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

M.E. DEGREE IN CAD/CAM (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
14CCT12	Machining Processes and Analysis	3	0	0	3	40	60	100
14CCT13	Computer Applications in Design	3	0	0	3	40	60	100
14CCT14	Micro and Nano Manufacturing Processes	3	0	0	3	40	60	100
	PRACTICAL							
14EDL11	Design and Analysis Laboratory	0	0	3	1	100	0	100
14CCL11	CAM Laboratory	0	0	3	1	100	0	100
				Total	**22**			

CA - Continuous Assessment, ESE – End Semester Examination

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(Autonomous)

M.E. DEGREE IN CAD/CAM (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
14CCT21	Design for Manufacture and Assembly	3	0	0	3	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	**21**			

CA - Continuous Assessment, ESE – End Semester Examination

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(Autonomous)

M.E. DEGREE IN CAD/CAM (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							
14CCP31	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							
14CCP41	Project Work Phase –II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 71

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

M.E. DEGREE IN CAD/CAM (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
14CCT21	Design for Manufacture and Assembly	3	0	0	3	40	60	100
	PRACTICAL							
14EDL21	Optimization Techniques and Simulation Laboratory	0	0	3	1	100	0	100
				Total	**11**			

CA - Continuous Assessment, ESE – End Semester Examination

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

M.E. DEGREE IN CAD/CAM (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							
14CCT12	Machining Process and Analysis	3	0	0	3	40	60	100
14CCT13	Computer Applications In Design	3	0	0	3	40	60	100
14CCT14	Micro and Nano Manufacturing Processes	3	0	0	3	40	60	100
	PRACTICAL							
14CCL11	CAM Laboratory	0	0	3	1	100	0	100
				Total	**10**			

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 CAD/CAM (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							
14CCP31	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							
14CCP41	Project Work Phase –II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 71

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
14CCE02	Modeling and Analysis of Manufacturing Systems	3	0	0	3
14EDE05	Vibration and Noise Control	3	0	0	3
14CCE03	Computer Aided Process Planning	3	0	0	3
14CCE04	Robotics	3	0	0	3
14CCE05	Metrology and Non Destructive Testing	3	0	0	3
14CCE06	CNC Technology and Programming	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
14CCE09	Data Communication in CAD/CAM	3	0	0	3
14CCE10	Precision Engineering	3	0	0	3
14MME09	Rapid Prototyping and Tooling	3	0	0	3
14CCE11	Reliability Engineering	3	0	0	3
14MMT16	Microcontroller and Applications	3	1	0	4

*- 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

14CCT12 MACHINING PROCESSES AND ANALYSIS

3 0 0 3

Pre-requisites: Fundamentals of material removal processes

UNIT – I **9**

Mechanics of Cutting: Chip Formation-Introduction-Types of Chips-Primary Plastic Deformation in Continuous Chip Formation-Tool-Chip Friction and Secondary Deformation-Chip Control-Burr Formation and Control Measurement of Cutting Forces and Chip Thickness -Force Components-Empirical Force Models Specific Cutting Energy-Shear Plane and Slip Line Theories for Continuous Chip Formation Shear Plane Models for Oblique Cutting-Shear Zone Models-Minimum Work and Uniqueness Assumptions-Finite Element Models-Discontinuous Chip Formation-Built-Up Edge Formation.

UNIT – II **9**

Tool Nomenclauture: Nomenclature of single point cutting tool-System of tool nomenclature and conversion of rake angles-nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.

UNIT – III **9**

Thermal Aspects in Machining and Tool Material: Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining-cutting fluids Essential requirements of tool materials-development in tool materials-ISO specification for inserts and tool holders-tool life-conventional and accelerated tool life tests-concept of mach inability index-economics of machining.

UNIT – IV **9**

Wear Mechanisms and Chatter in Machining: Processing and Machining – Measuring Techniques – Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter-mechanism of chatter.

UNIT – V **9**

Abrasive Machining Processes: Abrasive machining processes- mechanics of grinding process, grinding wheel specification- conventional- super abrasive – grinding wheel wear- selection of grinding wheel- super finishing processes.

TOTAL: 45

REFERENCE BOOKS:

1. Boothroid D.G. & Knight W.A., “Fundamentals of machining and machine tools”, Marcel Dekker, Newyork, 1989.
2. Shaw.M.C.”Metal cutting principles”, oxford Clare don press, 1984.
3. Bhattacharya.A., “Metal Cutting Theory and practice”, Central Book Publishers, India, 1984

Course Outcomes:

On completion of the course the students will be able to

- utilize fundamentals of metal cutting as applied to the machining
- know the importance of cutting tool nomenclauture
- know the influence of thermal aspects in cutting tool material
- know how the wear occurs while machining
- select proper abrasive machining process for a given components

14CCT13 COMPUTER APPLICATIONS IN DESIGN

(Common to CAD/CAM & Mechatronics)

3 0 0 3

Pre-requisites: Applied Mathematics, Engineering Drawing

UNIT – I **9**

Introduction to Computer Graphics: Design Process and CAD – Constraints – Computer graphics principles – Line and Circle drawing algorithms- Parametric equations (lines, circle) -2-D & 3-D transformation -Translation, scaling, rotation -Windowing, view ports - Clipping transformation.

UNIT – II **9**

Visual Realism and Curves: Data Exchange formats – IGES, STEP- Hidden Line, Surface, Solid removal Algorithms - Shading – Coloring – RGB, HSV, HLS - Synthetic curves- Cubic Spline, Bezier.

UNIT – III **9**

Solid Modeling: Solid Modeling Techniques – Constructive Solid Geometry & Boundary Representation - Solid modeling systems – Surface modeling- Rapid prototyping - Parametric modeling- Creation of prismatic and revolved parts using solid modeling packages.

UNIT – IV **9**

Tolerance analysis and Mass property calculations: Assembly Modeling – Tolerance modeling and analysis - Mass property calculations – Curve length, Area, Volume, Mass, Moment of inertia.

UNIT – V **9**

Computers in Design Productivity: Reverse engineering of components – Design optimization. Developing design programs using C / LISP for applications like design of shafts, gears etc.

TOTAL : 45

REFERENCE BOOKS:

1. Zeid, Ibrahim, "Mastering CAD/CAM", Tata McGraw Hill, New Delhi, 2006.
2. Hearn Donald and Baker M Pauline, "Computer Graphics" Prentice Hall Inc, 2000.
3. Neumann William M. and Sproul Robert., "Principles of Computer Graphics" McGraw-Hill Book Co. Singapore 2000.
4. Rao P N., "CAD/CAM: Principles and Applications", Second Edition, Tata McGraw Hill,. 2004.

Course Outcomes:

On completion of the course the students will be able to

- know the importance of mathematical concepts behind computer graphics
- understand the basic techniques used to draw 3D objects in the 2D monitor
- get exposure about the synthetic curves and solid modeling techniques
- know the application of Computers in Design Productivity
- know the tolerance analysis and Mass property calculations

14CCT14 MICRO AND NANO MANUFACTURING PROCESSES

3 0 0 3

Pre-requisites: Fundamentals of manufacturing processes

UNIT – I **9**

Micro Manufacturing: Introduction - Miniaturization and Applications -Classification -Subtractive Processes -Traditional Micromachining-Advanced Micromachining Processes-Nanofinishing Processes-Additive Processes-Mass Containing Processes-Microforming-Micromolding-Microcasting-Microjoining-Miscellaneous Applications-Challenges in Meso-, Micro-, and Nanomanufacturing

UNIT – II **9**

Micromachining: Microgrinding: Introduction - Types of Grinding Wheels -Machining and Grinding—A Comparison - Grindability - Grinding Mechanisms-Micro grinding—Its Definition and Applications. **Advanced Micromachining:** Micro- and Nano manufacturing by Focused Ion Beam-Introduction - Focused Ion Beam System (Dual Beam)-Ion–Matter Interaction -Working Principle of Focused Ion Beam.

UNIT– III **9**

Nanofinishing: Magnetorheological and Allied Finishing Processes: Introduction - Magnetorheological (MR) Fluid-Magnetorheological Finishing (MRF)- Magnetorheological Abrasive Flow Finishing (MRAFF). **Magnetic Abrasive Finishing (MAF):** Introduction -Working Principle of Magnetic Abrasive Finishing-Allied and Hybrid MAF Processes-Pulsating Current Magnetic Abrasive Finishing (PC-MAF).

UNIT – IV **9**

Microjoining & Microforming: Micro joining: Laser Micro welding- Introduction - Laser Welding Process-Laser Welding Practice-Laser Micro welding Applications -Electron Beams for Macro and Micro welding Applications-Introduction - Description of an EBW Setup - Design Considerations of the Electron Gun Column-Electron Beams for Micro Operations. **Micro forming:** Micro and Nanostructured Surface Development by Nano Plastic Forming and Roller Imprinting-Introduction - Nano Plastic Forming -NPF-CRI Technique - Micro- and Nanostructured Surface Development.

UNIT – V **9**

Dimensional Metrology for Micro/Mesoscale Manufacturing: Introduction-Touch Probe Measurement - Optical Measurements-Scanning Probe Microscopy -Hybrid Processes - On-Machine Metrology.

TOTAL: 45

REFERENCE BOOKS:

1. V. K. Jain, "Micromanufacturing Processes", CRC Press, 2013.
2. V.K.Jain, "Introduction to Micromachining", Narosa Publishing House, 2010.
3. Mark J. Jackson, "Micro Fabrication and Nano machining", Taylor and Francis, 2006.
4. Yi Qin, "Micro-Manufacturing Engineering and Technology", Elsevier Publication, 2010.
5. Serope Kalpakjain, "Manufacturing Engineering and Technology", Pearson Education, 2005.

Course Outcomes:

On completion of the course the students will be able to

- compare between newer machining processes with the traditional machining processes
- analyse the concept, mechanism of material removal in micro manufacturing
- analyse the different parameters influence on the nano machining
- know concepts of various micro joining and forming processes
- measure the micro and nano finished component at micro/meso scale level

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

14CCL11 CAM LABORATORY

0 0 3 1

Prerequisites: Fundamentals of CAD/CAM

LIST OF EXPERIMENTS:

1. Study of G codes and M codes for machining centre and turning centre.
2. Programming and machining of given component using HMT VMC 200T.
3. Programming and machining of given component using HMT VMC T70.
4. Programming and machining of given component using CNC Turning Centre.
5. Programming and simulation of given component using MASTER CAM (Lathe).
6. CNC code generation of given component using MASTER CAM (Lathe) and interfacing it to CNC turning centre.
7. Programming and machining of given component using CNC Machining Centre.
8. Programming and simulation of given component using MASTER CAM (Milling).
9. CNC code generation of given component using MASTER CAM (Mill) and interfacing it to CNC Machining Centre.
10. CNC code generation of given component using Pro Manufacturing.

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

- CNC Lab Manuals
- Master CAM, Pro Manufacturing

Course Outcomes:

On completion of the course the students will be able to

- write G and M codes for various machining components
- write part program for different machining process
- generate CNC code for a given component
- simulate the programme for a given component
- interface MASTERCAM to CNC milling centre

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

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

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 and 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)
(Approve 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 Fiberrein forced 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

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

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

14CCE03 COMPUTER AIDED PROCESS PLANNING

3 0 0 3

Pre-requisites: CAD/CAM/CIM

UNIT – I **9**

Process and Production Planning: The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology.

UNIT – II **9**

Part Design Representation: Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure - Geometric modelling for process planning - GT coding - The optiz system - The MICLASS system.

UNIT – III **9**

Process Engineering and Process Planning: Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach – Forward and Backward planning, Input format.

UNIT – IV **9**

Computer Aided Process Planning Systems: Logical Design of a Process Planning - Implementation considerations –manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT – V **9**

An Intergraded Process Planning Systems: Totally integrated process planning systems - An Overview - Modulus structure – Data Structure, operation - Report Generation, Expert process planning.

TOTAL : 45

REFERENCE BOOKS:

1. Gideon Halevi and Roland D. Weill, " Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.
2. Tien-Chien Chang, Richard A.Wysk, "An Introduction to automated process planning systems ", Prentice Hall, 1985
3. Chang, T.C., " An Expert Process Planning System ", Prentice Hall, 1985.
4. Nanua Singh, " Systems Approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons, 1996
5. Rao, “Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2000.

Course Outcomes:

On completion of the course the students will be able to

- know the role of process planning in manufacturing
- characteristics of traditional and CAPP systems
- know the structure of typical CAPP systems from a holistic prospective
- apply the process capabilities, such as process parameters, process boundaries, process performance and process cost
- implement CAPP based on process planning criteria, and implementation and economic considerations

14CCE04 ROBOTICS

(Common to CAD/CAM & Embedded Systems)

3 0 0 3

Pre-requisites: Kinematics of Machinery, Fundamentals of Instrumentation and measurements

UNIT – I **9**

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

UNIT – II **9**

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

UNIT– III **9**

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

UNIT– IV **9**

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

UNIT – V **9**

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

TOTAL : 45

REFERENCE BOOKS:

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987.
2. Yoram Koren, “ Robotics for Engineers” Mc Graw-Hill, 1987.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984
4. Deb, S.R. “Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, “Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int. 1986.
6. Timothy Jordanides et al , “Expert Systems and Robotics” , Springer –Verlag, New York, May 1991.

Course Outcomes:

On completion of the course the students will be able to

- express the concept of developmental stages in robotics
- create and evaluate newer techniques and processes in the factories of future
- assess and implement robotic process for specific application in their work flow
- selectively increase the mobility and speed of robots for specific application
- enhance the productivity of robots for specific applications by selecting the appropriate programming language and techniques

14CCE05 METROLOGY AND NON DESTRUCTIVE TESTING

3 0 0 3

Pre-requisites: Basics of Metrology

UNIT – I **9**

Measuring Machines: Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Image shearing microscope – Use of computers - Machine vision technology - Microprocessors in metrology.

UNIT – II **9**

Statistical Quality Control : Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing.

UNIT – III **9**

Liquid Penetrant and Magnetic Particle Tests: Characteristics of liquid penetrants - different washable systems - Developers - applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test - Applications - Advantages and limitations.

UNIT – IV **9**

Radio Graphy: Sources of ray-x-ray production - properties of d and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.

UNIT – V **9**

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

TOTAL : 45

REFERENCE BOOKS:

1. Jain R,K. " Engineering Metrology ", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.
3. American Society for Metals, “Metals Hand Book ", Vol.II, 1976.
4. Progress in Acoustic Emission, " Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.

Course Outcomes:

On completion of the course the students will be able to

- implement different types of measuring techniques
- take decision to implementation of measuring techniques on shop floor depending on the types of industries
- know the advanced NDT methods to improve the availability, maintainability of the modern plant for optimal running condition
- implement the concept of Ultrasonic application, Acoustic emission examination
- understand, analyze and take appropriate decision for live problems observed in industries

14CCE06 CNC TECHNOLOGY AND PROGRAMMING

3 0 0 3

Pre-requisites: CAD/CAM/CIM

UNIT – I **9**

Introduction to NC/CNC/DNC: Introduction to NC/CNC/DNC and its role in FMS and CIMS, basics elements of CNC system, CNC hardware elements including drives actuators and sensors, construction of modern CNC machine tool controllers.

UNIT – II **9**

Introduction to Part Programming: Introduction to CNC programming- manual part programming – preparatory, miscellaneous functions – computed aided part programming - post processors - APT programming- programming for CNC turning center, machining center and CNC EDM.

UNIT – III **9**

Advanced Programming Features: Advanced programming features and canned cycles, geometric modelling for NC maching & maching of free form surfaces.

UNIT – IV **9**

Feedback Devices: Feedback devices– interpolators - tooling for CNC– point-to-point and contouring systems – DNC-Adaptive Control – ACO and ACC systems- graphical numerical control.

UNIT – V **9**

Generation of CAD Models: NC program generation of CAD models, NC program verification and virtual NC Recent developments in CNC machine tools

TOTAL : 45

REFERENCE BOOKS:

1. Yoram Koren, "Computer Control of Manufacturing Systems", McGraw Hill Book Co. New Delhi, 1986.
2. Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2009.
3. Radhakrishnan P., "Computer Numerical Control Machines", New Book Agency, Calcutta, 1991
4. Kundra T. K., Rao P. N., and Tiwari N. K., "CNC and Computer Aided Manufacturing", Tata McGraw Hill, New Delhi, 1991.
5. Fitzpatric.M., “Machining and CNC Technology”, McGraw Hill, 2004

Course Outcomes:

On completion of the course the students will be able to

- know the development of NC/CNC/DNC
- write CNC part programming for a given component
- write advanced programming techniques
- know how the feedback systems work.
- generate CAD models

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

14CCE09 DATA COMMUNICATION IN CAD/CAM

3 0 0 3

Pre-requisites: CAD/CAM/CIM

UNIT – I **9**

Digital Computers & Micro Processors: Block diagram - register transfer language - arithmetic, logic and shift micro operations - instruction code - training and control instruction cycle - I/O and interrupt design of basic computer. Machine language - assembly language - assembler. Registers ALU and Bus Systems - timing and control signals - machine cycle and timing diagram - functional block diagrams of 80 x 86 and modes of operation. Features of Pentium Processors.

UNIT – II **9**

Operating System & Environments: Types - functions - UNIX & WINDOWS NT - Architecture - Graphical User Interfaces. Compilers - Analysis of the Source program - the phases of a compiler - cousins of the compiler, the grouping of phases - compiler construction tools.

UNIT – III **9**

Communication Model: Data communication and networking - protocols and architecture - data transmission concepts and terminology - guided transmission media - wireless transmission – data encoding - asynchronous and synchronous communication - base band interface standards RS232C, RS449 interface.

UNIT – IV **9**

Computer Networks: Network structure - network architecture - the OSI reference model services – network standardization – example - Managing remote systems in network - network file systems - net working in manufacturing.

UNIT – V **9**

Internet: Internet services - Protocols - intranet information services - mail based service – system and network requirements - Internet tools - usenet - e-mail - IRC - www - FTP - Telnet.

TOTAL : 45

REFERENCE BOOKS:

1. Morris Mano. M., "Computer System Architecture", Prentice Hall of India, 1996.
2. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications of 8085", Penram International, 1997.
3. Peterson J.L., Galvin P. and Silberschaz, A., "Operating Systems Concepts", Addison Wesley, 1997.
4. Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman, "Compilers Principles Techniques and Tools", Addison Wesley, 1986.
5. William Stallings, "Data of Computer Communications" Prentice Hall of India, 1997
6. Andrew S. Tanenbanum "Computer Networks", Prentice Hall of India 3rd Edition, 1996.

Course Outcomes:

On completion of the course the students will be able to

- acquire and apply fundamental principles of science and engineering
- analysis the identify, formulate and model problems and find engineering solutions based on a system approach
- create to conduct investigation on engineering problems in a chosen field of study
- review current events in the field of communications
- get a sound working knowledge in today's competitive environment

14CCE10 PRECISION ENGINEERING

3 0 0 3

Pre-requisites: Metrology and measurements

UNIT – I **9**

Precision Engineering: Introduction - Accuracy & precision – Need – application precision machining–Tool based Micro & Ultra precision Machining grinding – Thermal effects – Materials for tools and machine elements – carbides – ceramic, CBN & diamond.

UNIT – II **9**

Tolerance and Fits: Tolerance – Zone – fits – Variation – Hole & shaft system – limits – expected Accuracy of machining processes – Selective assembly – gauges acceptance tests for machine tools.

UNIT – III **9**

Ultra Precision Machine Elements: Introduction – Guide ways – Drive systems – Spindle drive – preferred numbers – Rolling elements – hydrodynamic & hydrostatic bearings – pneumatic bearings.

UNIT – IV **9**

MEMS: Introduction – MEMS – principle – Elements – Characteristics – Design – Application: automobile defence, aerospace etc.,

UNIT – V **9**

Error Control: Error – Sources – Static stiffness – Variation of the cutting force – total compliance – Different machining methods – Thermal effects – heat source – heat dissipation – Stabilization – decreasing thermal effects – forced vibration on accuracy – clamping & setting errors – Control – errors due to locations – principle of constant location surfaces.

TOTAL : 45

REFERENCE BOOKS:

1. Nakazawa, H. “Principles of Precision Engineering”, Oxford University Press, 1994.
2. Murthy R.L., “Precision Engineering in Manufacturing”, New Age International Publishers, New Delhi, First Edition, 1996.
3. Institute of Physics Publishing, Bristol and Philadelphia, Bristol, BSI 6BE U.K.

Course Outcomes:

On completion of the course the students will be able to

- know the importance of precision engineering
- know how to inspect the manufactured component precisely
- identify the ultra precision machine elements and its applications
- characterize the MEMS product
- control the errors

14MME09 RAPID PROTOTYPING AND TOOLING

(Common to Mechatronics & CAD/CAM)

3 0 0 3

UNIT – I **9**

Introduction to RP systems: Introduction: Product design and rapid product development - Need for time compression in product development, Conceptual design - Detail design Prototype fundamentals, Fundamentals of RP systems - 3D modelling-3D solid modeling software and their role in RPT - Data format - STL files, History of RP systems, classification of RP systems, benefits of RPT.

UNIT – II **9**

Liquid based RP systems: Stereo Lithography Apparatus (SLA) – Principle - Photo polymers - Post processes - Process parameters - Machine details - Advantages, Solid Ground Curing (SGC) – Principle - Process parameters - Process details - Machine details - Limitations. Solid Object Ultraviolet Laser Printer (SOUP) Principle - Process parameters - Process details - Machine details - Applications.

UNIT – III **9**

Solid based RP systems: Fusion Deposition Modeling (FDM) – Principle - Raw materials – BASS - Water soluble support system - Process parameters - Machine details - Advantages and limitations, Laminated Object Manufacturing – Principle - Process parameters - Process details - Advantages and limitations. Solid Deposition Manufacturing (SDM) - Principle - Process parameters - Process details - Machine details - Applications.

UNIT – IV **9**

Powder based RP systems: Selective Laser Sintering (SLS) – Principle - Process parameters - Process details - Machine details, Advantages and applications, 3-Dimensional Printers (3DP) – Principle - Process parameters - Process details - Machine details – Advantages and limitations, Laser Engineered Net Shaping (LENS) – Principle – Process details - Advantages and applications, Concept Modelers.

UNIT – V **9**

Rapid Tooling and Applications of RP: Indirect Rapid Tooling - Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Direct Rapid Tooling - Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, DMLS, ProMetal, Sand casting tooling, soft tooling vs hard tooling, Applications of RP in product design, automotive industry, medical field – Conversion of CT/MRI scan data - Customised implant - Case studies, reverse engineering - Surface Generation from points on cloud, Growth of RP industry.

TOTAL : 45

REFERENCE BOOKS:

1. Chua, C. K., Leong, K. F. and Lim, C. S., "Rapid Prototyping: Principles and Applications", World Scientific, New Jersey, 2010.
2. Pham, D. T. and Dimov, S. S., "Rapid manufacturing", Springer-Verlag, London, 2011.
3. Jacobs, P. F., "Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography",

McGraw-Hill, New York, 1992.

4. Hilton, P. D., "Rapid Tooling", Marcel Dekker, New York, 2000.
5. home.utah.edu/~asn8200/rapid.html
6. Rapid Prototyping Journal, Emerald Group Publishing Limited
7. http://www.cheshirehenbury.com/rapid/index.html

Course Outcomes :

On completion of the course students will be able to

- understand and apply the concepts of rapid prototyping in product development
- understand the principle, process, machines and process parameters of different RP processes
- demonstrate the ability to conceptualize manufacturing processes and systems through direct and indirect tooling systems

14CCE11 RELIABILITY ENGINEERING

3 0 0 3

Pre-requisites: Total Quality Management, Process planning and cost estimation

UNIT – I **9**

Reliability Concept: Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posterior probabilities – Mortality of a component –Bath tub curve – Useful life.

UNIT – II **9**

Failure Data Analysis: Data collection –Empirical methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Hazard plotting – Goodness of fit tests.

UNIT – III **9**

Reliability Assessment: Different configurations – Redundancy – m/n system – Complex systems: RBD – Baye's method – Cut and tie sets – Fault Tree Analysis – Standby system.

UNIT – IV **9**

Reliability Monitoring: Life testing methods: Failure terminated – Time terminated – Sequential Testing – Reliability growth monitoring – Reliability allocation – Software reliability.

UNIT – V **9**

Reliability Improvement: Analysis of downtime – Repair time distribution – System MTTR – Maintainability prediction – Measures of maintainability – System Availability – Replacement theory.

TOTAL : 45

REFERENCE BOOKS:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", Tata McGraw Hill, 2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2000

Course Outcomes:

On completion of the course the students will be able to

- evaluate risks as applied to different engineering disciplines
- summarize reliability engineering throughout the product life cycle
- perform reliability engineering analysis
- compare the characteristics and differences in common Life Testing methodologies
- compute reliability engineering parameters and estimates for applications in mechanical and electronic devices and manufacturing environments

14MMT16 MICROCONTROLLER AND APPLICATIONS

(Common to Mechatronics & CAD/CAM)

3 1 0 4

UNIT – I **9**

8051 Microcontroller: Microcontroller and embedded processors - Overview of the 8051 family - 8051 microcontroller architecture - Memory organization of 8051 - PSW register - Register banks and stack, Input/ Output ports, pins.

UNIT – II **9**

8051 Programming: Timer/Counter - Serial Communications Interrupts - Instruction set - Addressing modes - I/O port Programming - Timer / counter programming - Serial communications Programming - Interrupt Programming.

UNIT – III **9**

PIC Microcontrollers Architecture: PIC microcontroller overview and features - Harvard architecture - Pipelining – Architecture of PIC18-PinDescription-Memory organization: Program memory-Data Memory -Register Organization.

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UNIT – IV **9**

PIC 18Features: I/O Ports Timers Counters-Capture/ Compare - PWM- External Hardware Interrupts- USART-ADC-Interfacing to External memory.

UNIT – V **9**

PIC 18 programming: Addressing Modes - Instruction set-Simple Programs. I/O port programming-Timer/Counter programming- Serial communications Programming - Interrupt Programming.

Lecture:45 Tutorial:15 TOTAL: 60

REFERENCE BOOKS:

1. Mazidi Muhammad Ali and Mazidi Janice Gillispie, "The 8051 Microcontroller and Embedded Systems", Twelfth Impression second edition, Pearson Education, 2013.
2. Mazidi,MuhammadAli,Mckinlay,RolinD.,andCauseyDanny,"PICMicrocontroller and Embedded SystemsusingAssemblyandCforPIC18", Pearson Education Asia, 2008.
3. Ayala Kenncth J., "The 8051 Microcontroller Architecture, Programming and Applications", Second edition, Penarm international publishing (India), Mumbai, 2004.
4. Peatman John B., "Design with PIC Microcontroller", Twelfth Indian reprint, Pearson education, New Delhi, 2005.
5. www.microcontroller.com
6. www.atmel.com
7. www.mirochip.com

Course Outcomes:

On completion of the course the students will be able to

- understand the organization of 8051 microcontroller and its programming concepts
- interpret the basic architecture and features of PIC18 microcontroller
- apply the programming skills for interfacing and various applications using PIC18 microcontroller