KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
(Autonomous)

M.E. DEGREE IN ENGINEERING DESIGN (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14AMT13	Applied Probability and Statistics	3	1	0	4	40	60	100
14EDT11	Finite Element Method in Engineering Applications	3	1	0	4	40	60	100
14CCT11	Applied Materials Engineering	3	0	0	3	40	60	100
14EDT12	Engineering Design Methodology	3	0	0	3	40	60	100
14EDT13	Advanced Strength of Materials	3	1	0	4	40	60	100
14EDT14	Mechanical Vibrations	3	1	0	4	40	60	100
	PRACTICAL							
14EDL11	Design and Analysis Laboratory	0	0	3	1	100	0	100
14EDL12	Advanced Vibration Laboratory	0	0	3	1	100	0	100
				Total	**24**			

CA - Continuous Assessment, ESE – End Semester Examination

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
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M.E. DEGREE IN ENGINEERING DESIGN (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14EDT21	Optimization Techniques in Design and Manufacturing	3	1	0	4	40	60	100
14EDT22	Mechanical Behaviour of Materials	3	0	0	3	40	60	100
14EDT23	Mechanism Design and Synthesis	3	1	0	4	40	60	100
	Elective-I (Professional)	3	0	0	3	40	60	100
	Elective-II (Professional)	3	0	0	3	40	60	100
	Elective-III (Professional)	3	0	0	3	40	60	100
	PRACTICAL							
14EDL21	Optimization Techniques and Simulation Laboratory	0	0	3	1	100	0	100
14CCL21	Automation Laboratory	0	0	3	1	100	0	100
				Total	**22**			

CA - Continuous Assessment, ESE – End Semester Examination

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M.E. DEGREE IN ENGINEERING DESIGN (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective-IV (Professional)	3	0	0	3	40	60	100
	Elective-V (Professional)	3	0	0	3	40	60	100
	Elective-VI (Open)	3	0	0	3	40	60	100
	PRACTICAL							
14EDP31	Project Work – Phase I	0	0	12	6	50	50	100
14EDL31	Advanced Mechanical Laboratory	0	0	3	1	100	0	100
				Total	**16**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – IV

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	PRACTICAL							
14EDP41	Project Work – Phase II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 74

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
(Autonomous)

M.E. DEGREE IN ENGINEERING DESIGN (PART TIME)
CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14AMT13	Applied Probability and Statistics	3	1	0	4	40	60	100
14EDT11	Finite Element Method in Engineering Applications	3	1	0	4	40	60	100
14CCT11	Applied Materials Engineering	3	0	0	3	40	60	100
	PRACTICAL							
14EDL11	Design and Analysis Laboratory	0	0	3	1	100	0	100
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14EDT21	Optimization Techniques in Design and Manufacturing	3	1	0	4	40	60	100
14EDT22	Mechanical Behaviour of Materials	3	0	0	3	40	60	100
14EDT23	Mechanism Design and Synthesis	3	1	0	4	40	60	100
	PRACTICAL							
14EDL21	Optimization Techniques and Simulation Laboratory	0	0	3	1	100	0	100
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

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M.E. DEGREE IN ENGINEERING DESIGN (PART TIME)
CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14EDT12	Engineering Design Methodology	3	0	0	3	40	60	100
14EDT13	Advanced Strength of Materials	3	1	0	4	40	60	100
14EDT14	Mechanical Vibrations	3	1	0	4	40	60	100
	PRACTICAL							
14EDL12	Advanced Vibration Laboratory	0	0	3	1	100	0	100
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – IV

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective-I (Professional)	3	0	0	3	40	60	100
	Elective-II (Professional)	3	0	0	3	40	60	100
	Elective-III (Professional)	3	0	0	3	40	60	100
	PRACTICAL							
14CCL21	Automation Laboratory	0	0	3	1	100	0	100
				Total	**10**			

CA - Continuous Assessment, ESE – End Semester Examination

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
(Autonomous)

M.E. DEGREE IN ENGINEERING DESIGN (PART TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – V

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective-IV (Professional)	3	0	0	3	40	60	100
	Elective-V (Professional)	3	0	0	3	40	60	100
	Elective-VI (Open)	3	0	0	3	40	60	100
	PRACTICAL							
14EDP31	Project Work – Phase I	0	0	12	6	50	50	100
14EDL31	Advanced Mechanical laboratory	0	0	3	1	100	0	100
				Total	**16**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – VI

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	PRACTICAL							
14EDP41	Project Work – Phase II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 74

LIST OF ELECTIVES					
Course Code	**Course Title**	**Hours/Week**			**Credit**
		L	**T**	**P**	
14EDE01	Smart Structures and MEMS Design	3	0	0	3
14CCE01	Integrated Product and Process Development	3	0	0	3
14EDE02	Designing with New Materials *	3	0	0	3
14EDE03	Tribology in Design	3	0	0	3
14EDE04	Mechanics of Composite Materials	3	0	0	3
14EDE05	Vibration and Noise Control	3	0	0	3
14CCE02	Modelling and Analysis of Manufacturing Systems	3	0	0	3
14CCT21	Design for Manufacture and Assembly	3	0	0	3
14EDE06	Applied Finite Element Analysis	3	0	0	3
14EDE07	Fracture Mechanics	3	0	0	3
14EDE08	Experimental Stress Analysis	3	0	0	3
14EDE09	Design of Material Handling Equipment	3	0	0	3
14CCE07	Product Data Management	3	0	0	3
14EDE10	Advanced Tool Design	3	0	0	3
14CCE08	Safety in Engineering Industry *	3	0	0	3
14EDE11	Design of Hydraulic and Pneumatic System	3	0	0	3
14EDE12	Design of Heat Exchangers	3	0	0	3
14EDE13	Productivity Management and Reengineering	3	0	0	3
14EDE14	Instrumentation and Measurements	3	0	0	3
14EDE15	Applied Engineering Acoustics	3	0	0	3
14EDE16	Modeling of Dynamic Systems	3	0	0	3

*- Open Elective

14AMT13 APPLIED PROBABILITY AND STATISTICS

(Common to Engineering Design & CAD/CAM)

3 1 0 4

UNIT – I **9**

Probability and Random Variables: Axioms of Probability- Conditional probability – Total probability – Baye's theorem – Random variable – Probability mass function – Probability density function – Moments – Moment generating functions.

UNIT - II **9**

Standard distributions: Discrete distributions – Binomial distribution – Poisson distribution – Geometric distribution – Continuous distributions - Uniform distribution – Exponential distribution – Normal distribution.

UNIT - III **9**

Two dimensional random variables: Joint distributions – Marginal and conditional distributions - Covariance – Simple linear correlation – Rank Correlation – Linear Regression.

UNIT - IV **9**

Testing of Hypothesis: Sampling Distributions – Large Sample Tests – z tests - Testing the significance of single proportion - difference of proportions - single mean - difference of means – Small Sample Tests – Testing the significance of means (student's t-test) - Testing the significance of Variances (F-test) - Testing the significance of goodness of fit - independent of attributes (χ^2-test).

UNIT - V **9**

Design of Experiments: Analysis of variance- One way classification – Completely Randomized Design - Two way classification – Randomized Block Design – Latin Square Design.

Lecture : 45, Tutorial : 15, TOTAL : 60

REFERENCE BOOKS

1. Richard Johnson, Miller & Freund's "Probability and Statistics for Engineers", Seventh Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
2. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", John Wiley and Sons, 2002.
3. Jay L Devore, "Probability and Statistics for Engineering and the Sciences", Thomson Asia, 2002.
4. Fruend, J.E. and Miller, I, "Probability and Statistics for Engineers", Prentice Hall of India Ltd. 1994.
5. Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2005.

Course Outcomes:

On completion of the course the students will be able to

- apply probabilistic concepts in engineering problems
- measure the relationship between variables
- develop various tests of significance for attributes and variables
- control extraneous variables and minimize experimental errors

14EDT11 FINITE ELEMENT METHOD IN ENGINEERING APPLICATIONS

(Common to Engineering Design & CAD/CAM)

3 1 0 4

Pre-requisites: Fundamentals of matrix multiplication, addition and subtraction, Knowledge on governing differential equations & Fundamentals of strength of materials

UNIT – I **9**

One Dimensional Applications: Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation – Ritz Method – Finite Element Modelling – Element Equations – Linear and Quadratic Shape functions – Bar and Beam Elements – Galerkin's method- Application of structural bar and heat transfer.

UNIT – II **9**

Two Dimensional Scalar Variable Applications: Basic boundary value problems in two dimensions – Constant Strain Triangular element - Higher order elements – Poisson's and Laplace's Equation – Weak Formulation – Element Matrices and Vectors – Load consideration: Point load and Pressure- Plane stress and Plane strain conditions. Two dimensional heat transfer: Finite element equation - Potential energy approach- Conduction – Side and face convection – Internal heat generation. Application of Structural and Heat transfer.

UNIT – III **9**

Two Dimensional Vector Variable Problems: Introduction to Axi-symmetric Formulation - linear element - Elemental Element Matrices and Vectors - Load Consideration- Application of Structural and Heat Transfer Problems - Application of Plane Trusses.

UNIT – IV **9**

ISO-Parametric Formulation: Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Isoparametric Elements – Formulation – Numerical Integration – Gauss quadrature – one and two dimensional Integration – rectangular elements – Serendipity elements – Finite element modeling - Illustrative Examples.

UNIT – V **9**

Structural Dynamics and Refinements: Dynamic Analysis – Equation of Motion – Mass & damping matrices – Free vibration analysis –Natural frequencies of Longitudinal, Transverse and Torsional vibration – Introduction to transient field problems. Refinement techniques – h & p elements.

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. Reddy J.N., "An Introduction to the Finite Element Method", Third Edition, McGraw Hill, Edition, 2005.
2. Logan D.L, "A First Course in the Finite Element Method", Third Edition, Thomson Learning, 2011.
3. Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis", Fourth Edition, Wiley, John & Sons, 2003.
4. Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984.
5. S.S.Rao, "Finite Element Analysis", Fifth Edition, McGraw Hill, 2012.

Course Outcomes:

On completion of the course the students will be able to

- derive and solve the finite element equation in 1D structural and thermal problems
- derive and solve the finite element equation in 2D scalar variable problems
- derive and solve the finite element equation in 2D vector variable problems and trusses
- solve the one and two dimensional numerical integration problems and solve the engineering problems using four node quadrilateral elements
- solve the structural dynamic problems in various applications

14CCT11 APPLIED MATERIALS ENGINEERING

(Common to CAD/CAM & Engineering Design)

3 0 0 3

Pre-requisites: Fundamentals of Material Science and Engineering

UNIT – I **9**

Introduction of Physical Metallurgy: Concept of phase diagram - phases and micro constituents in steels and cast irons -equilibrium and non-equilibrium cooling of various Fe-C alloys - effects of alloying elements and cooling rate on structure and properties of steels and cast irons.

UNIT – II **9**

Introduction to Heat Treatment and Specifications: TTT diagram and CCT diagram - hardenability, measurement, annealing - normalising-hardening and tempering - heat treatment furnaces - atmospheres - quenching media - case hardening techniques. Types of steels: plain carbon steels, alloy steels, tool steels; stainless steels types of cast irons compositions, properties and applications.

UNIT – III **9**

Characterization of Materials: Stereographic projections, X-ray diffraction, crystal structure and phase identification, residual stress measurement and other applications. Scanning Electron Microscopy – Optics and performance of a SEM, image interpretation, crystallographic information in a SEM, analytical microscopy. Transmission Electron Microscopy – Construction and operation of a TEM, Electron diffraction, image interpretation.

UNIT – IV **9**

Corrosion Engineering: Degradation of materials: Oxidation, corrosion and wear. Basics of thermodynamics and kinetics of oxidation and corrosion. Pourbaix diagram, Polarization. Different types of corrosion. Atmospheric, galvanic, pitting, crevice corrosion, intergranular and de-alloying. Stress corrosion cracking, season cracking, Hydrogen damage and radiation damage. Hydrogen embrittlement. Corrosion rate measurement.

UNIT – V **9**

Metallurgical Failure Analysis and Plastic Deformation: Stages of failure analysis, classification and identification of various types of fracture. Overview of fracture mechanics, characteristics of ductile and brittle fracture. General concepts, fracture characteristics revealed by microscopy, factors affecting fatigue life Creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure. Some case studies failures.Basics of plastic deformation: Mohr's circle, yield theories, plastic stress, strain relationship, plastic works constitute relationships, mechanical working, work hardening.

TOTAL: 45

REFERENCE BOOKS:

1. Avner, S. H., "Introduction to Physical Metallurgy", second edition, McGraw Hill, 1985.
2. Philips V. A., 'Modern Metallographic Techniques and their Applications', Wiley Interscience, 1971
3. H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Settle, "Instrumental Methods of Analysis", 6th Ed., CBS.

4. Fontana. M.G., “Corrosion Engineering”, Tata McGraw Hill, 3rd Edition, 2005.
5. Colangelo.V.J. and Heiser.F.A., “Analysis of Metallurgical Failures”, John Wiley and Sons Inc. New York, USA, 1974.
6. Hosford W.F. and Caddell R.M. “Metal forming mechanics and metallurgy”, PrinticeHall 1983.

Course Outcomes:

On completion of the course the students will be able to

- learn the microstructures of steels and cast irons
- learn the different heat treatment processes for various applications
- determine the microstructure for utilizing the material characterization
- assess the causes and impacts of corrosion
- solve the problems in plastic deformation of materials and to analyse the failures

14EDT12 ENGINEERING DESIGN METHODOLOGY

3 0 0 3

Pre-requisites: Quality Engineering, Total quality managements, Fundamentals of design and manufacturing courses.

UNIT – I **9**

The Product Design Process: Importance of Product Design, Design Process, Consideration of a Good Design, Morphology of Design, Concurrent Engineering, CAD & CAM, Product and Process Cycle. Need identification- Identifying customer needs, Benchmarking, Customer requirements.

UNIT – II **9**

Tools in Engineering Design: Concept Generation – Creativity and Problem solving, Creative methods. Embodiment Design – Product Architecture, Configuration Design, Parametric Design, Design Guidelines, Industrial Design, Human factors in Design. Modelling - Role of models in Engineering Design, Mathematical modeling, Geometric modeling, finite element modeling, Rapid Prototyping.

UNIT – III **9**

Material Selection and Materials in Design: Relation of Material selection to Design, Performance characteristics of Materials, Material selection process, Value analysis, Recycling, Design for brittle fracture, Design for fatigue failure, Design for corrosion resistance, Design with plastics.

UNIT – IV **9**

Material Processing and Design: Classification of manufacturing processes and their role in design, Factors determining the process selection, Design for manufacturing, Design for casting, Design for forging, Design for sheet metal forming, Design for machining, Design for welding, Design for heat treatment, Design for plastic processing.

UNIT – V **9**

Design and Quality Engineering, Legal and Ethical Issues in Design: Design for environment, Design for Reliability, Design for safety, Quality Design – Optimisation Methods. The origin of laws, Contracts, Liability, Tort Law, Product Liability, Protecting intellectual Property, Legal and Ethical Domains, Codes of ethics, solving ethical conflicts.

TOTAL: 45

REFERENCE BOOKS:

1. Dieter George. E, "Engineering Design: A Materials and Processing Approach". Third Edition, McGraw-Hill, International Edition, Singapore, 2000.
2. Ulrich Karl T. and Eppinger Steven D. "Product design and Development", Fifth Edition, McGraw-Hill, International Edition, 2011.
3. Gerhard Pahl and Beitz W, "Engineering Design: A Systematic Approach" Springer - Verlag, NY, 2007.
4. Ray M.S. "Elements of Engineering Design", Printice Hall Inc, USA, 1985
5. Suh. N. P. "The Principles of Design". Oxford University, Press NY 1990.

Course Outcomes:

On completion of the course the students will be able to

- apply the knowledge on various design process and methods for product design.
- implement the various design modelling, design methods and optimization tools for tool design.
- apply the knowledge on the material selection process by considering the various design factors.
- implement the various manufacturing process with design of materials for various applications.
- implement the knowledge on legal aspect, environmental, quality and safety aspect for designing of materials.

14EDT13 ADVANCED STRENGTH OF MATERIALS

(Approved Data book may be permitted)

3 1 0 4

Pre-requisites: Strength of Materials, Engineering Mechanics

UNIT – I **9**

Elasticity: Stress – Strain relation and General equation of elasticity in Cartesian , polar ,cylindrical and Spherical coordinates- differential equation of equilibrium – compatibility equation – boundary conditions, representations of three dimensional stress in tension – generalized Hooke's law – St.Vennant's Principle – Plane strain, plane stress – Airy's stress function.

UNIT – II **9**

Unsymmetrical Bending and Shear Centre: Stresses and deflection in beams subjected to unsymmetrical loading – Kern of a section. Location of shear centre for various sections – shear flow.

UNIT – III **9**

Curved Beams: Curved flexural members - circumferential and radial stresses – deflection and radial curved beam with re-strained ends – closed ring subjected to concentrated load and uniform load – chain link and Crane hooks.

UNIT – IV **9**

Stresses Due to Rotation and Contact Stresses: Stresses due to rotation – Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speed. Contact Stresses – Hertz equation for contact stresses – applications to rolling contact elements.

UNIT – V **9**

Stresses in Flat Plates and Torsion of Non Circular Sections: Stresses in circular and rectangular plates due to various types of loading and end conditions – Buckling of plates. Torsion of rectangular cross section – St.Vennant Theory – ElasticMembrane analogy – torsional stresses in hollow thin walled tubes.

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. Timoshenko, S., "Strength of Materials", Third Edition. CPS Publishers, 2008
2. Timoshenko and Gaodler, "Theory of Elasticity", Tata McGraw-Hill, 2006
3. Den-Hartog, "Advanced Strength of Materials", Dover Publications, New York, 1987
4. Rajput, R.K., "Strength of Materials", S. Chand & Co, New Delhi, 2009.
5. Sadhu Singh, "Applied Stress Analysis", Khanna Publishers, New Delhi, 2009.

Course Outcomes:

On completion of the course the students will be able to

- calculate the stresses and strains at a point
- calculate analytically the shear centre and stresses in unsymmetrical bending
- determine the stresses and deflections in curved beams
- determine the stresses due to rotation and contact stresses
- solve the stresses in plates and the torsion in noncircular members

14EDT14 MECHANICAL VIBRATIONS

3 1 0 4

Pre-requisites: Fundamentals of Mathematics, Fundamentals of Dynamics of Machines, Fundamentals of strength of materials

UNIT – I **9**

Fundamentals of Vibration and Single Degree of Freedom System: Review of Single degree freedom systems – Response to arbitrary periodic, Excitations- Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation – Single degree freedom forced vibration with elastically coupled viscous dampers – System Identification from frequency response – Transient Vibration.

UNIT – II **9**

Two Degree Freedom System: Free vibration of spring-coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation.

UNIT – III **9**

Multi-Degree Freedom System: Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and Eigen vectors – Orthogonal properties – Modal matrix-Modal Analysis – Forced Vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies.

UNIT – IV **9**

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

UNIT – V **9**

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

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, Fourth Edition, New Delhi, 2004.
2. V.P.Singh, "Mechanical Vibrations", Dhanpat Rai & Co Ltd, New Delhi, 2014.
3. Rao, J.S., and Gupta, K., "Introductory Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., New Delhi, 2006.
4. Den Hartog, J.P, "Mechanical Vibrations," Crastre Press, 2008.
5. Rao, S.S.," Mechanical Vibrations," Fifth Edition, Prentice Hall, 2004.

Course Outcomes:

On completion of the course the students will be able to

- solve and identify the frequency response of single degree of freedom system
- solve and design vibration absorber for the two degrees of freedom system
- solve and determine the natural frequency of Multi degrees of freedom system
- solve and analyse the vibration characteristics of continuous system
- analyse and understand the vibration measuring instruments and machine signature

14EDL11 DESIGN AND ANALYSIS LABORATORY

(Common to Engineering Design & CAD/CAM)

0 0 3 1

Prerequisites: Strength of materials, Design of machine elements, Modeling skill, Technical drawing reading skill, Knowledge in modeling and analysis software.

LIST OF EXPERIMENTS:

1. Modelling a component using Pro/E, Importing to ANSYS and Meshing.
2. Modelling and meshing a component using ANSYS & ANSYS WORKBENCH.
3. Modelling and Assembly of Screw Jack using Pro/E.
4. Modelling and Assembly of an Industrial component using Pro/E and meshing the model using ANSYS.
5. Finding shear Force and Bending Moment diagram using ANSYS.
6. Structural Analysis of 3D Cantilever Beam and validating the results with 1D and 2D options in ANSYS.
7. Non-Linear Structural Contact Analysis of a component using ANSYS.
8. Thermal Analysis of a piston using ANSYS.
9. Contact Analysis of a two spherical balls using ANSYS and validating the results with Hertz Solutions.
10. Modal and Harmonic Analysis of a structure using ANSYS.
11. Coupled Field Analysis using ANSYS.
12. Creating APDL in ANSYS for a parametric case study.
13. Rotor Dynamic Analysis using ANSYS.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

- Laboratory Manuals

Course Outcomes:

On completion of the course the students will be able to

- analyze the problem with various fields using analysis software
- analyze and simulate the behaviours structural members with external load for different applications
- analyze the non-linear structural, thermal and coupled field problems for various applications
- analyze the fatigue and dynamic characteristics of the components
- do modeling and meshing of various components

14EDL12 ADVANCED VIBRATION LABORATORY

0 0 3 1

Prerequisites: Knowledge on Basics of Vibration, Knowledge on free and forced vibration, Knowledge on safety for instrument handling

LIST OF EXPERIMENTS:

1. Determination of natural frequency of a steel beam.
2. Determination of natural frequency of a composite beam.
3. Condition monitoring on lathe machine.
4. Condition monitoring on grinding machine.
5. Condition monitoring on milling machine.
6. Condition monitoring on drilling machine.
7. Fault identification of ball bearing through time domain and frequency domain signal
8. Fault identification of journal bearing through time domain and frequency domain signal
9. Drawing of Mode shapes and Modal analysis of plates and beams
10. Condition monitoring of worm gear box using speed reducer apparatus.
11. Performance analysis of journal bearing using journal bearing apparatus.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

- Laboratory Manuals

Course Outcomes:

On completion of the course the students will be able to

- measure the natural frequency of beam using the measuring instruments
- identify the faults in the ball bearing and journal bearing using time domain and frequency domain signals
- identify the condition of the machines through the vibration signals

14EDT21 OPTIMIZATION TECHNIQUES IN DESIGN AND MANUFACTURING

(Common to Engineering Design & CAD/CAM)

3 1 0 4

Pre-requisites: Fundamentals of mathematics, Operation Research, Knowledge in designing the static and dynamic problems, Fundamentals of mechanical and physical properties of materials & Basics of simulation procedures

UNIT – I **9**

Introduction: Introduction to optimum design-global & local –Problems-General Characteristics of mechanical elements-adequate and optimum design-general principles of optimization, formulation of objective function, design constraints – Classification of optimization problem -Saddle point-Single variable optimization-Multi variable optimization with no constraints.

UNIT – II **9**

Unconstrained Optimization Techniques: Single variable and multivariable optimization with constraints, Techniques of unconstrained minimization -Golden section, pattern and gradient search methods -Interpolation methods -Quadratic function method.

UNIT – III **9**

Constrained and Advanced Optimization Techniques: Optimization with equality and inequality constraints - Indirect methods using penalty functions, Lagrange multipliers; Geometric programming- Constrained, mixed inequality and unconstrained minimization; Introduction - GA, SA and NN based on optimization - Fuzzy systems - Taguchi Technique - Parallel processing.

UNIT – IV **9**

Static Applications: Structural applications – Design of simple truss members-Reanalysis techniques Design applications -Design of simple axial, transverse loaded members for minimum cost, maximum weight -Design of shafts and torsionally loaded members – Design of springs.

UNIT – V **9**

Dynamic Applications: Optimum design of single and two degree of freedom systems, vibration absorbers. Optimum design of simple linkage mechanisms. Case study: optimization of process parameters in production operation.

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. Rao, Singaresu, S., "Engineering Optimization – Theory & Practice", New Age International (P)Limited, New Delhi, 2012.
2. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India Pvt. 2010.
3. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New York, 2005
4. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1990.
5. International journal of fuzzy system and International journal mechanical design
6. www.searchengineoptimization.com.

Course Outcomes:

On completion of the course the students will be able to

- understand and formulate the design optimization problems
- assess about the unconstrained optimization problems with mathematical equations
- know about the evaluation procedures of constrained and heuristic optimization problems
- create and analyses the static structural application problem
- make decision with respect to structural dynamics optimization problems

14EDT22 MECHANICAL BEHAVIOUR OF MATERIALS

(Common to Engineering Design & CAD/CAM)

3 0 0 3

Pre-requisites: Fundamentals of material sciences, Fundamental of physical properties of the materials, Basic type of metal and non-metallic materials

UNIT – I **9**

Elasticity of the Materials: Analysis of stress-definition and notation of stress - equation of equilibrium -description of stress at apoint- principal stresses - two and three dimensional Mohr's circles diagram. Boundary condition in terms of surface forces.

Analysis of strain-strain components- description of strain at a point - compatibility equations of elasticity: Generalized Hooke's law-formulations of elastic problems - two and three dimensional Mohr's circles diagram - strain energy.

UNIT – II **9**

Plane Stress and Plane Strain Problems: The governing differential equations - bending of narrow cantilever beam of rectangular cross section under an end load - General equations in cylindrical co-ordinates – effect of small circular holes in strained plates-stress concentration.

UNIT – III **9**

Elements of the Theory of Plasticity: Introduction - flow curves-tensile test - true stress/true strain-yield criteria for ductile metals- plastic stress-strain relations. Creep definition-creep tests and properties of creep. Theories of failure.

UNIT – IV **9**

Fracture: Overview of problem of fracture and fatigue in structures-stress analysis for members with cracks-stress intensity equations- Relationship between stress intensity factor and fracture toughness. Experimental determination -K_{IC} and Kc values-effect of temperature, loading rate and plate thickness on fracture toughness.

UNIT – V **9**

Fracture Mechanics Design: fatigue crack initiation- fatigue crack propagation under constant load and variable load - fatigue damage tolerance, Elastic - plastic fracture mechanics.

TOTAL : 45

REFERENCE BOOKS:

1. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 2013.
2. Wang C.T, "Applied Elasticity", McGraw-Hill, New York, 1953.
3. Thomas H. Courtney, "Mechanical Behavior of Materials", Second edition, Waveland Press, 2005.
4. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., "Selection and Use of Engineering Materials", Third edition, Butterworth-Heiremann, 1997.
5 Barsoom, John M and Rolte, Stanley T., "Fracture and Fatigue Control in Structures", Prentice-Hall, New Jersey, 1987.
6 Martin Joseph., "Mechanical Behaviour of Materials", Prentice-Hall, New Jersey, 1985.

Course Outcomes:

On completion of the course the students will be able to

- understand the elasticity behaviours of the materials
- analyse the problems with plane stress and strain conditions
- understand the plastic behaviours of the materials
- implement the various fracture stress analysis with various conditions
- implement the fracture mechanics and the design for various conditions

14EDT23 MECHANISM DESIGN AND SYNTHESIS

3 1 0 4

Pre-requisites: Fundamentals of kinematic and kinetic, Basic of vector loop equation, Basic drawing skill

UNIT – I **9**

Fundamental of Kinematics: Review of fundamentals of kinematics - Mobility Analysis – Formation of one D.O.F of Complex Mechanism - Kinematic Inversion. Position Analysis – Vector loop equations for Four bar, Slider crank, Inverted slider crank, Geared five bar and Six bar linkages.

UNIT – II **9**

Kinematic Analysis: The velocity and acceleration Analysis– simple four bar linkage mechanism and Plane complex mechanism – Normal acceleration-Goodman's indirect method- Auxiliary point method.

UNIT – III **9**

Path Curvature Theory: Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature – Bobillier theorem.

UNIT – IV **9**

Synthesis of Mechanisms: Type synthesis – Number synthesis – Associated linkage concept. Dimensional synthesis – Function generation, Path generation, Motion generation. Two, Three and Four position synthesis-Graphical methods. Cognate Linkages -Coupler curve synthesis-Bloch's method of synthesis- Design of six-bar mechanisms.

UNIT – V **9**

Dynamics and Spatial Mechanism Analysis: Static force and Inertia force analysis of simple mechanism - Graphical method. Mobility of four bar spatial linkage – Wobble plate mechanism - Kinematic analysis of spatial RSSR mechanism – Denavit – Hartenberg parameters. Forward and Inverse kinematics of robotic manipulators.

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. Shigley, J.E., and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw Hill, New York, 2010.
2. Rattan S. S., "Theory of Machines", Third edition, Tata McGraw Hill Education, New York, 2009.
3. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prenticen Hall, New Jersey, 1984.
4. Jack T. Kimbrell, Kinematics analysis and synthesis", McGraw-Hill, Inc. New York, 1991.
5. Ghosh Amitabha and Mallik Asok Kumar., "Theory of Mechanism and Machines", EWLP Delhi, 2002.
6. Nortron R.L., "Design of Machinery", Tata McGraw Hill, New Delhi, 2005
7. Waldron Kenneth J and Kinzel Gary L., "Kinematics, Dynamics and Design of Machinery", John Wiley and Sons, New York, 2004.

Course Outcomes:

On completion of the course the students will be able to

- construct the one D.O.F of the complex mechanism by changing the links and find out the position of links in various mechanisms
- analyze the velocity and acceleration of the various plane complex mechanisms by using various methods
- determine the path of curvature of the various plane mechanisms
- synthesis the various mechanism links by different synthesis methods
- analyze the static and dynamics force of the mechanism and different spatial robotics mechanisms

14EDL21 OPTIMIZATION TECHNIQUES AND SIMULATION LABORATORY

(Common to Engineering Design & CAD/CAM)

0 0 3 1

Pre-requisites: Basics of mechanical softwares, Design of machine elements, Manufacturing process

LIST OF EXPERIMENTS:

1. Design of Experiments for Threading operation
2. Design of Experiments for milling operation
3. Process parameter optimization in welding by Response surface method
4. Process parameter optimization in surface grinding by Response surface method
5. Simulation of Scheduling process using Arena software
6. Simulation of three bar mechanism using ADAMS software
7. Simulation of four bar mechanism using ADAMS software
8. Simulation of slider crank mechanism using ADAMS software
9. Simulation of simple pendulum mechanism using ADAMS software
10. Simulation of reciprocating mechanism using ADAMS software

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

- MAT Lab, ADAMS and C, C++
- Minitab DOE Genetic Algorithms etc.

Course Outcomes:

On completion of the course the students will be able to

- exhibit the different optimization techniques
- demonstrate the influencing parameters of various machining operations
- simulate and analyze the machining process

14CCL21 AUTOMATION LABORATORY

(Common to CAD/CAM & Engineering Design)

0 0 3 1

Pre-requisites: Design of Hydraulics and Pneumatics

LIST OF EXPERIMENTS:

1. Construction of Ladder programming for Boolean operations & Math operations.
2. Interfacing of Electro – Pneumatic system with PLC.
3. Temperature control using PLC.
4. Speed control of AC Motor using PLC and Variable Frequency Drive.
5. Flow control using PLC
6. Pressure control using PLC
7. HMI Interface with PLC.
8. Interfacing PLC real time tag with SCADA
9. Develop a SCADA screen program for process plant operation.
10. Develop a Data base and Recipe tag base in SCADA.
11. Interfacing servo drive with PLC

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

- Laboratory manuals

Course Outcomes:

On completion of the course the students will be able to

- design and simulate PLC programmes for different logical applications
- interface analog modules with PLC
- develop SCADA for given problem
- interface various drives
- design semi automatic setup for given problem

14EDL31 ADVANCED MECHANICAL LABORATORY

(Common to Engineering Design & CAD/CAM)

0 0 3 1

Pre-requisites: Strength of materials, Thermodynamics and solar applications, Knowledge on materials microstructure and materials properties

LIST OF EXPERIMENTS:

1. Analyse the dimensional properties of the components using Coordinate measuring machine (CMM).
2. Study the surface profile of the machined components using profile measurements.
3. Analyze the tensile stress distribution of the given components using Electronic Tenso meter setup.
4. Analysis of pressure distribution around aerofoil templates in Wind tunnel.
5. Study the effect of variation in tilt angle on solar photovoltaic module output power
6. Study the effect of shading on solar photovoltaic module output power
7. Evaluation of overall heat loss coefficient, heat removal factor and efficiency of solar flat plate Collector
8. Determine the micro structure of aluminum alloys.
9. Determine the Micro structure of copper alloys.
10. Determine the Micro structure of Grey cast iron and SG iron.
11. Hardness Measurement- Vickers hardness, Rockwell hardness, Birnell hardness.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

- Laboratory manuals

Course Outcomes:

On completion of the course the students will be able to

- design and analyse aerofoil structures
- estimate the performance of solar PV module and flat plat collector
- understand the different structures of alloys
- know about the hardness measurements

14EDE01 SMART STRUCTURES AND MEMS DESIGN

(Common to Engineering Design & CAD/CAM)

3 0 0 3

Pre-requisites: Engineering Mechanics, Materials sciences

UNIT – I **9**

MEMs Design: Overview-microsystems and microelectronics - working principle of Microsystems - micro actuation techniques - micro sensors – types – microactuators – types – micropump-micromotors-micro-valves-microgrippers-scaling laws-scaling in geometry-scaling in rigid body dynamics- scaling in electrostatic forces- scaling in electricity- scaling in fluid mechanics- scaling in heat transfer.

UNIT – II **9**

Materials and Fabrication Process : Substrates and wafer-single crystal silicon wafer formation-ideal substrates-mechanical properties-silicon compounds - SiO_2, SiC, Si_3N_4 and polycrystalline silicon - Silicon piezoresistors - Gallium arsenide - Quartz-piezoelectric crystals-polymers for MEMS - Photolithography - Ion implantation - Diffusion – Oxidation –CVD - PVD - Deposition by epitaxy - etching process.

UNIT – III **9**

Micromechanics: Introduction-static bending of thin plates-circular plates with edge fixed - rectangular plate with all edges fixed and square plate with all edges fixed – Mechanical vibration-resonant vibration- micro accelerometers-design theory and damping coefficients- thermo mechanics-thermal stresses-fracture mechanics-stress intensity factors, fracture toughness and interfacial fracture mechanics.

UNIT – IV **9**

Micro System Manufacturing: Clean room technology-bulk micro manufacturing- surface micro machining –LIGA-SLIGA-Micro system packaging-materials-die level-device level-system level-packaging techniques-die preparation-surface bonding-wire bonding-sealing.

UNIT – V **9**

Micro System Design: Design considerations-process design-mask layout design- mechanical design-applications of micro system in -automotive industry-bio medical –aero space-telecommunications.

TOTAL : 45

REFERENCE BOOKS:

1. Gad-el-Hak, Mohamed. “The MEMS Handbook”, CRC Press, London, 2002.
2. Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw-Hill, New Delhi, 2012.
3. Fatikow, S. and Rembold, U. “Microsystem Technology and Microrobotics“, Springer-Verlag, Berlin, 1997.
4. Tay, Francis E.H and Choong, W.O. “Microfludics and BioMEMS Applications”, Springer-Verlag, Berlin, 2002.

5 Gardner, Julian W. Varadan, Vijay K. and AwadelKarim, Osama O. “Microsensors MEMS and Smart Devices”, John Wiley & sons Ltd., New Delhi, 2001.

Course Outcomes:

On completion of the course the students will be able to

- understand the knowledge about the scaling laws for MEMS
- find the suitable materials for MEMS components
- analyse the mechanical behavior of micro-systems
- understand the manufacturing process for MEMS
- attain the design skills for MEMS products

14CCE01 INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

(Common to CAD/CAM & Engineering Design)

3 0 0 3

Pre-requisites: Basic knowledge in new product development, Knowledge in bill of materials, Knowledge in survey and product structure

UNIT – I **9**

Introduction to Product Development: Characteristics of Successful Product Development-Who Designs and Develops Products-Duration and Costs of Product Development- Challenges of Product Development -Development Processes and Organizations-A Generic Development Process-Concept Development: The Front-End Process Adapting the Genetic Product Development Process- Product Development Process Flows-The AMF Development Process-Product Development Organizations-The AMF Organization

UNIT – II **9**

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

UNIT – III **9**

Product Specifications: What Are Specifications -When Are Specifications Established-Establishing Target Specifications-Setting the Final Specifications-Concept Generation-The Activity of Concept Generation-Clarify the Problem- Search Externally-Search Internally-Explore Systematically- Reflect on the Results and the Process.

UNIT – IV **9**

Concept Selection: Concept Selection- Overview of Methodology-Concept Screening-Concept Testing-Define the Purpose of the Concept Test- Choose a Survey Population- Choose a Survey Format- Communicate the Concept- Measure Customer Response-Interpret the Results- Reflect on the Results and the Process.

UNIT – V **9**

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

TOTAL : 45

REFERENCE BOOKS:

1. Ulrich, Karl T., and Eppinger, Steven D., "Product Design and Development", McGraw- Hill, New York, 2008.
2. Otto, Kevien and Wood, Kristin., "Product Design" Pearson Publications, New Delhi, 2009.
3. Rosenthal, Stephen, "Effective Product Design and Development", Business One Orwin, Homewood, 1992.
4. Pugh, Stuart, "Tool Design: Integrated Methods for successful Product Engineering", Addison Wesley Publishing, New York, 1991.

5 Kemnneth Crow, Concurrent Engg. /Integrated Product Development. DRM Associates, 26/3,ViaOlivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book.

Course Outcomes:

On completion of the course the students will be able to

- develop product development process and organization
- identify organizational needs and develop a product planning for new products
- generate specifications of a product and generate concept
- select suitable product concept so that, the product will compete in a market
- set/develop product architecture, to enable easy manufacturing of product

14EDE02 DESIGNING WITH NEW MATERIALS

(Common to Engineering Design & CAD/CAM)

3 0 0 3

Pre-requisites: Introduction to material science and engineering

UNIT – I **9**

Modern Materials in Design & Plastics: Modern materials in design plastics composites and smart materials Polymers - classification - Thermoplastics and thermosetting plastics - Thermoforming processes - compression and transfer molding - injection molding - extrusion - blow molding - calendaring - lamination and pultrusion.

Design consideration of plastic components manufacturing considerations of plastics.

UNIT – II **9**

Rubber: Rubber - additives - applications. Stages in raw rubber and latex rubber technology - Processing of rubbers –Manufacturing techniques - tyres - belts - hoses - foot wears - cellular products - cables. Manufacture of latex based products.

UNIT – III **9**

Glass: Glass - characteristics - application - glass making - Glass forming machines - hollow wares flat glasses, fiberglass, bulbs, bottles, heat absorbing glasses, amber glass and their manufacturing methods, general plant layouts for manufacture of different types of glasses.

UNIT – IV **9**

Ceramics: Ceramics - classification - traditional ceramics - structural ceramics - fine ceramics - bio ceramics - ceramic super conductors. Ceramic processing techniques - hot pressing - hot isostatic pressing (HIP) - Sintering - injection molding - slip casting - tape casting - gel casting - extrusion.

UNIT – V **9**

Composites: Composites - requirements of reinforcement and matrix - Manufacturing of composites - casting - solid state diffusion - cladding - HIP - liquid metal infiltration - liquid phase sintering - preparation of molding compounds and prepregs - hand layup method - autoclave method - filament winding method - compression molding - reaction injection molding - knitting - braiding.

TOTAL : 45

REFERENCE BOOKS:

1. J. A. Brydson and Newnes-Butterwarths, “Plastic materials”, London, 1989.
2. J. L. White, “Rubber Processing Technology, Materials and Principles”, Hanser Publishers, 1995.
3. E. B. Shand, “Glass Engineering Handbook”, McGraw-Hill, 2nd Edition, 1958
4. M.W. Barsoum, “Fundamentals of Ceramics”, McGraw-Hill Co., Inc., 1997.
5. George Lubin, “Handbook of Composites”, Springer, 1st Edition, 1982.

Course Outcomes:

On completion of the course the students will be able to

- understand the manufacturing and design aspects of plastics
- understand processing and applications of rubber products
- understand the processing and applications of glasses
- understand the processing and applications of ceramics
- understand the processing and applications of composites

14EDE03 TRIBOLOGY IN DESIGN

(Common to Engineering Design & CAD/CAM)
(Use of approved data book is permitted)

3 0 0 3

Pre-requisites: Fundamentals of friction, materials, lubrication aspects, Knowledge on bearings, design considerations and limitations, Fundamentals of machine design

UNIT – I **9**

Introduction to Surfaces and Friction : Topography of surfaces – Surface features – Experimental determinations of surface structures – Chemical analysis of surfaces – Surface effects in Tribology – Analysis of surface roughness – Surface topography measurements. Surface treatments, Surface modifications and Surface coating. Friction – Mechanism of friction, Equations and models of friction, Friction measurements, Friction properties of metallic and non metallic materials, Friction in extreme conditions.

UNIT – II **9**

Fundamentals of Wear and Lubrication: Wear – Types, Mechanism, Mapping, Measurements, Wear resistance materials – Lubricants – selection criteria – lubrication regimes. Hydrodynamic, Elasto and plasto hydrodynamic lubrication, Basic equations, Reynold's equation, Boundary lubrication, Boundary lubricating films and its properties.

UNIT – III **9**

Design of Hydrodynamic Bearings: Dynamic analysis of hydrodynamic bearing performance, thrust and journal bearings– full, partial, fixed and pivoted – mass flow rate, friction, power loss, heat and temperature difference, dynamic loads, oil film thickness, stiffness of squeeze film - problems.

UNIT – IV **9**

Hydrostatic and Rolling Element Bearings: Hydrostatic lubrication -hydrostatic bearing design. Slider bearings – Self acting finite bearings, Failure modes, Materials for rolling element bearings – Types, Bearing geometry and kinematics, load ratings and life prediction.

UNIT – V **9**

Contact Mechanics and Tribo Measurements : Contact mechanics, Analysis of contacts, Elastic-plastic contact of frictionless solids, problems. Bearing torque calculation, temperature analysis, endurance testing and failure analysis, bearing performance measurements, bearing vibration measurements.

TOTAL : 45

REFERENCE BOOKS:

1. Williams, J.A. "Engineering Tribology", Oxford University Press, 2005.
2. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981.
3. Bharat Bhushan, "Principles and Applications of Tribology", New York, John Wiley & Sons, New York, 2013.
4. Neale, M.J. "Tribology Handbook", Butterworth Heinemann, 1997.
5 Sahoo, P. "Engineering Tribology", PHI Learning, India, 2013.

Course Outcomes:

On completion of the course the students will be able to

- comprehend the surface effects in tribology.
- apply the basic concepts of friction, wear and lubrication in industrial components.
- design the hydrodynamic bearings with realistic constraints.
- design the hydrostatic bearings with appropriate assumptions and basics about rolling element bearings.
- apply the principles of tribo measurement techniques and contact mechanics in industrial applications.

14EDE04 MECHANICS OF COMPOSITE MATERIALS

(Common to Engineering Design & CAD/CAM)
(Approved Data book may be permitted)

3 0 0 3

Pre-requisites: Advanced Strength of Materials

UNIT – I **9**

Basics of Composites and Manufacturing : Basics of fibers, matrices and composites: Definition – Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Fiber surface treatments.
Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding.

UNIT – II **9**

Performance: Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Long term properties, Fracture Behavior and Damage Tolerance – Quality Inspection Methods.

UNIT – III **9**

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

UNIT – IV **9**

Design Analysis and Thermal Behaviour: Failure Predictions, Laminate Design Consideration-design criteria-design allowable -design guidelines, Joint design-Bolted and Bonded Joints, Design Examples-Design of a tension member – design of a compression member – design of a beam-design of a torsional member, Application of FEM for design and analysis of laminated composites.
Assumption of Constant Coefficient of Thermal expansion. Modification of Hooke's law. Orthotropic Lamina C.T.E's. C.T.E's for special laminate configurations, Zero C.T.E laminates.

UNIT – V **9**

Particulate Based MMC & PMC: Processing Of MMC –Diffusion Bonding – Stir Casting – Squeeze Casting. Basics Of Graphite, Carbon Nanotube,Nanoclay, Nanosilica. Particulate Reinforced Polymer Composites – Processing, Interactions, Morphological, Rheological, Mechanical Properties.

TOTAL : 45

REFERENCE BOOKS:

1. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Marcel Dekker Inc, 1993
2. Autar K. Kaw, "Mechanics of Composite Materials" CRC Press, 2006.
3. Agarwal B.D. and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley & Sons, New York, 1990.
4. Gibson Ronald, "Principles of Composite Material Mechanics", Tata McGraw-Hill, New Delhi, 1994.

5 Chawla, K.K., "Composite Materials", Springer – Verlag, Boston, 2006.

Course Outcomes:

On completion of the course the students will be able to

- demonstrate the knowledge on the fundamentals and manufacturing of composites
- understand the performance of fiber reinforced composites
- understand and solve problems concerning the mechanics of composite materials
- understand the design concepts and thermal behavior of composite materials
- demonstrate the knowledge on the fundamentals of particulate reinforced composites

14EDE05 VIBRATION AND NOISE CONTROL

(Common to Engineering Design & CAD/CAM)

3 0 0 3

Pre-requisites: Fundamentals of Mathematics, Fundamentals of Dynamics of Machines, Fundamentals of strength of materials

UNIT – I **9**

Basics of Vibration: Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT – II **9**

Basics of Noise: Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT – III **9**

Automotive Noise Sources: Noise - Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT – IV **9**

Control Techniques: Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, applications dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT – V **9**

Source of Noise and Control: Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

TOTAL : 45

REFERENCE BOOKS:

1. Rao, Singiresu S., “Mechanical Vibrations”, Fifth edition, Pearson Education, New Delhi, 2010.
2. Pujara, Kewal., “Vibrations and Noise for Engineers, Fourth edition Dhanpat Rai& Sons, New Delhi, 2004.
3. Challen, Bernard and Baranescu, Rodica., “Diesel Engine Reference Book”, Second Edition - SAE International, Warrendale, 2006.
4. Happian-Smith, Julian., “An Introduction to Modern Vehicle Design”- Butterworth-Heinemann, Boston, 2011.
5 Fenton, John., “Handbook of Automotive Body Construction and Design Analysis: Professional Engineering Publishing, UK, 1998.

Course Outcomes:

On completion of the course the students will be able to

- solve and identify the frequency response of the system
- analyse the noise related parameters
- solve and design the Automobile related noise systems
- solve and analyse the vibration isolation and control systems
- identify and analyse the sources of vibration, noise and control

14CCE02 MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

(Common to CAD/CAM, Engineering Design & Mechatronics)

3 0 0 3

Pre-requisites: Industrial Engineering

UNIT – I **9**

Manufacturing Systems and Models : Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building.

UNIT – II **9**

Material Flow Systems: Assembly lines-Reliable serial systems, approaches to line balancing, sequencing mixed models. Transfer lines and general serial systems-paced lines without buffers, unpaced lines. Shop scheduling with many products. Flexible manufacturing systems-system components, planning and control. Group technology-assigning machines to groups, assigning parts to machines. Facility layout-Quadratic assignments problem approach, graphic theoretic approach.

UNIT – III **9**

Supporting Components: Machine setup and operation sequencing-integrated assignment and sequencing. Material handling systems-conveyor analysis, AGV systems. Warehousing-storage and retrieval systems, order picking.

UNIT – IV **9**

Generic Modeling Approaches: Analytical queuing models, a single workstation, open networks, closed networks. Empirical simulation models-event models, process models, simulation system, example manufacturing system.

UNIT – V **9**

Synchronization Manufacturing and Petri Nets: Synchronization Vs Optimization, defining the structure, identifying the constraint, exploitation, buffer management. Basic definitions-dynamics of Petri nets, transformation methods, event graphs, modeling of manufacturing systems.

TOTAL : 45

REFERENCE BOOKS:

1. Askin Ronald G, "Modeling and Analysis of Manufacturing Systems", John Wiley & Sons, New York, 1993.
2. Mengchu Zhou, "Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach", 2000.
3. Jean Marie Proth and XiaolanXie, "Petri Nets: A Tool for Design and Management of Manufacturing Systems", John Wiley & Sons, New York, 1996.
4. BrandimarteP, and Villa A, "Modeling Manufacturing Systems", Springer Verlag, Berlin, 1999.

Course Outcomes:

On completion of the course the students will be able to

- select the appropriate types of manufacturing systems and models
- know about the assembly line transfer line and FMS
- use various materials handling systems
- know about generic modeling systems
- use theory of constraints for modeling the component

14CCT21 DESIGN FOR MANUFACTURE AND ASSEMBLY

(Common to CAD/CAM & Engineering Design)

3 0 0 3

Pre-requisites: Machine drawing, Manufacturing Technology

UNIT – I **9**

DFMA Guidelines and Geometric Tolerance: General design principles for manufacturability - Design for assembly - strength and mechanical factors - Geometric tolerances – Worst case method - Assembly limits –Design and Manufacturing Datum – Conversion of design datum into manufacturing datum -Tolerance stacks- Process capability

UNIT – II **9**

Form Design: Principal materials - Selection of materials and processes - Mechanisms selection - Possible solutions - Evaluation method - Influence of materials on form design - form design of grey iron, malleable iron, steel and aluminium castings, welded members and forgings.

UNIT – III **9**

Machining Considerations: Design features to facilitate machining – Single point and multipoint cutting tools - Doweling procedures - Reduction of machined area- Simplification by separation - Simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility.

UNIT – IV **9**

Casting Considerations: Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes – Design rules for sand castings – The die casting cycle, Determination of number of cavities and appropriate machine size in die casting- Identification of uneconomical design - Modifying the design - Computer applications in DFMA

UNIT – V **9**

Design for the Environment: Environmental objectives – Basic DFE methods – Lifecycle assessment –AT&T's environmentally responsible product assessment - Weighted sum assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.

TOTAL : 45

REFERENCE BOOKS:

1. Peck, Harry., "Design For Manufacture", Pitman Publications, London 1983.
2. Boothroyd, G, "Product Design for Manufacture and Assembly", New York, CRC Press, London, 2002.
3. Otto, Kevien and Wood, Kristin, "Product Design". Pearson Publication, New Delhi, 2004.
4. Matousek, "Engineering Design: A Systematic Approach", Blackie & Son Ltd., Glasgow, 1974.
5 Bralla, "Design for Manufacture Handbook", McGraw Hill, New York, 1999.

Course Outcomes:

On completion of the course the students will be able to

- know the importance of geometrical tolerances in manufacturing oriented design
- design guidelines for manufacturing and assembly oriented design
- get exposure about the various form design aspects of different materials
- know the machining and casting considerations for manufacturing oriented design
- get the exposure about the impact of design on environment to achieve eco-friendly component design

14EDE06 APPLIED FINITE ELEMENT ANALYSIS

3 0 0 3

Pre-requisites: Fundamentals of matrix multiplication, addition and subtraction, Knowledge on governing differential equations, Fundamentals of strength of materials

UNIT – I **9**

Bending of Plates and Shells: Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C_0 and C_1 Continuity Elements – Application and Examples.

UNIT – II **9**

Non-Linear Problems: Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation – Application in Metal Forming Process and Contact Problems.

UNIT – III **9**

Dynamic Problem: Direct Formulation – Free, Transient and Forced Response – Solution Procedures – Subspace Iterative Technique – Houbolt, Wilson, Newmark – Methods – Examples.

UNIT – IV **9**

Fluid Mechanics and Heat Transfer: Governing Equations of Fluid Mechanics – Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming – Navier Stokes Equation – Steady and Transient Solution.

UNIT – V **9**

Error Estimates and Adaptive Refinement: Error norms and Convergence rates – h-refinement with adaptivity – Adaptive refinement

TOTAL : 45

REFERENCE BOOKS:

1. Reddy J.N., "An Introduction to the Finite Element Method", McGraw Hill, International Edition, 2005.
2. Bathe K.J, "Finite Element Procedures in Engineering Analysis", Prentice Hall, New Jersey, 1996.
3. Logan D.L, "A First Course in the Finite Element Method", Third Edition, Thomson Learning, 2011.
4. Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis", Fourth Edition, Wiley, John & Sons, 2003.
5. Segerlind L.J., "Applied Finite Element Analysis", John Wiley, 1984.
6. S.S.Rao, "Finite Element Analysis", Fifth Edition, McGraw Hill, 2012.

Course Outcomes:

On completion of the course the students will be able to

- formulate and analyse the finite element equation using plate and shell elements for various applications
- analyze the behaviour of non-linear materials
- simulate and compute the responses under dynamics conditions
- simulate the fluid flow phenomena of various application
- estimate the error and remesh the given structure for reducing the discretization error

14EDE07 FRACTURE MECHANICS

3 0 0 3

Pre-requisites: Mechanical behaviour of materials

UNIT – I **9**

Elements of Solid Mechanics: The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis.

UNIT – II **9**

Stationary Crack under Static Loading: Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – J integral and its relation to crack opening displacement.

UNIT – III **9**

Energy Balance and Crack Growth: Griffith analysis – Linear Fracture Mechanics-Crack Opening displacement – Dynamic energy balance – crack arrest.

UNIT – IV **9**

Fatigue Crack Growth Curve: Empirical Relation describing crack growth by fatigue – Life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment.

UNIT – V **9**

Elements of Applied Fracture Mechanics: Examples of crack-growth Analysis for cyclic loading - leak before break – crack Initiation under large scale yielding – Thickness as a Design parameter – crack instability in Thermal or Residual – stress fields.

TOTAL : 45

REFERENCE BOOKS:

1. George E. Dieter, "Mechanical Metallurgy", McGraw Hill, 2013.
2. Broek, David, "Elementary Engineering Fracture Mechanics", Fifthoff and Noerdhoff International Publisher, 1978.
3. Hellan, Kare., "Introduction of Fracture Mechanics", Tata McGraw-Hill Book Company, New Delhi, 1985.
4. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, Allagabad, 1999.

Course Outcomes:

On completion of the course the students will be able to

- know the behavior of crack under load
- design the components under fracture mechanics principles
- know the linear fracture and crack propagation in the fracture mechanics
- know on fatigue crack growth with various loads
- use fracture mechanics for various materials

14EDE08 EXPERIMENTAL STRESS ANALYSIS

3 0 0 3

Pre-requisites: Fundamentals of vibration, Fundamental of acoustic, Knowledge on fatigue and Crack mechanism

UNIT – I **9**

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

UNIT – II **9**

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

UNIT – III **9**

Acoustics and Wind Flow Measures: Principles of Pressure and Flow Measurements – Pressure transducers – Sound level meter – Venturimeter and flow meters – Wind tunnel and its use in structural analysis – Structural modeling – direct and indirect model analysis.

UNIT – IV **9**

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

UNIT – V **9**

Non Destructive Testing Methods: Load testing on structures, Buildings, Bridges and Towers – Rebound Hammer – Acoustic emission – ultrasonic testing principles and Application – Holography – use of laser for structural testing – Brittle coating.

TOTAL : 45

REFERENCE BOOKS:

1. Sadhu Singh., "Experimental Stress Analysis", Khanna Publishers, New Delhi, 2009.
2. Dalley, J W and Riley, W F, "Experimental Stress Analysis", Tata McGraw-Hill, New Delhi, 1991.
3. Srinath, L.S. et al, "Experimental Stress Analysis", Tata McGraw-Hill, New Delhi, 1984
4. Sirohi, R.S and Radhakrishna, H C, "Mechanical Measurements", New Age International New Delhi, 2007.
5 Garas, F.K and Clarke, J.L. "Structural Assessment: The Use of Full and Large Scale Testing", Butterworths, London, 1987.
6 Bray, D.E. and Stanley, R. K., "Non-destructive Evaluation", CRC Press UAS, 1996.

Course Outcomes:

On completion of the course the students will be able to

- handle the force and strain measuring instruments for various engineering applications
- understand the vibration measuring instruments
- use acoustic and win flow measuring instrument to analysis the acoustic and wind flow
- know distress measurements with various controls
- familiarize various non-destructive testing methods for various building

14EDE09 DESIGN OF MATERIAL HANDLING EQUIPMENT

(Common to Engineering Design & CAD/CAM)

(Use of approved data book is permitted)

3 0 0 3

Pre-requisites: Fundamentals of Material Handling Equipment, Knowledge on Machine Element and Transmission System .

UNIT – I **9**

Flexible Hoisting Appliances: Type, selection and applications of material handling equipments, choice of material handling equipment – hoisting equipment – components and theory of hoisting equipment – chain and ropes – selection of ropes, pulleys, pulley systems, sprockets and drums

UNIT – II **9**

Load Handling Equipments and Brakes: Forged standard hooks – forged Ram shorn hooks – solid triangular eye hooks – crane grabs, electric lifting magnetic – grabbing attachments for loose materials, arresting gear – brakes: shoe, band and cone types – elements of shoe brakes – thermal calculation in shoe brakes.

UNIT – III **9**

Surface and Overhead Transportation Equipment: Hand operated trucks – powered trucks – tractors – electronically controlled tractors - hand truck on rails – industrial railroad equipments: locomotives - winches – capstans – turntables – monorail conveyors –pipe rail systems – flat bar monorails. Rail travelling mechanism, cantilever and monorail cranes, cogwheel drive, monocable tramways- reversible tramways.

UNIT – IV **9**

Elevating Equipment: Continuous-motion vertical conveyors – reciprocating-motion vertical conveyors – stackers – work levelers and tail gates – industrial lifts – passenger lifts – freight elevators – mast type elevators – vertical skip hoist elevators, bucket elevators: design, loading and bucket arrangements.

UNIT – V **9**

Conveying Equipment: Belt conveyors - chain conveyors – apron conveyors – escalators – flight conveyors – roller conveyors - oscillating conveyors. Design of belt conveyors, screw conveyors and pneumatic conveyors.

TOTAL: 45

REFERENCE BOOKS:

1. Rudenko. N., “Materials Handling Equipment”, MIR Publishers, Moscow, 1969.
2. Spivakovsky, A.O and Dyachkov, V.K., “Conveying Machines”, Volume I & II, MIR Publishers, Moscow, 1985.
3. Alexandrov, M., “Materials Handling Equipments”, MIR Publishers, Moscow, 1981.
4. Boltzharol, A., “Materials Handling Handbook”, The Ronald Press Company, New York, 1958.
5. P.S.G Tech.., “Design Data Book”, KalaikathirAchchagam, Coimbatore, 2003.
6. Lingaiah, K., “Machine Design Data Book”, Second Edition, McGraw Hill, New York, 2003.
7 Chowdary, R.B and Tagore, G.R.N., “Materials Handling Equipment”, Khanna Publishers, New Delhi, 1996.

Course Outcomes:

On completion of the course the students will be able to

- design and demonstrate the flexible hoisting machine
- design and demonstrate the load handling equipments and brakes
- design and demonstrate the surface and overhead transportation equipments
- design the various elevating equipments
- design and demonstrate the various conveying equipments

14CCE07 PRODUCT DATA MANAGEMENT

(Common to CAD/CAM & Engineering Design)

3 0 0 3

Pre-requisites:

Knowledge in bill of materials, Knowledge on product life cycle

UNIT – I **9**

Description of PDM: Definition, Basic functionality, Typology of PDM functions. Information architecture: Document management, creation and viewing of documents, creating parts, versions and version control of parts and documents. System architecture: Client sever system in PDM. Trends in PDM, Collaborative Product Development, Case studies.

UNIT – II **9**

Configuration Management: Base lines, meta data, Configuration management: CM function, CM ladder, interchangeability. Structuring the Bill of Material, product structure, Engineering structure, Manufacturing Structure. Case studies

UNIT– III **9**

Change Management: Change issue, change requests: production problem, origination of change, change request, request process, concept of Engineering change order.

Change Cost: Costing a change, Design and Development Cost, Manufacturing and Field Costs, Materials and Parts Costs, Cost policy, Charge Back of Costs. Case studies.

UNIT – IV **9**

Change Control and Work Flow: Types of change, Class of change, software changes, Revision drafting, change impacts, customer review and approval.

Projects and Roles: life cycle of a product, life cycle management. Work flows - creation of work flow templates, life cycle, work flow integration. Case studies.

UNIT – V **9**

Configurators and Variants: Configurators: Product configurator, sales configurator, comparison between product configurator and sales configuration, Types of configurator solutions, Product configurator engine. Varient configuration. Case studies.

TOTAL: 45

REFERENCE BOOKS:

1. IvicaCrnkovic, Ulf Asklund, AnnitaPerssonDahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management" Artech House, USA, 2003.
2. Frank B Watts, "Engineering Documentation Control Handbook – Configuration Management", Noyel Publications, New Jersey, USA, Second Edition, 2000.
3. AnttiSaaksvuori, AnselmiImmonen, "Product Lifecycle Management", Springer, New York, Third Edition, 2008.
4. www.cimdata.com

Course Outcomes:

On completion of the course the students will be able to

- know the concept of PDM
- develop a configuration management in a PLM environment
- know the various workflows and roles in a project
- know the product life cycle in change management and its issues
- use the different configurators

14EDE10 ADVANCED TOOL DESIGN

(Common to Engineering Design & CAD/CAM)

3 0 0 3

Pre-requisites: Design of Jigs and Fixtures, Manufacturing Technology

UNIT – I **9**

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

UNIT – II **9**

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

UNIT– III **9**

Design of Drill Jigs and Fixtures: Introduction – Fixed Gages – Gage Tolerances – The selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Drill jigs and modern manufacturing. Fixtures and economics – Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures.

UNIT – IV **9**

Dies and Tool Design: Types of Die construction – Die-design fundamentals – Blanking and Piercing die construction – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing operations.

UNIT – V **9**

Numerically Controlled Machine: The need for numerical control – A basic explanation of numeric control – Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – Tool holding methods for numerical control – Automatic tool changers and tool positioners – Tool presetting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines.

TOTAL : 45

REFERENCE BOOKS:

1. Donaldson Cyrll, LeCain, George H and Goold, V.C., “Tool Design”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2000.
2. Joshi, PrakashHiralal, “Tooling Data”, Wheeler Publishing, Ahmedabad, 2000.
3. Cole, C.P, “Tool Design”, D.B Taraporevala, Bombay, 1972.
4. Pollock. Herman.W., “Tool Design”, D.B Taraporevala, Bombay, 1983.

Course Outcomes:

On completion of the course the students will be able to

- know the concepts and working principles of latest developments in tool design
- understand the tooling materials
- design and develop the drill jigs and fixtures
- understand the selection of dies
- develop programming for NC machines

14CCE08 SAFETY IN ENGINEERING INDUSTRY

(Common to CAD/CAM & Engineering Design)

3 0 0 3

Pre-requisites: Manufacturing Technology

UNIT – I **9**

Safety in metal working machinery and wood working Machines: General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT – II **9**

Principles of Machine Guarding: Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing-presses- forgehammer – flywheels - shafts couplings-gears-sprockets wheels and chains- pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.

UNIT– III **9**

Safety in Welding and Gas Cutting: Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases - colour coding – flashback arrestor – leak detection - pipe line safety - storage and handling of gas cylinders.

UNIT – IV **9**

Safety in Cold Forming and Hot Working of Metals: Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes , hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

UNIT – V **9**

Safety in Finishing, Inspection and Testing: Heat treatment operations, electro plating, paint shops, sand and shot lasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry- industrial waste disposal.

TOTAL : 45

REFERENCE BOOKS:

1. John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travelers Book seller, New Delhi, 1994.
2. Krishnan N.V. "Safety in Industry" Jaico Publishers, 1996.
3. "Health and Safety in Welding and Allied processes", Welding Institute, UK, High Tech. Publishing Ltd., London, 1989.
4. "Accident Prevention Manual" – NSC, Chicago, 1982.
5. "Occupational safety Manual" BHEL, Trichy, 1988.
6. "Indian Boiler acts and Regulations", Government of India.
7. "Safety in the use of Wood Working Machines", HMSO, UK 1992.
8. Blake R.B, "Industrial Safety" Prentice Hall, New Jersey, 1973.

Course Outcomes:

On completion of the course the students will be able to

- work safely in metal and wood working machines
- identify proper guarding for different applications
- work safely in welding and allied process
- work safely in cold and hot working metals
- handle safely testing and inspection instruments

14EDE11 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEM

(Common to Engineering Design & CAD/CAM)

3 0 0 3

Pre-requisites: Gas Laws, Knowledge in Fluid properties, Knowledge in different types of valves

UNIT – I **9**

Oil Hydraulic Systems and Hydraulic Actuators: Hydraulic Power Generators – Selection and specification of pumps, pump characteristics- Determination of volumetric, mechanical and overall efficiencies of positive displacement pumps. Linear and Rotary Actuators – selection, specification and characteristics.

UNIT – II **9**

Control and Regulation Elements: Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems. Electrical control solenoid valves, relays, Electro hydraulic servo valves.

UNIT– III **9**

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

UNIT – IV **9**

Pneumatic Systems and Circuits: Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT – V **9**

Installation, Maintenance and Special Circuits: Pneumatic equipment's- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

TOTAL : 45

REFERENCE BOOKS:

1. Espossito, Antony., "Fluid Power with Applications", Seventh Edition, Prentice Hall, New York, 2008.
2. Pease, Dudleyt, A. and Pippenger, John J., "Industrial Hydraulics", Tata MGraw- Hill, New Delhi, 1987.
3. Parr, Andrew., "Hydraulic and Pneumatics" (HB), Jaico Publishing House, New Delhi, 2005 .
4. Bolton, W., "Pneumatic and Hydraulic Systems ", Butterworth –Heinemann, Boston, 1997.

Course Outcomes:

On completion of the course the students will be able to

- understand the characteristics of a pumps and actuators
- understand the working of control and regulation elements
- design different types of hydraulic circuits for different applications with various valves
- design different types of (electro) pneumatic and hydraulic control systems in complex system and subsystems
- understand troubleshooting, maintenance and safety issues revolving around (electro) pneumatic and hydraulic circuits

14EDE12 DESIGN OF HEAT EXCHANGERS

(Approved data books may be permitted for examinations)

3 0 0 3

Pre-requisites: Heat Transfer, Strength of Materials

UNIT – I **9**

Classification of Heat Exchangers: Parallel flow, Counter flow and Cross flow, Shell and tube and Plate type, Single pass and multi pass, Once through steam generators, Analysis of heat exchangers – LMTD and NTU methods.

UNIT – II **9**

Process Design of Heat Exchangers: Heat transfer correlations, Overall heat transfer coefficient, Effect of baffles, Effect of turbulence, Sizing of finned tube heat exchangers, U tube heat exchangers, Fouling factors, Pressure drop calculations.

UNIT– III **9**

Mechanical Design of Shell and Tube Heat Exchangers: Thickness calculations, Tubesheet design using TEMA formula, Flow induced vibration risks including acoustic issue and remedies, Tube to tube sheet joint design, Buckling of tubes, Thermal stresses.

UNIT – IV **9**

Compact and Plate Heat Exchangers: Types - Merits and Demerits – Design of Compact heat exchangers, Plate heat exchangers, Performance influencing parameters, Limitations.

UNIT – V **9**

Condensers and Cooling Towers: Design of surface and evaporative condensers – Cooling tower – Performance characteristics.

TOTAL : 45

REFERENCE BOOKS:

1. KuppanThulukkanam, "Heat Exchanger Design Handbook", Second Edition, CRC Press(Taylor & Francis Group), 2013.
2. Walkers, "Industrial Heat Exchangers – A Basic Guide", McGraw Hill Book Co., 1980.
3. Sinnott, R K, "Chemical Engineering Design- Volume6", Coulson and Richardson's Chemical Engineering Series, Fourth Edition, Elsevier, 2005.
4. Arthur, P. Frass, "Heat Exchanger Design", Second Edition,John Wiley and Sons, 1989.
5. Nicholas Cheremistoff, "Cooling Tower", Ann Arbor Science Pub., 1981.

Course Outcomes:

On completion of the course the students will be able to

- identify the type of heat exchanger and analyse it
- demonstrate an understanding of design aspects of various heat exchangers
- design a shell and tube heat exchanger with TEMA standards
- design compact and plate heat exchangers
- assess the performance of cooling tower and condenser

14EDE13 PRODUCTIVITY MANAGEMENT AND REENGINEERING

3 0 0 3

Pre-requisites: Fundamentals of production and process, Knowledge in basics of mathematics, Fundamentals steps of software, Essentials knowledge of various production resources

UNIT – I **9**

Introduction of Productivity Concepts: Definitions and various factors for productivity –problems in productivity and production –comparison of productivity measures- Productivity concepts – Macro and Micro factors of productivity, Productivity benefit model-case study- productivity cycle.

UNIT – II **9**

Productivity Measurement: Productivity measurement at International, National and Organizational level-External Environment Economic utility model with productivity index, Total productivity models- problems -Strategies for productivity improvement.

UNIT – III **9**

Productivity Management and Organizational Transformation: Productivity management in manufacturing and service sector-case study -Productivity evaluation models, Productivity improvement models and techniques – laboratory -case study. Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the work force for transformation and reengineering, methodology and guidelines. .

UNIT – IV **9**

Productivity Models: PMI models, Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model –Case studies and applications -DSMCQ and PMP model-case study.

UNIT – V **9**

Re-Engineering Process Improvement Models, Re-Engineering Tools and Implementation: Analytical and process tools and techniques process tools and packages - Information and communication technology - Enabling role of IT.RE-opportunities, process redesign - cases. Software methods in BPR tools and techniques matrix-case study based on information resources - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability-case study from few information resources-application models.

TOTAL : 45

REFERENCE BOOKS:

1. Sumanth, D.J., “Productivity Engineering and Management ", Tata McGraw-Hill, New Delhi, 1998.
2. Edosomwan, J.A., “Organizational Transformation and Process Re-engineering ", British Library cataloging in pub. Data, 2001 .
3. Rastogi, P.N. “Re-Engineering and Re-inventing the Enterprise", Wheeler publishing, New Delhi, 1997.
4. Premvrat, Sardana, G.D. and Sahay, B.S, "Productivity Management: A systems approach", Narosa Publications, New Delhi, 2001.Wesley Publishing, New York, 1991,

Course Outcomes:

On completion of the course the students will be able to

- know and measure the Macro, Micro factors of productivity and its benefit
- optimize the productivity through influencing parameters
- formulate the organizational transformation models
- apply and solve about the productivity models
- solve and optimize the process reengineering tools

14EDE14 INSTRUMENTATION AND MEASUREMENTS

3 0 0 3

Pre-requisites: Basic knowledge of measurement system and its characteristics, Basic knowledge statistical mathematics

UNIT – I **9**

Introduction to Instruments and Their Representation: Introduction, Typical Application of Instrument Systems, Functional Elements of a measurement System, Classification of Instruments, Standards and Calibration. Static and Dynamic characteristics of Instruments: Introduction, Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Dead Band, Backlash, Drift, Formulation of Differential Equations for Dynamic Performance- Zero Order, First Order and Second order systems, Response of First and Second Order Systems to Step, Ramp, Impulse and Harmonic Functions, Problems including the characteristics study.

UNIT – II **9**

Transducer Elements: Introduction, Analog and Digital Transducers, Variable Capacitance, Piezo-Electric Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Digital Transducers, Frequency Domain Transducer, Vibrating String Transducer, Binary codes, Digital Encoders.

UNIT– III **9**

Intermediate, Indicating and Recording Elements: Introduction Amplifiers, Mechanical, Hydraulic, Pneumatic, Optical, Electrical Amplifying elements, Compensators, Differentiating and Integrating Elements, Filters, Classification of Filters, A-D and D-A Converters, Digital Voltmeters (DVMs), Cathode Ray Oscillo scopes (CROs), Galvanometric Recorders, Magnetic Tape recorders, Data Acquisition Systems, Data Display and Storage.

UNIT – IV **9**

Motion, Force and Torque Measurement: Introduction, Relative motion Measuring Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices, Seismic Devices, Spring Mass & Force Balance Type, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, and Torque Meters.

UNIT – V **9**

Pressure, Flow and Temperature Measurement: Pressure Measurement: Introduction, Moderate Pressure Measurement, Monometers, Elastic Transducer, Dynamic Effects of Connecting Tubing, High Pressure Transducer, Low Pressure Measurement, Calibration and Testing

Flow Measurement: Quantity and rate meters, Flow visualization and its techniques

Measurement of Temperature: Non Electrical Methods – Solid Rod Thermometer, Bimetallic Thermometer, Pressure Thermometer, Electrical Methods – Electrical Resistance Thermometers-RTDs, Semiconductor Resistance Sensors (Thermistors), Thermo– Electric Sensors, Thermocouple Materials and circuitry.

TOTAL : 45

REFERENCE BOOKS:

1. Ernest O. Doebelin, "Measurement System: Application and Design", McGraw Hill, Fifth Edition, 2003.
2. Alan S. Morris, "Principles of Measurement and Instrumentation", Prentice Hall of India, 1993.
3. B.C. Nakra and K.K. Chaudhary, "Instrumentation, Measurement and Analysis", Tata MaGraw Hill, 2003.
4. D. S. Kumar, "Mechanical Measurements and Control Engineering", Metropoliton Book Company, 1979.
5. A.K Tayal, "Instrumentation, Mechanical Measurements and Controls", Galgotia Publisher, 2008.

Course Outcomes:

On completion of the course the students will be able to

- demonstrate the knowledge on calibration and characteristic analysis
- select transducers at different stages of a measurement system and relate them to manipulation and presentation devices
- identify and relate manipulating and presentation system
- demonstrate the use of motion, force and torque measurement
- demonstrate the use of pressure, flow and temperature measurements

14EDE15 APPLIED ENGINEERING ACOUSTICS

3 0 0 3

Pre-requisites: Fundamentals of Mathematics, Fundamentals of Acoustics, Fundamentals of vibrations

UNIT – I **9**

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

UNIT – II **9**

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

UNIT– III **9**

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

UNIT – IV **9**

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

UNIT – V **9**

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

TOTAL : 45

REFERENCE BOOKS:

1. Kinsler, Lawrence E., and Frey, Austin R., “Fundamentals of Acoustics”, Fourth edition, New Age International, New Delhi, 2010.
2. Bies, David, A. and Hansen, Colin H., “Engineering Noise Control: Theory and Practice”, Fourth Edition, Chapman-Hall, London, 2009.
3. Hansen, C.H. and Snyder, S.D., “Active Control of Sound and Vibration”, Third edition, E and FN Spon, London 2003.

Course Outcomes:

On completion of the course the students will be able to

- identify and analyse the fundamentals of acoustics and wave motion
- identify and analyse the characteristics of sound
- solve and design the transmission phenomenon of sound
- measure and assessment of sound systems
- control the vibration and noise in machines

14EDE16 MODELING OF DYNAMIC SYSTEMS

3 0 0 3

Pre-requisites: Fundamentals of Mathematics, Fundamentals of Control Systems

UNIT – I **9**

Mathematical Models of Physical Systems: Introduction to control systems, differential equations of physical systems, dynamics of robotic mechanism, transfer functions, block diagram algebra, single flow graphs.

UNIT – II **9**

Feedback Characteristics of Control Systems and Components: Feedback and non-feedback systems, reduction of parameter variations, control over system dynamics, control of the effects of disturbance signals, linearizing effect, regenerative feedback. Regenerative feedback. Linear approximation on non-linear systems, stepper motors, hydraulic systems, pneumatic systems.

UNIT– III **9**

Time Response Analysis and Stability in Time Domain: Standard test signals, time response of first-order systems, time response of second-order systems, steady-state errors and error constraints, effect of adding a zero to a system, design specifications of second-order systems, design considerations for higher-order system, performance indices, robotic control systems, state variable analysis, approximation of higher-order systems by lower order systems, concept of stability, necessary conditions, Routh stability criterion, relative stability analysis.

UNIT – IV **9**

Frequency Response Analysis and Stability in Frequency Domain: Correlation between time and frequency response, polar plots, bode plots, all-pass and minimum-phase systems, experimental determination of transfer functions, log-magnitude versus phase plots, Nyquist stability criterion, assessment of relative stability, closed loop frequency response, sensitivity analysis.

UNIT – V **9**

Introduction to Design and State Variable Analysis: Preliminary considerations, realization of basic compensators, cascade compensation in time domain and frequency domain, feedback compensation, robust control system design. Concepts of state, state variables and state model, state models for linear-continuous-time systems, state variables and linear discrete-time systems, solutions of state equations, concepts of controllability and observability, pole placement by state feedback.

TOTAL : 45

REFERENCE BOOKS:

1. Nagrath, I J, and Gopal, M, "Control Systems Engineering", Fourth Edition, New Age International Publishers, New Delhi, 2006.
2. Okata, K, "Modern Control Engineering", Fifth Edition, Pearson/Prentice Hall of India, New Delhi, 2009.
3. Gopal, M., "Control Systems: Principles and Design", Second Edition, Tata McGraw-Hill, 2008.
4. Norman, S Nise., "Control System Engineering", Sixth edition, John Wiley & Sons Inc, New York, 2013.
5. Lyshevski, Sergey Edward., "Control Systems: Theory with Engineering Applications", Springer-Verlag, New York, 2002.
6. Zak, Stainslaw H, "Systems and Control", Oxford University Press, Oxford, 2003.

Course Outcomes:

On completion of the course the students will be able to

- identify and solve the mathematical models of physical systems
- calculate the feedback characteristics of control systems and their components
- evaluate the time and frequency response analysis and stability of the System
- solve and analyse the vibration isolation and control systems
- identify and design the state variables