcome:

1. The student will be equip with the basic knowledge of Pressure, Temperature, flow, level, density and viscosity measurements.
2. The student knows to calibrate the various instruments also he knows to apply the instrument in various fields.

TEXT BOOKS:

1. Earnest O Doebelin, “Measurement systems Applications & Design”, McGraw Hill.
2. B.C Nakra and K.K Choudhary, “Instrumentation Measurement and analysis”, Tata McGraw Hill.

REFERENCES:

1. Rangan C.S., Sharma G.R, Mani V.S.V, “Instrumentation devices and Systems”, Tata McGraw Hill, New Delhi.
2. Donald P Eckman, “Industrial Instrumentation”, Wiley Eastern Ltd., New Delhi.
   Beckwith Thomas G., and Buck, N. Lewis, “Mechanical Measurements”, Oxford & IBH,New Delhi.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME 6508	INDUSTRIAL INSTRUMENTATION	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Instrumentation: Introduction to Instruments and their representation. Static and Dynamic characteristics of Instruments, analysis of steady state and transient response.	6	15
MODULE 2: **Mechanical measurements**: Transducer Elements, Intermediate Elements, Indicating and recording Elements.	6	15
FIRST INTERNAL TEST		
MODULE 3: **Mechanical Measurements:** a) Frequency Measurement b) Displacement Measurement c) Force Measurement, and d) Torque Measurement.	6	15
MODULE 4: **Pressure measurements**: Pressure and Vacuum measurement, Flow measurements.	6	15
SECOND INTERNAL TEST		
MODULE 5: Temperature Measurements using Industrial Thermocouples, resistance thermometers, radiation temperature measurements.	9	20
MODULE 6: **Measurement of vibration**: Study of vibrometer, vibration analyser - measurement of noise – Study of noise meter, noise analyser, Signal and system analysis.	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6512	Computer Aided Design in Manufacturing	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

1. To introduce the student to the basic tools of computer-aided design (CAD) and computer-aided manufacturing (CAM).
2. To expose the student to contemporary computer design tools for aerospace and mechanical engineers.
3. To prepare the student to be an effective user of a CAD/CAM system.

Syllabus

Overview of CAD systems, CAD hardware and software, Computer graphics and graphics transformation, geometric modeling, boundary representations, parametric design and object representation, introduction to finite element analysis

Course Outcome:

1. Be able to model a part.
2. Be able to create an assembly of parts.
3. Be able to use a commercial CAD/CAM software package as an engineering tool
4. Be able to create basic NC sequences necessary for material removal.

TEXT BOOKS:

1. C. S. Krishnamoorthy and S. Rajeev, “Computer aided design”, Narosa Publishing
2. House, 1991
3. Ibrahim Zeid, “CAD/CAM theory and practice”, McGraw Hill Inc, 1991
4. David V. Hutton, “Fundamentals of finite element analysis”

REFERENCES:

1. New man &Sproull, “Principles of interactive graphics”, McGraw Hill.
2. Vera B. Anand, “Computer graphics and geometric modelling for engineers”, John Wiley & Sons Inc., 1993
3. Sandhu Singh, “Computer aided design and manufacturing”, Khanna Publishers, 1998
4. User’s Manuals for Ansys, Adams, Pro/Engineer, Cadds 5 and Autocadsoftwares.
5. R. D. Cook, “Concepts and applications of finite element analysis”
6. Daryl L. Logan, “A first course in the finite element method”
7. David F. Rogers and J. Alan Adams, “Mathematical elements for computer graphics”, Second Edition, McGraw Hill, 1990

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME 6512	COMPUTER AIDED DESIGN IN MANUFACTURING	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Overview of CAD systems: Conventional and computer aided design processes–advantages and disadvantage – CAD hardware and software – analytical and graphics packages – networking of CAD systems.	6	15
MODULE 2: Computer graphics and graphics transformation: Image processing–transport of graphics data – graphic standards – display and viewing – transformations – customizing graphics softwares.	6	15
FIRST INTERNAL TEST		
MODULE 3: Geometric modeling: Wire frame, surface and solid modeling–applications and advantages–Boolean operations – half-spaces – filleting of edges of solids – boundary representations – constructive solid geometry – sweep representation.	6	15
MODULE 4: Parametric design and object representation: Object-oriented representation–types of coordinate system – parametric design – definition and advantages – parametric representation of analytic and synthetic curves – parametric representation of surfaces and solids – manipulations. Mechanical assembly – mass property calculation.	6	15
SECOND INTERNAL TEST		
MODULE 5: Introduction to finite element analysis: Basic steps in finite element problems formulation – element type and characteristics – element shapes – co-ordinate systems.	9	20
MODULE 6: 1D link elements and beam elements – shape functions – stiffness matrices – direct stiffness method – 2 D elements – axisymmetric elements – plane stress problem – higher order elements.	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6514	Principles of Robotics and Applications	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

1. Teach students about basic robotics through lectures.

Syllabus

Introduction to robotics, Kinematic principles, Introduction to dynamics, Drives and sensors, Robot application

Course Outcome:

Students should be able to:

1. Define a robot
2. Describe moral and ethical issues related to robotics
3. Apply and practice basic principles of robotic design
4. Contribute in a teamwork environment method

TEXT BOOKS:

1. Deh S. R., “Robotics technology and flexible automation”, Tata McGraw Hill, 1994
2. Craig, J. J., “Robotics: mechanics and control”, Addison Wesley, 1989

REFERENCES:

1. Shiman Y., “Handbook of industrial robotics”, John Wiley & Sons, 1985
2. Groover M. P., “Fundamentals of modern manufacturing materials, processes, and systems”, Prentice Hall, 1996
3. Craig J., “Adaptive control of mechanical manipulators”, Addison Wesley, 1988
4. Snyder W. E., “Industrial robots: computer interfacing and control”, Prentice Hall, 1985
5. Song S. M., and Waldron K. J., “Machines that walk”, MIT Press, 1988
6. “IEEE journal of robotics and automation”
7. “International journal of robotics research”
8. “IEEE transactions on man, system, and cybernetics”
9. Richard D. Klafter, Thomas A. Chmielwski, Michael Negin, “Robotics engineering, an integrated approach”, Prentice Hall of India. 1989
10. Mikell. P. Groover et al., “Industrial robots – technology, programming and application”, McGraw Hill, 1980

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 6514	PRINCIPLES OF ROBOTICS AND APPLICATIONS	3-0-0:3	
MODULES		Contact Hours	Sem.Exam Marks;%
MODULE 1: Introduction: Definition, configurations, work envelopes, specifications, and other basic parameters of robots.		6	15
MODULE 2: Kinematic principles: Position and orientation, co-ordinate systems, relative frames, homogeneous co-ordinates, direct and inverse kinematics, differential motions and the Jacobeans.		6	15
FIRST INTERNAL TEST			
MODULE 3: Introduction to dynamics: Types of motions: slew–joint-interpolated–straight line interpolated motions. Path planning – trajectory planning and control.		6	15
MODULE 4: Drives: electrical, hydraulic, and pneumatic drives – basics and relative merits. Components: harmonic reduction units, servo valves, and grippers. Sensors: basic types including vision, force – torque wrist sensors.		6	15
SECOND INTERNAL TEST			
MODULE 5: Robot application: Robot motion planning–configuration space concepts. Robot programming concepts: off line programming and simulation – work cell application.		9	20
MODULE 6: Development: requirements – modeling – work cell calibration – layout planning. Case studies.		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6516	EXPERIMENTAL STRESS ANALYSIS	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

Imparts basic idea of experimental stress analysis, Stress analysis – Analytical, Numerical and Experimental approaches, Specific domain of these approaches, Advantages and disadvantages

Syllabus

General introduction, Strain gauges and their applications, photoelasticity, other stress analysis techniques.

Course Outcome:

Students should be able to:

1. Students will demonstrate a basic understanding of experimental methods (e.g. strain gauges, photoelasticity, image correlation) commonly used in experimental mechanics
2. Students will demonstrate the ability to complete a detailed laboratory report and present their findings in a structured, logical manner.
3. Students will demonstrate the ability to analyse experimental data and develop appropriate, logical conclusions based on comparisons to theoretical results and other experimental evidence.

TEXT BOOKS:

1. Dalley and Riley, “Experimental stress Analysis”, McGraw Hill, 1991.
2. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 1996.

REFERENCES:

1. Dove and Adams, “Experimental Stress Analysis and Motion measurement”, Prentice Hall, 1965.
2. Hetenyi, “Handbook of Experimental stress Analysis”, John Wiley, 1960.
3. Perry and Lissener, “Strain gauge Primer”, McGraw Hill, 1962.
4. W.J. McGonnagle, “Non-destructive Testing”, McGraw Hill, 1961.
5. American Society for Metals, “Metals Hand Book – Vol.7”, 1984.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME 6516	EXPERIMENTAL STRESS ANALYSIS	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE 1: Introduction:– Principal stresses and strains – Three dimensional stress – strain relationships – Plane stress and Plane strain conditions. Strain gauges – Types – Mechanical, Optical and Electrical strain gauges – Electrical resistance strain gauges – Gauge factor – Strain gauge circuitry – Temperature compensation – Bridge balancing and calibration of D.C and A.C bridges.	6	15
MODULE 2: Application of strain gauges :- Transverse sensitivity–Selection and mounting of strain gauges–Strain gauge rosettes – Analysis of strain gauge data and stress calculations – Recording equipments for static and dynamic strains – Strain gauge transducers – Introduction to semiconductor strain gauges - Residual stresses - Beneficial and harmful effects – Principle of residual stress measurement methods.	6	15
FIRST INTERNAL TEST		
MODULE 3: Photoelasticity: Theory of photoelasticity - Stress-optic law - Plain Polariscope& Circular Polariscope – Isoclinic & Isochromatic fringes – Partial fringe value and compensation techniques – Tardy's Method.	6	15
MODULE 4: Photoelastic model materials and their desired properties - use of photo elastic coatings. Applications of Photoelasicity for two dimensional models - Separation of Principal stresses– Scaling models to prototype. Introduction to 3D Photoelasticity.	6	15
SECOND INTERNAL TEST		
MODULE 5: Other Stress analysis techniques - Moire fringe method and Brittle coating technique for stress analysis. Introduction to Holography in stress analysis.	9	20
MODULE 6: Non-destructive testing – Types – Dye penetrate methods, Radiography, X-ray and Gamma ray - X-ray fluoroscopy – Penetrameter - Magnetic particle method. Introduction to lasers in NDT – Ultrasonic flaw detection	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6518	Numerical Methods	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

The primary goal is to provide students with a basic knowledge of numerical methods including root-finding, elementary numerical linear algebra, solving systems of linear equations, curve fitting and numerical solution to ordinary differential equations.

Syllabus

Algebraic and transcendental equation, Simultaneous linear equations, Interpolation and curve fitting, Numerical integration and differentiation, Numerical solution of ordinary differential equation, boundary value and eigen value problem.

Course Outcome:

Students should be able to:

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Apply numerical methods to obtain approximate solutions to mathematical problems
3. Analyse and evaluate the accuracy of common numerical methods

TEXT BOOKS:

1. Computer Based Numerical and Statistical Techniques, Manish Goyal, Laxmi Publications (P) Ltd, New Delhi
2. Introductory Methods of Numerical Analysis, S. S. Sastry, Prentice-Hall of India (P) Ltd, New Delhi

REFERENCES:

1. Numerical Methods is Engineering, Salvadori M G, Baron M L, Prentice-Hall
2. Numerical Methods for Engineers, Chapra S C, Canale R P, 2nd Ed, McGraw-Hill, New York
3. Applied Numerical Analysis, Gerald C F, Wheatley P O, 6th edition, Pearson Education, 1999
4. Numerical Methods for Partial Differential Equations, William F. Ames, 2nd Edition, Academic Press, 1977

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 6518	NUMERICAL METHODS	3-0-0:3	
MODULES		Contact Hours	Sem.Exam Marks;%
MODULE 1: Algebraic and transcendental equation: Bisection method, Fixed point, Regula-Falsi method, Newton-Raphson method, Rate of convergence, Merits and demerits of methods.		6	15
MODULE 2: Simultaneous Linear Equations: Motivation, Gauss elimination, Solution accuracy, Iterative methods, Jacobi method, Gauss-Seidel method, Relaxation method.		6	15
FIRST INTERNAL TEST			
MODULE 3: Interpolation and Curve Fitting: Motivation, Polynomial forms, Linear interpolation, Lagrangean interpolation, Newton interpolation, spline interpolation, Regression analysis, Fitting linear equations, Least-square method, Fitting transcendental equations, Polynomial functions.		6	15
MODULE 4: Numerical integration and differentiation: Maximum and Minima, Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Weddle's rule, Euler-Mclaurin's formula.		6	15
SECOND INTERNAL TEST			
MODULE 5: Numerical solution of ordinary differential equation: Euler's method, Modified Euler's method, Runge-Kutta Methods		9	20
MODULE 6: Boundary value and Eigen value problem: Motivation, Shooting method, Finite difference method, Finite volume method, Polynomial Method, Power method, Elliptic, Parabolic and Hyperbolic Partial Differential Equations		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6522	Oil Hydraulics and Pneumatics	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

Students will be able to

1. Demonstrate an understanding of Hydraulic and Pneumatic principles, equipment, Seals and industries.
2. Identify and describe the basic operation of Hydraulic / Pneumatic systems, the various equipment used in their operation, Hydraulic / Pneumatic terms as well as actuator Sealing Device design / material strengths and weaknesses.

Syllabus

Fluid power fundamentals, Hydraulic cylinders, Control valves, Hydraulic circuits and pneumatic circuits, design of circuit

Course Outcome:

Students should be able to:

1. Demonstrate the ability to understand the basic concepts of the Industrial Hydraulics and Pneumatics Course deals with fluid power, and describes the basic principles and the importance of pressure, flow, speed, and efficiency rating factors.
2. Understand the operation of hydraulics &pneumatics circuits and components typically used in industry
3. Read hydraulics & pneumatics circuit drawings
4. Understand how PLCs are interfaced and used to control pneumatic systems.

TEXT BOOKS:

1. Pippengar, John J. and Koff, Richard M, “Fluid Power Controls”, McGraw Hill, 1959
2. Dr. HeinzaZoebl. Techn, “Fundamentals of Hydraulic Circuitry”, Iliffe, 1970.
3. Kirshner, Joseph M, “Fluid amplifiers”, McGraw Hill, 1966.

REFERENCES:

1. Pippengar, John J. and Hicks, Tyler G, “Industrial Hydraulics”, McGraw Hill, 1979.
2. Kirshner, Joseph M. and Silas Katz, “Design Theory of Fluidic Components”, Academic press, 1975.
3. Leskiewics H.J. and Zarhmba M, “Pneumatic and Hydraulic components and instrumentations in automatic controls”, International Federation of Automatic Control, 1980.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 6522	OIL HYDRAULICS AND PNEUMATICS	3-0-0:3	
MODULES		**Contact Hours**	**Sem.Exam Marks;%**
MODULE 1: Fluid power fundamentals: Introduction - operation principle of fluid power–definitions, units, standards and symbols – advantages and disadvantages – applications in various fields.		6	15
MODULE 2: Hydraulic cylinders: Classification and characteristics - connection types and performance parameters - differential and float concepts - typical cylinder structure - ancillary hydraulic elements.		6	15
FIRST INTERNAL TEST			
MODULE 3: Control valves: Directional control valve - structure and operation of pilot-operated check valves and the directional control valves - standard symbols for representing the elements - concepts of position and way - actuation mechanisms.		6	15
MODULE 4: Pressure control valves – operation - remote pressure adjustment of the pilot-operated pressure relief valve - pressure reducing valve, sequence valve, counterbalance valve and pressure switch. Flow control valves – throttle characteristics of various orifices - flow regulating valve. Cartridge valves, proportional valves and servo valves.		6	15
SECOND INTERNAL TEST			
MODULE 5: Hydraulic circuits: Rapid motion circuits, speed control circuits, synchronous circuits, sequential circuits, counter balance circuits and unloading circuits. Typical hydraulic system examples - movable platform system of modular machine tools - the hydraulic system of truck cranes		9	20
MODULE 6: Pneumatic circuits: Compressed air production and distribution, pneumatic control components, examples of application including electro-pneumatic and hydro pneumatic controls. Design of circuits: Hydraulic circuit design for typical hydraulic systems such as hydraulic press, movable platform of modular machine tools, truck cranes – design calculations. Pneumatic circuit design and associated design calculations.		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6524	Advanced Machine Tool Design	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

Students will be able to

1. Implement the tool design process when designing tooling for the manufacturing of a product.
2. Evaluate and select appropriate materials for tooling applications.
3. Design, develop, and evaluate cutting tools and work holders for a manufactured product.
4. Use CAD and conventional techniques in creating tooling drawings

Syllabus

Kinematics of machine tools, Design of drives, Design of machine tool structures, Design of slide ways and circular ways, machine tool noise control, automatic machine tool and transfer machines with control systems, application of CAD/CIM/CAM in machine tool design, NC and CNC machines, Hydraulic and pneumatic circuit design for tools.

Course Outcome:

Students should be able to know about machine tool drive, regulation of speed and feed rates, design of machine tool structure, design of guide ways and power screws, design of spindles and spindle supports, dynamics of machine tools.

TEXT BOOKS:

1. Mehta, N.K., “Machine Tool Design”, Tata McGraw Hill, 1989.
2. Acherkan N., “Machine Tool Design”, Vol. I – IV, Mir Publications.

REFERENCES:

1. M. Weck, “Handbook Of Machine Tools, Vol. 1-4”, John Wiley, USA. 1980.
2. Cyrll Donaldson, G.H.LeCain& V.C. Goold, “Tool Design”, Tata McGraw Hill, 1973.
3. J. Tlusty&F.Koenigsbeger, “Machine Tool Structure, Vol. I”, Pergamon press, UK, 1970.
4. Pippengar, John J. and Koff Richard M, “Fluid Power Controls”, McGraw Hill, 1959.
5. Pippengar, John J. and Hicks, Tyler G, “Industrial Hydraulics”, McGraw Hill, 1979.
6. Leskiewics H.J. and Zarhmba M., “Pneumatic and Hydraulic components and
7. Instrumentations in Automatic Controls”, International Federation of Automatic controls,1980.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 6524	ADVANCED MACHINE TOOL DESIGN	3-0-0:3	
MODULES		**Contact Hours**	**Sem.Exam Marks;%**
MODULE 1: **Kinematics of Machine tools:** Classifications of motions for shaping surfaces, Kinematic structure of Machine tools having mechanical and non-mechanical kinematic constraints. Machine tool dynamics, Selection of power drives.		6	15
MODULE 2: Design of drives. Transmission ratio, Design and classification of Speed and feed gear boxes, Step less drives, Bearing selection, Mechanism for rectilinear motion, Reversing devices.		6	15
FIRST INTERNAL TEST			
MODULE 3: Design of Machine tool structures like beds, columns, Tables, Cross rails, Carriages, Design of slide ways and Circular ways-Static and Dynamic stiffness, Profiles, application of new materials – treatment of slide way. Machine tool noise and concepts of noise control.		6	15
MODULE 4: Automatic machine tools and Transfer machines with control systems: Selection of control systems, Control systems with pre-selection of speeds or feeds, Manual and Automatic controls, Remote controls, Safety devices in machine tools. Significance of Machine tool automation, working members.		6	15
SECOND INTERNAL TEST			
MODULE 5: Application of CAD/CAM/CIM in Machine tool design, N.C machines, C.N.C Machines, Transfer machines & their controls. Recent trends in machine tool design.		9	20
MODULE 6: General principles of Hydraulic and Pneumatic drives. Different types control valves for Hydraulic and Pneumatic circuits, Hydraulic & Pneumatic circuit design for machine tools.		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6526	Fracture Mechanics and Design	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

1. The course will treat linear and nonlinear fracture mechanics principles and their applications to structural design.
2. Fracture phenomena in metals and non-metals will be discussed and testing methods will be highlighted. In the end computer assisted techniques for fracture study will be discussed

Syllabus

Fracture mechanics, fatigue testing methods, notches and stress concentration, analysis of crack tip field, principles of crack arrest, nonlinear fracture mechanics, fracture design.

Course Outcome:

Upon completing this course, the students will be able to:

1. Predict material failure for any combination of applied stresses.
2. Estimate failure conditions of a structure
3. Determine the stress intensity factor for simple components of simple geometry
4. Predict the likelihood of failure of a structure containing a defect

TEXT BOOKS:

1. Hortezberg, R.W., “Determination of fracture mechanics of engineering materials”, Wiley,1983
2. Knott, J.F., “Fracture in engineering materials”, Butterworth, 1973.

REFERENCES:

1. Kanninen, M.F and Popelar, C.H, “Advanced fracture mechanics”, Oxford University Press, 1985.
2. John M. Barson and Stanely T. Rolfe, “Fracture and Fatigue Control in Structures”, Prentice Hall, Inc, USA, 1987.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS
04 ME 6526	FRACTURE MECHANICS AND DESIGN	3-0-0:3

MODULES	Contact Hours	Sem.Exam Marks;%
MODULE1 : Fracture mechanics: The geometry of stress and strain, elastic deformation, plastic and elasto plastic deformation - limit analysis. Damage tolerant fracture mechanics – Fatigue testing methods - statistical nature of fatigue data - theories of fatigue - crack initiation and growth in fatigue.	6	15
MODULE 2: Notches and stress concentration – Stress intensity solutions for 2-D and 3-D crack geometries – Fractography - Structure modes and types.	6	15
FIRST INTERNAL TEST		
MODULE 3 : Analysis of crack tip field: Elements of elasticity - linear elastic crack tip fields. Stress intensity factor - energy release rate - Criterion for crack growth - Crack resistance curve - Principles of crack arrest.	6	15
MODULE 4: Small-scale yielding (SSY) - crack growth relation in SSY - Stable crack growth in SSY. Irwin plastic zone correction- Actual shape of plastic zone - Plane stress - Plane strain.	6	15
SECOND INTERNAL TEST		
MODULE 5 : Fatigue crack growth: Fatigue crack growth test - stress intensity factor, factors affecting stress intensity factor - variable amplitude service loading - Dynamic energy balance – crack arrest - retardation model.	9	20
MODULE 6: Nonlinear fracture mechanics: J integral–Elastic–plastic stationary crack tip fields, ductile structure criterion, J-controlled crack growth and stability – Tearing modulus – the x factor. Engineering approach to plastic fracture - J-integral – testing single specimen testing – standard test methods. Fracture design: Selection of materials - fatigue crack growth rate curve - stress intensity factor range - use of crack growth law.	9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 6592	Mini Project	0-0-4:4	2015

Pre-requisites: Nil

Course Objectives:

1. Understanding customer needs through market survey and suitably incorporating it in the product
2. Working out the complete cost of the product
3. Preparing a business plan to launch and market the product.
4. Working out the after sales services plan for the product

Course Outcome:

The students have to identify a marketable product whose initial functionality wise design is complete. He/She is expected to refine the crude product by improving its aesthetics and ergonomics. At the end of the semester the student is expected to prepare and submit a report for final evaluation.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 9594	Computer Aided Engineering Design	0-0-2:1	2015

Pre-requisites: Nil

Course Objectives:

1.Familiriaze the students in using computer for designing a structure

2.Reduce the lead time in product development

Syllabus

1.Computer aided drafting: Use of AutoCAD or Drawing Editor for 2-D drafting, plan/elevation/side view, etc.

2.3D Solid modeling: Part creation, surface generation and solid modeling of machine parts, assembly of parts (simple exercises only).

3.Finite Element Analysis: Creation of models, use of different elements, mesh generation, assigning material properties, treatment of different loads and boundary conditions. Solution - static and dynamic analysis. Post-processing – displacement, stress and strain plots – stress concentration. Various exercise problems using software (simple exercises only).

4. Software: Students must be trained in 3D Modeling and Finite Element Software such as SolidWorks, ABAQUS, ANSYS, NASTRAN or COSMOS, as part of the Lab exercise.

Course Outcome:

Upon completing this course, the students will be able to:

` 1.Make 3D models independently
2. Analyze them for strength considerations
3.Optimize their structure

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7590	Industrial Training	0-0-4:0	2015

Pre-requisites: Nil

Course Objectives:

1. Expose students to experience and knowledge which is required in industry.
2. Develop an appreciation of the structure and operation of industrial organisations.
3. Understand the role of the engineer and engineering in industry.
4. Appreciate the ethical basis of engineering practice in industry.
   Appreciate the importance of good communication and interpersonal skills, and to develop these skills

Syllabus

The student shall undergo an industrial training for a minimum period of 12 weeks in an industry/ company approved by the institution and under the guidance of a staff member in the concerned field. The candidate is also required to identify, define, formulate and offer an acceptable solution for a problem observed in the organization. At the end of the training he/she has to submit a report on the work being carried out.

Course Outcome:

Upon completing this course, the students will be able to:

1.Get Familiarized with the general operations happening in an industry.

2.Get an experience in shaping oneself for entering an industry

SEMESTER 3

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7501	Computer Integrated Manufacturing	3-0-0:3	2015

Pre-requisites: Nil

Course objectives

- Imparts an understanding of manufacturing tools and techniques for advocacy and implementation of computer-integrated manufacturing systems.
- Provides knowledge of automated processes in a modern manufacturing environment.

Syllabus

CAD/CAM contents and tools, CAD/CAM hardware, Transformations, Basic definitions: Geometric modelling Types and representation of surfaces, Types and representation of solids: Computer numerical control of machine tools, CNC Part Programming, Computer aided process planningComputer process monitoring

Course OutCome

1. A basic fundamental of CAD/Cam is acquired.
2. CNC part programming is studied.
3. Knowledge of automated processes in a modern manufacturing environment is obtained

TEXT BOOKS:

1. Sandhu Singh, “Computer aided design and manufacturing”, Khanna Publishers, 1998
2. David V. Hutton, “Fundamentals of finite element analysis”

REFERENCES:

1. Newman & Sproull, “Principles of interactive graphics”, McGraw Hill.
2. C. S. Krishnamoorthy and S. Rajeev, “Computer aided design”, Narosa Publishing House,1991
3. Ibrahim Zeid, “CAD/CAM theory and practice”, McGraw Hill Inc, 1991
4. Vera B. Anand, “Computer graphics and geometric modelling for engineers”, John Wiley &Sons Inc., 1993
5. User’s Manuals for Ansys, Adams, Pro/Engineer, Cadds 5 and Autocad softwares.
6. R. D. Cook, “Concepts and applications of finite element analysis”
7. Daryl L. Logan, “A first course in the finite element method”
8. David F. Rogers and J. Alan Adams, “Mathematical elements for computer graphics”, Second Edition, McGraw Hill, 1990

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 7501	COMPUTER INTEGRATED MANUFACTURING	3-0-0:3	
MODULES		**Contact hours**	**Sem.Exam Marks;%**
MODULE 1: **CAD/CAM contents and tools**, Definition of CAD/CAM tools, industrial look at CAD/CAM **CAD/CAM hardware**: Types of systems: Mainframe-based Systems, minicomputer-based systems, microcomputer-based systems, workstation-based systems, input devices, output devices: architecture of graphics system. Graphic displays: raster display, rasterization, plasmadisplays, LCD displays, 3 dimensional viewers. **CAD/CAM hardware**: Types of systems: Mainframe-based Systems, minicomputer-based systems, microcomputer-based systems, workstation-based systems, input devices, output devices: architecture of graphics system. Graphic displays: raster display, rasterization, plasma displays, LCD displays, 3 dimensional viewers.		6	**15**
MODULE 2: **Transformations:** Homogeneous coordinates 2D & 3D transformations, rotation, translation and scaling, combining transformations, hardcopy printers and plotters. Hardware integration and networking: star, ring and bus LAN Configurations. CAD/CAM software graphics standards. **Basic definitions**: Data structure, data base, DBMS, database coordinate system, user interface, software modules: operating system module, graphics module, application module, programming module, communication module.		6	**15**
FIRST INTERNAL EXAM			
MODULE 3: **Geometric modelling:** Types and mathematical representation of curves, wire frame models, wire frame entities, curve representation, parametric representation of analytic curves: line, circles, parametric representation of synthetic curves: Bezier curves.		6	**15**
MODULE 4: **Types and representation of surfaces**: Surface models, surface entities, surface representation, parametric representation of analytic surfaces: ruled surfaces, surface of revolution, tabulated cylinder, parametric representation of synthetic surfaces: Bezier Surface **Types and representation of solids:** Solid models, solid entities, solid representation, B-rep, CSG, sweep representation.		6	**15**
SECOND INTERNAL EXAM			
MODULE 5: **Computer numerical control of machine tools**: Principles types of CNC machine tools and their construction features – tooling for CNC – ISO designation for tooling – CNC operating systems. CNC Part Programming - detailed manual part programming on lathe &		9	**20**

milling machines using G & M codes CNC part programming with CAD system – machining centers, 5 axis machining - design changes for manufacturing problems Programming (a typical control system), computer aided CNC part programming – generation of tool path, generation of G & M codes, optimization of toolpath (to reduce machining time),		
MODULE 6: Computer aided process planning: Group technology and process planning: concepts of group technology. Traditional & computer aided process planning, retrieval & generative processplanning, machinability data systems, computer-generated time standards, generation of routesheets, selection of optimal machining parameters, methods. **Computer process monitoring:** Process control methods, direct digital control, supervisory computer control, steady state optimal control, on line search strategies, adaptive control.	9	**20**

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7503	Sensors For Industrial Applications	3-0-0:3	2015

Pre-requisites: Nil

COURSE OBJECTIVES:

- Provides the participants the state of the art knowledge in the field of sensors.
- Explain various methodologies presently prevalent in the industry for the design of sensors

SYLLABUS

Introduction to sensor fundamentals characteristics operation principles of different sensors Electrical, optical, acoustic, pneumatic, magnetic, temperature, electro optical and vision sensors Condition monitoring of manufacturing systems Acoustic emission Network architecture in manufacturing Automatic identification techniques for shop floor control radio frequency identification systems

EXPECTED OUTCOME:

- Knowledge about basic working principles different of sensors.
- Knowledge of condition monitoring techniques

TEXT BOOKS:

1. Sabrie Solomon, “Sensors: hand book, McGraw Hill
2. JorgScholz (Editor), “Thermal sensors”: Vol. IV, sensors: a comprehensive survey, John Wiley&sons.

REFERENCES:

1. H.H. Bau (Editor), “Mechanical sensors: Vol. VII, sensors: a comprehensive survey”, John Wiley& sons.
2. LjubisaRistia (Editor), “Sensor technology and devices”, Artech House Publishers.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 7503	**SENSORS FOR INDUSTRIAL APPLICATIONS**	**3-0-0:3**	
MODULES		**Hours**	**Sem.Exam Marks;%**
MODULE 1**:** Introduction – sensor fundamentals – characteristics – operation principles of different sensors		6	**15**
MODULE 2: Electrical, optical, acoustic, pneumatic, magnetic, temperature, electro optical and vision sensors.		6	**15**
FIRST INTERNAL EXAM			
MODULE 3: Condition monitoring of manufacturing systems – principles – techniques – selection of sensors		6	**15**
MODULE 4: Sensors for monitoring force, pressure, humidity, radiation, temperature, vibration and noise Sensor Materials and technologies		6	**15**
SECOND INTERNAL EXAM			
MODULE 5: Acoustic emission – principles and applications – concepts of pattern recognition Sensor network to detect machinery faults Network architecture in manufacturing – fiber optic networks. Laser sensors.		9	**20**
MODULE 6: Automatic identification techniques for shop floor control – bar code scanners – radio frequency identification systems – optical character recognition.		9	**20**

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7505	Acoustics and Noise Control for Engineers	**3-0-0:3**	**2015**

Pre-requisites: Nil

COURSE OBJECTIVES:

1. To teach the students the basic principles of acoustics
2. To teach the students the use and application of acoustic analysis instruments.
3. The objective is to provide detailed information on engineering noise control options and applications for specific equipment to enable students to address a variety of noise control challenges.

SYLLABUS

Introduction: Basic Acoustic PrinciplesTransmission through pipes branched and unbranched-resonatorsNoise measurementAcoustic insulation-acoustic materials acousticHuman reaction to soundEnvironmental noise controlSound transmission through structures

EXPECTED OUTCOME:

1. Basic knowledge in acoustics and its principles
2. Noise monitoring and noise reduction techniques

TEXT BOOKS:

1. Harris, C.K., “Handbook of Noise control”, McGraw Hill, 1979.
2. Berenek, L.L., “Noise and Vibration control”, McGraw Hill, 1971.

REFERENCES:

1. Kinsler and Frey, “Fundamentals of Acoustics”, Wiley, 1950.
2. Petrusowicz and Longmore, “Noise and Vibration control for industrialists”, Elsevier,1974.
3. Thumann and Miller, “Secrets of noise control”, Fairmont press, 1974.
4. Graf, “Industrial noise and vibration”, Prentice Hall, 1979.

COURSE PLAN

Course CODE	COURSE TITLE	CREDITS
04 ME 7505	ACOUSTICS AND NOISE CONTROL FOR ENGINEERS	3-0-0:3

MODULES	Hours	Sem.Exam Marks;%
Module1: Introduction: Basic Acoustic Principles - Acoustic terminology and definitions Basic Acoustic Principles - Acoustic terminology and definitions - Plane waves harmonic solution-velocity of sound in viscid fluids-relationship between wave length particle velocity, acceleration – Energy density – acoustic intensity – reference standards and measurement- Transmission through one, two and the media.	6	**15**
Module 2: Transmission through pipes branched and unbranched-resonators-Transmission loss reflection at plane surface-standing waves and standing wave apparatus, spherical waves – radiation – simple source –hemispherical source-radiating piston-pressure intensity distribution-Beam width and directivity index	6	**15**
FIRST INTERNAL EXAM		
Module 3: Noise measurement: Decibel scale-relationship between pressure intensity and power-sound level meter	6	**15**
Module 4: Noise analyser and graphic level recorder- Measurement in anechoic and reverberation chambers.	6	**15**
SECOND INTERNAL EXAM		
Module 5: Human reaction to sound-definitions of speech interference level, perceived noise level, phone and sone etc, hearing loss-principles of noise control-control at source, during transmission and at receiver-protection of receiver. Acoustic insulation-acoustic materials acoustic filter and mufflers – plenum chamber-noise criteria and standards- noise and number index guide lines for designing quieter equipment's – reducing machine noise generated by bearings, gears, motors, fans, propellers, generator sets, cooling towers, pump-sets, pipes etc.	9	**20**
Module 6: Environmental noise control: Noise ratings, human tolerance levels, equivalent sound level and loudness contours - Engine noise and muffler designs - Noise control through barriers and enclosures and absorbent linings - Vehicular noise and control. Sound transmission through structures – noise control by damping and other methods. Principles of noise control in an auditorium-requirements of a good auditorium.	9	**20**

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7507	Computational Fluid Dynamics	3-0-0:3	2015

Pre-requisites: Nil

COURSE OBJECTIVES:

1. Develop an understanding of introductory concepts in computational fluid mechanics.
2. Ability to implement and utilize various numerical methods and basic mathematical analysis for canonical problems in fluid mechanics.
3. To develop an understanding for the major theories, approaches and methodologies used in CFD.
4. To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes.
5. To gain experience in the application of CFD analysis to real engineering designs

SYLLABUS

An overview of CFD, Classification of partial differential equations Viscous flow: A Finite difference scheme for solution of viscous flow Grid generation and solution: Numerical Grid Generation Finite volume method Discretization for one, two and three dimensions - false diffusion – Calculation flow field Algorithms for pressure velocity coupling- semi implicit method for pressure linked equations

EXPECTED OUTCOME:

1. Helps to attain basic concepts and fundamentals of computational fluid dynamics.
2. Helps to gain experience in the application of CFD analysis to real engineering designs

TEXT BOOKS:

1. J.D. Anderson, “Computational Fluid Dynamics”, McGraw Hill, 1995.
2. S V Patankar, “Numerical Heat Transfer”, Hemisphere, 1980

REFERENCES:

1. Fletcher C.A., “Computational Techniques for Fluid Dynamics - Vol 1 & 2”, Springer Verlag, 1988.
2. K.Muralidhar and G. Biswas, “Advanced Engineering Fluid Mechanics”, Narosa Publishers, 1996

COURSE PLAN

Course CODE	COURSE TITLE	CREDITS
04 ME 7507	**COMPUTATIONAL FLUID DYNAMICS**	**3-0-0:3**

MODULES	Hours	Sem.Exam Marks;%
Module 1: **An overview of CFD:** Fluid properties, characteristics, governing equations - potential, inviscid and viscous flow. Classification of partial differential equations. Co-ordinate transformations.	6	**15**
Module 2: General and special (Cartesian, Cylindrical and Spherical Co-ordinates).Derivation of equations for generalized curvilinear coordinates, finite difference approximations for space and timecoordinates.	6	**15**
FIRST INTERNAL EXAM		
Module 3: **Viscous flow**: A Finite difference scheme for solution of viscous flow – stream function vorticity-vorticity transport equation solution of stream function equations-wall vorticity estimation	6	**15**
Module 4: Solution of vorticity transport equation-procedure for drawing contours (Stream function and iso-vorticity) plot and velocity vector plotApplications on flow past bodies such as isolated airfoils and airfoils in cascades.	6	**15**
SECOND INTERNAL EXAM		
Module 5: **Grid generation and solution:** Stability analysis - solution of Laplace equation for regular and irregular geometrics using finite difference method. Numerical Grid Generation- Elliptical and Hyperbolic grids. Solution of time dependent problems- Explicit and implicit schemes. Implementation of prescribed and gradient boundary conditions.	9	**20**
Module 6: **Finite volume method**: Finite volume method for convection - diffusion equations- Governing equations for incompressible variables in primitive variables - upward –hybrid and power law schemes. Discretization for one, two and three dimensions - false diffusion – Calculation of flow field. Algorithms for pressure velocity coupling- semi implicit method for pressure linked equations - solution of two and three dimensional problems in Cartesian and cylindrical coordinate systems.	9	**20**

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7509	Mechanical Behaviour of Materials	3-0-0:3	2015

Pre-requisites: Nil

COURSE OBJECTIVES:

1. Provides basic knowledge in mechanical behavior of engineering materials subjected to different types of loading.
2. Provide students with basic understanding of phase transformation by heat treating and stress-induced hardening, linear and nonlinear elastic behavior, deformation under multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, brittle versus ductile fracture, fracture mechanisms at different scales, fatigue, contact deformation, and wear

SYLLABUS

Different responses of material to loading, material properties, macroscopic experiments and its relevance, physical mechanisms controlling the behavior. Elasticity: Atomic structure and bonding Generalized Hooke's law, anisotropic linear Plasticity: Theoretical shear strength of crystals Theoretical shear strength of crystals Creep and Fracture: Mechanisms Fatigue: Cyclic loads, constant amplitude and variable amplitude Viscoelasticity and viscoplasticity:
Mechanical Characterization of Materials

EXPECTED OUTCOME:

Basic knowledge in mechanical behavior of engineering materials subjected to

1. Basic knowledge in mechanical behavior of engineering materials subjected to different types of loading.
2. Basic understanding of phase transformation

TEXT BOOKS:

1. Norman E. Dowling, Mechanical behavior of materials: Engineering Methods for Deformation,Fracture and Fatigue, Prentice Hall.
2. Marc Meyers and Krishnan K. Chawla, Mechanical behavior of materials, CambridgeUniversity Press.

REFERENCES:

1. William F. Hosford, Mechanical behavior of materials, Cambridge University Press.
2. Thomas H. Courtney, Mechanical behavior of materials, Overseas Press.
3. Joachim Roesler, HaraldHarders, and Martin Baeker, Mechanical Behavior of EngineeringMaterials, Springer.
4. Prashant Kumar, Elements of fracture mechanics, Tata McGraw Hill.
5. S. Suresh, Fatigue of Materials, Cambridge University Press
6. RW Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley &Sons.
7. D. Hull, DA Bacon, Introduction to dislocations, Pergamon. G. E. Dieter, MechanicalMetallurgy, McGraw Hill.

COURSE PLAN

COURSE CODE	COURSE TILE	CREDITS	
04 ME 7509	MECHANICAL BEHAVIOUR OF MATERIALS	3-0-0:3	
MODULES		**Hours**	**Sem.Exam Marks;%**
Module 1: Different responses of material to loading, material properties, macroscopic experiments and its relevance, physical mechanisms controlling the behavior.		6	**15**
Module 2: **Elasticity:** Atomic structure and bonding, Atomic interaction, physical origin of elastic modulus Generalized Hooke's law, anisotropic linear elasticity of crystals, orientation dependence of elastic modulus		6	**15**
FIRST INTERNAL EXAM			
Module 3: **Plasticity:** Theoretical shear strength of crystals, Point, line and volume defects, edge and screw dislocations, Burgers circuit and Burgers vector, force between dislocations, movement and interactions of dislocations, slip planes, twinning, strengthening mechanisms, work hardening, grain boundary strengthening and solid solution strengthening		6	**15**
Module 4: True stress-strain curve, necking phenomenon, yield criteria, rheological models, plastic stress- strain relationships		6	**15**
SECOND INTERNAL EXAM			
Module 5: **Creep and Fracture:** Mechanisms, creep laws, Analysis and Applications in Design, Brittle, ductile and fatigue fracture, fracture surfaces, Griffith's theory, modes of fracture, energy release rate, stress intensity factor, crack tip plasticity, J-integral and Crack Tip Opening Displacement. **Fatigue:** Cyclic loads, constant amplitude and variable amplitude loads, cycle counting techniques, infinite life, safe-life, fail-safe, damage-tolerant design philosophies, Low cycle and high cycle fatigue Stress-Life approach, Strain-Life approach, and Fracture mechanics approach, Cumulative damage theories		9	**20**
Module 6: **Viscoelasticity and viscoplasticity:** Responses of viscoelastic materials under different loading, creep and relaxation, Maxwell and Kelvin models, Three parameter solid and four parameter fluid, generalized Maxwell's and generalized Kelvin's models, primary, secondary and tertiary creep, creep mechanisms, dislocation creep, diffusion creep and grain boundary creep. **Mechanical Characterization of Materials:** Mechanical testing for material Characterization, Measurement techniques in experimental solid mechanics, Non destructive testing.		9	**20**

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7511	Advanced Materials and Processes	3-0-0:3	2015

Pre-requisites: Nil

COURSE OBJECTIVES:

1. An appreciation of a range of new and advanced materials and processes.
2. Be aware of current and potential applications of the developments covered.
3. Understand some of the barriers to the introduction of Advanced Materials and Processes

SYLLABUS

Compositions, properties and applications of: Inter-metallics, Ni and Ti aluminides, smart materials, shape memory alloys, Metallic glass- quasi crystals, Dielectrics, semi conductors, conductors & super conducting materials. Magnetic and photoelectric materials, optical materials, Bio materials, micro electronic materials and nano materials.

Process parameters, advantages, limitations and applications of ultrasonic machining, laser beam machining and electrochemical machining

EXPECTED OUTCOME:

1. Basic knowledge of advanced materials and processes
2. Appreciation of a range of new and advanced materials and processes.
3. aware of current and potential applications of the developments covered

TEXT BOOKS:

1. HMT Handbook" – Production Technology (TMH)
2. S. Kalpaljian& Steven R. Schmidt, (Pearson Education) "Manufacturing Processe for Engineering Materials"

REFERENCES:

1. Willer, "Non- traditional Machining Processes", SME publications.
2. G.F.Benidict, "Advanced Manufacturing Processes", Marcel Dekker Publisher
3. E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, "Materials & Processes in Manufacturing", (PHI)
4. Geoff Eckold "Design & Manufacturing of Composite Structures", (Jaico Publishing House)
5. Krishnan K.Chawla, "Composite Material Science and Engineering", Springer- Verlog, 1987
6. Agarwal D & Brontman L.J., "Analysis & Performance of Fibre Composites", John Willey Publications, 1990
7. Mallik P.K. & Newman S.,"Composite Materials Technology", Henser Publications, 1990
8. "Non Conventional Machining", – P.K.Mishra (IIT, Kharagpur), Narosa Publishing House
9. "Manufacturing Science" - A. Ghosh and Malik – Affiliated East West Press Pvt. Ltd.
10. " Physical Metallurgy" – Vijendra Singh (Standard Publishers Distributors, New Delhi)

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 7511	ADVANCED MATERIALS AND PROCESSES	3-0-0:3	
MODULES		**Hours**	**Sem.Exam Marks;%**
Module1: **Modern materials**- Compositions, properties and applications of: Inter-metallics, Ni and Ti aluminides, smart materials, shape memory alloys, Metallic glass- quasi crystals, Dielectrics, semi conductors, conductors & super conducting materials. Magnetic and photoelectric materials, optical materials, Bio materials, micro electronic materials and nano materials.		6	15
Module 2: **Non Metallic Materials**: Polymer materials, formation of polymer structures, production techniques of fibers, foams, adhesives and coatings. Structure, properties and applications of engineering polymers. Advanced structural ceramics, WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN and diamond- properties, processing and applications.		6	15
FIRST INTERNAL TEST			
Module 3: **Composites**: **Fibers**-glass, boron, carbon, organic, ceramic and metallic fibers**-** Matrix materialspolymers, metals and ceramics. Processing of polymer matrix composites: open mould process, bag molding, compression molding with BMC and SM- filament winding, pultrussion- centrifugal casting, injection molding, applications of PMC's.		6	15
Module 4: Processing of metal matrix polymers: solid state fabrication techniques- diffusion bonding, powder metallurgy techniques, plasma spray, chemical and physical vapor deposition of matrix on fibers, Liquid state fabrication methods, Infiltration, squeeze casting, Rheo casting, compo casting. Applications of MMC's.		6	15
SECOND INTERNAL TEST			
Module 5: **Classification and Types of Conventional Manufacturing Processes**- forging, rolling, extrusion, wire drawing, sheet metal processes. Manufacturing automation. Economics of automated manufacturing. Introduction to micromachining and MEMS. Introduction to coatings and tribology**.** **Non Conventional Machining Processes**: Introduction and need for nonconventional machining processes, Principle and theory of material removal. Process parameters, advantages, limitations and applications of ultrasonic machining, laser beam machining and electrochemical machining		9	20
Module 6: **Special Processes:** Principles, salient features, advantages and applications of abrasive floor machining, magnetic abrasive finishing, wire EDM, electrochemical grinding, honing, lapping and super finishing. Principles, elements, process, advantages, applications and surface preparation etc. of physical vapor deposition, chemical vapor deposition, electro less coating and thermal metal spraying.		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7513	Design for Production	3-0-0:3	2015

Pre-requisites: Nil

COURSE OBJECTIVES:

1. Introduces a range of industry standard production processes, including print production.
2. Explores methods of selection and sourcing of appropriate suppliers and manufacturers in relation to a specific project outcome.
3. Emphasis on workflow for production, and examines communication issues for designers and manufacturers.
4. Various aspects of production will be explored, including software and design methods that support design as activity for production, for mass production or for one-to-many communication.

SYLLABUS

Need Identification and Problem DefinitionEngineering Materials, Selection of MaterialsDesign for Casting,Design for Bulk Deformation ProcessesDesign for Bulk Deformation Processes Review of Assembly Processes,Design for reliabilityDesign for Brazing and SolderingDesign recommendation for brazing and soldering for good quality joints.

EXPECTED OUTCOME:

1. Introducing a range of industry standard production processes, including print production.
2. Understanding different methods of selection and sourcing of appropriate suppliers and manufacturers in relation to a specific project outcome

TEXT BOOKS:

1. Harry Peck, “Designing for manufacture”, Pitman Publications, 1983
2. Spotts M. F., “Dimensioning and tolerance for quantity production”, Prentice Hall Inc.,1983

REFERENCES:

1. Micheal Wader, “Lean tools: a pocket guide to implementing lean practices”, Productivity and Quality Publishing Pvt Ltd., 2002
2. Oliver R. Wade, “Tolerance control in design and manufacturing”, Industrial Press Inc.,New York, 1967
3. James G. Bralla, “Hand book of product design for manufacturing”, McGraw Hill, 1983
4. Trucks H. E., “Design for economic production”, Society of Manufacturing Engineers,Michigan, Second Edition, 1987

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 7513	DESIGN FOR PRODUCTION	3-0-0:3	
MODULES		**Hours**	**Sem.Exam Marks;%**
Module1: Need Identification and Problem Definition, Product life cycle, Steps involved in design for manufacturing, Concept Generation and Evaluation, Embodiment Design		6	15
Module 2: Engineering Materials, Selection of Materials, Selection of Shapes,Co-selection of Materials and Shapes Case studies		6	15
FIRST INTERNAL EXAMINATION			
Module 3: Design for Casting, Various Casting process, Defects in casting and its remedial measure ,recommendation for achieving good quality casting Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Advantages and disadvantages and design guide line of parts for machining.		6	15
Module 4: Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Advantages and disadvantages and design guide line of parts for machining		6	15
SECOND INTERNAL EXAMINATION			
Module 5: Review of Assembly Processes, Design for welding, Defects in welding, methods for rectification Design for Brazing and Soldering Design recommendation for brazing and soldering for good quality joints. Design for adhesive bonding, Design for Joining of plastics Design for corrosion resistance, Design for wear resistance.		9	20
Module 6: Design for reliability, Failure Mode and Effect Analysis Principle basic structure of FMEA Design for quality. Approach to robust design, and Tools for achieving robust design in manufacturing Design for optimization		9	20

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7515	Vibration Control and Condition Monitoring	3-0-0:3	2015

Pre-requisites: Nil

COURSE OBJECTIVES:

1. To present fundamentals to a modern treatment of vibrations, the control strategies using active and passive control methods
2. To provide valuable information on machine condition monitoring as a tool for quickly identifying and correcting the root causes of machinery problems, achieving precise operation, and improving machinery performance.
3. To understand how to monitor operating conditions and vibrations of machinery and plant

SYLLABUS

Vibration Control - Review of Fundamentals of Single Degree Freedom Systems Artificial damping – Resilient isolation, Vibration isolation Selecting methods of condition monitoring Machine maintenance techniques Predictive Maintenance and Signature Analysis Dynamic balancing and alignment of machinery

EXPECTED OUTCOME:

1. Acquired fundamentals to a modern treatment of vibrations, the control strategies using active and passive control methods
2. Provides valuable information on machine condition monitoring as a tool for quickly identifying and correcting the root causes of machinery problems, achieving precise operation, and improving machinery performance.
3. Understands how to monitor operating conditions and vibrations of machinery and plant

TEXT BOOKS:

1. Singiresu S. Rao, “Mechanical Vibrations”, Addison-Wesley Publishing Company, 1995.
2. J.O. Den Hartog, “Mechanical Vibrations”, McGraw Hill, Newyork, 1985.

REFERENCES:

1. R.A.Collacott, “Vibration monitoring and diagnosis”, Wiley, 1979
2. R.A.Collacott, “Mechanical Fault diagnosis and condition monitoring”, Wiley, 1977
3. First course on “Condition monitoring in the process industries”, Manchester, edited byM.J.Neale, Nov 1979.
4. Newman, “Management of Industrial Maintenance”, Butterworth, 1978.
5. “Condition Monitoring Manual”, National Productivity Council, New Delhi.
6. “Terotechnology”, Institute of mechanical Engineers, 1975.

COURSE PLAN

COURSE CODE	COURSE TITLE	CREDITS	
04 ME 7515	VIBRATION CONTOL AND CONDITION MONITORING	3-0-0:3	
MODULES		**Hours**	**Sem.Exam Marks;%**
Module 1: **Vibration Control** - Review of Fundamentals of Single Degree Freedom Systems, Multi Degree Freedom Systems and Continuous systems. Reduction of Vibration at the Source - Control of Vibration – by Structural design – Material Selection – Localized additions		**6**	**15**
Module 2: Artificial damping – Resilient isolation, Vibration isolation, Vibration absorbers. Active vibration control – review of smart materials – types and characteristics - smart structures.		**6**	**15**
FIRST INTERNAL EXAMINATION			
Module 3: **Selecting methods of condition monitoring** - Machine condition monitoring and diagnosis – Vibration severity criteria		**6**	**15**
Module 4: Machine maintenance techniques – Machine condition monitoring techniques Vibration monitoring techniques – Instrumentation systems – Choice of monitoring parameter.		**6**	**15**
SECOND INTERNAL EXAMINATION			
Module 5: **Predictive Maintenance and Signature Analysis**-observational and estimation techniques, online techniques specially dealing with instrumentation system, offline technique like visual inspection, non-destructive testing and destructive testing for materials, fluids and general mechanical and electrical components, predictive analysis of potential failures and end of useful life.Diagnostic maintenance, applications to specific industrial machinery and plants.		**9**	**20**
Module 6: **Dynamic balancing and alignment of machinery**: 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.		**9**	**20**

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7593	Project (Phase 1)	3-0-0:3	2015

COURSE OBJECTIVES:

1. To discover and pursue a unique topic of research in order to construct new knowledge
2. To design and conduct an original research project
3. To develop skills in designing a discipline specific research methodology
4. To develop a working knowledge of relevant literature in machine design
5. To practice humanities/social science/scientific writing and learn how to participate in the peer review process

To be able to discuss research and other topics with academics in your field.

SYLLABUS

In Master's Project Phase-I, the students are expected to select an emerging research area in the field of specialization. After conducting a detailed literature survey, they should compare and analyze research work done and review recent developments in the area and prepare an initial design of the work to be carried out as Master's Project. It is mandatory that the students should refer National and International Journals and conference proceedings while selecting a topic for their Project. He/She should select a recent topic from a reputed International Journal. Emphasis should be given for introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work carried out on the Project topic.

Students should submit a copy of Phase-I Project report covering the content discussed above and highlighting the features of work to be carried out in Phase-II of the Project. The candidate should present the current status of the Project work and the assessment will be made on the basis of the work and the presentation, by a panel of internal examiners in which one will be the internal guide. The examiners should give their suggestions in writing to the students so that it should be incorporated in the Phase–II of the Project.

Master's Project-1 will undergo an evaluation by a panel of examiners including at least one external examiner appointed by university and internal examiner.

SEMESTER 4

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 ME 7594	Project (Phase 2)	0-0-0:21	2015

SYLLABUS

In the fourth semester, the student has to continue the Project work and after successfully finishing the work, he / she has to submit a detailed bounded Project report. The evaluation of M.Tech Project will be carried out by a panel of examiners including at least one external examiner appointed by university and internal examiner. The work carried out should lead to a publication in a National / International Conference or Journal. The papers received acceptance before the M.Tech evaluation will carry specific weightage.