SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)
(Affiliated to JNTUK, Kakinada), (Recognised by AICTE, New Delhi)
Accredited by NAAC with 'A' Grade
Recognised as Scientific and Industrial Research Organisation
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204

SCHEME OF INSTRUCTION & EXAMINATION

(Regulation R17)

M.TECH (CAD/CAM)

DEPARTMENT OF MECHANICAL ENGINEERING

(With effect from **2017-2018** Admitted Batch onwards**)**
Under Choice Based Credit System

I-SEMESTER

Code No.	Name of the Subject	Credits	Lec-ture Hrs	Tutorial Hrs	Lab Hrs	Contact Hrs/ Week	Internal Marks	External Marks	Total Marks
M17 CAD 1101	Industrial Robotics	3	3	1	--	4	30	70	100
M17 CAD 1102	Computer Aided Manufacturing	3	3	1	--	4	30	70	100
M17 CAD 1103	Special Manufacturing Processes	3	3	1	--	4	30	70	100
M17 CAD 1104	Geometric Modelling	3	3	1	--	4	30	70	100
#ELE-1	Elective-I	3	3	1	--	4	30	70	100
#ELE-2	Elective-II	3	3	1	--	4	30	70	100
M17 CAD 1111	Computer Aided Design Lab	2	--	--	3	3	50	50	100
Total		**20**	**18**	**6**	**3**	**27**	**230**	**470**	**700**

	Course Code	Course
#ELE-1	M17 CAD 1105	Computational Methods in Engineering
	M17 CAD 1106	Theory of Elasticity & Plasticity
	M17 CAD 1107	Nano Technology
#ELE-2	M17 CAD 1108	Design for Manufacturing & Assembly
	M17 CAD 1109	Mechatronics
	M17 CAD 1110	Computer Aided Process Planning

Code: M17 CAD 1101

INDUSTRIAL ROBOTICS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVE:

1. To familiarize the students with anatomy, kinematics, sensors and dynamics of a programmable machine of a robot.

COURSE OUTCOMES:

Students will be able to

1. Distinguish between fixed automation and programmable automation.
2. Identify various components of robot.
3. Select appropriate type of actuator for a joint.
4. Illustrate robot applications in manufacturing.
5. Analyze kinematics of a robot.
6. Derive equations of motion of a manipulator for a particular application.

SYLLABUS

UNIT - I

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation scheme, work volume, robot drive systems, control systems and dynamic performance, precision of movement.

CONTROL SYSTEM AND COMPONENTS: basic concepts and motion controllers, control system analysis, robot actuation and feedback components, Positions sensors, velocity sensors, actuators, power transmission systems, robot joint control design.

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation, forward and inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

MACHINE VISION: Functions, Sensing and Digitizing-imaging devices, Lighting techniques, Analog to digital single conversion, image storage: Image processing and Analysis-image data reduction, Segmentation, feature extraction, Object recognition. Training the vision system, Robotic application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot program as a path in space, Motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching, capabilities and Limitations of lead through methods.

ROBOT LANGUAGES: Textual robot Languages, Generations of robot programming languages, Robot language structures, Elements and function.

UNIT - V

ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detection, Work cell controller.

ROBOT APPLICATION: Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.

TEXT BOOKS:

1. Industrial Robotics /Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.

REFERENCE BOOKS:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall.
3. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley
5. Introduction to Robotics by SK Saha, The McGrah Hill Company, 6th, 2012.
6. Robotics and Control / Mittal R K & Nagrath I J / TMH.

Code: M17 CAD 1102

COMPUTER AIDED MANUFACTURING

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To understand the importance of NC and CNC technology in manufacturing industry.
2. To understand the application of CAD/CAM systems in generating Part Programmes, in particular for complex models.
3. To understand and apply the use of various transducers, Micro controllers encoders and feedback devices.
4. To understand the importance of computer Aided Process Planning in CAM.

COURSE OUTCOMES:

Students will be able to

1. Understand the principles of Numerical Control (NC) technology and describe the range of machine tools to which it is applied.
2. Outline the various routs for part programming in NC and CNC.
3. Explain the application of CNC for Machining & Turning Centers.
4. Apply the use of various transducers, Micro controllers encoders and feedback devices in CAM.
5. Apply the principles of Computer Aided Process Planning in CAM.

SYLLABUS

UNIT - I

COMPUTER AIDED PROGRAMMING: General information, APT programming, Examples Apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path generation.

UNIT - II

TOOLING FOR CNC MACHINES: Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

UNIT - III

POST PROCESSORS FOR CNC: Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP —based- Post Processor: Communication channels and major variables in the DAPP —based Post Processor, creation of a DAPP — Based Post Processor.

UNIT - IV

MICRO CONTROLLERS: Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications and Programming of Micro Controllers. Programmable Logic Controllers (PLC' s): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

UNIT - V

COMPUTER AIDED PROCESS PLANNING: Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.

TEXT BOOKS:

1. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill. 1983.
2. CAD/CAM Principles and Applications, P.N.Rao, TMH

REFERENCES:

1. Computer Aided Design Manufacturing – K. Lalit Narayan, K. Mallikarjuna Rao and
2. M.M.M. Sarcar, PHI, 2008.
3. CAD / CAM Theory and Practice,/ Ibrahim Zeid,TMH.
4. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age.
5. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson.
6. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

Code: M17 CAD 1103

SPECIAL MANUFACTURING PROCESSESS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To teach the students to understand the fundamentals of manufacturing and prototyping for product design and development.
2. To teach the students to gain practical experience in manufacturing and prototyping for product design and development.
3. To teach the students to develop ability to apply up-to-date technology in manufacturing products with considerations of safety and environmental factors.

COURSE OUTCOMES:

1. Describe the principle and operation of common manufacturing and rapid prototyping processes for product development.
2. Decide on the use of appropriate manufacturing processes in the manufacture of a product at the design stage.
3. Apply up-to-date technology in manufacturing products with considerations of safety and environmental factors.
4. Apply the reverse engineering process for product development.
5. Appreciate and report on the common practice in the product development industry.
6. Develop a prototype with modern prototyping techniques.

SYLLABUS

UNIT-I

SURFACE TREATMENT: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT- II

PROCESSING OF CERAMICS: Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT- III

FABRICATION OF MICROELECTRONIC DEVICES: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

UNIT - IV

ADVANCED MACHINING PROCESSES: EDM, WireEDM, ECM, LBM, EBM, AJM, WJM – Principle, working, limitations and applications.

UNIT -V

RAPID PROTOTYPING: Working Principles, Methods, Stereo Lithography, Laser Sintering, Fused Deposition Method, Applications and Limitations, Rapid tooling, Techniques of rapid manufacturing

TEXT BOOKS:

1. Manufacturing Engineering and Technology *I* Kalpakijian / Adisson Wesley, 1995.
2. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.

REFERENCE BOOKS:

1. Microelectronic packaging handbook / Rao. R. Thummala and Eugene, J. Rymaszewski /Van Nostrand Renihold.
2. MEMS & Micro Systems Design and manufacture / Tai — Run Hsu / TMGH.
3. Advanced Machining Processes / V.K.Jain / Allied Publications.
4. Introduction to Manufacturing Processes / John A Schey *I* Mc Graw Hill.

Code: M17 CAD 1104

GEOMETRIC MODELLING

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To highlight the importance of geometric modeling in design and manufacturing.

COURSE OUTCOMES:

Students will be able to

1. Use various mathematical equation to represent curves.
2. Apply the cubic splines in modeling of a product.
3. Select appropriate synthetic curves in modeling process.
4. Implement the surface modeling for design of various consumer products.

SYLLABUS

UNIT - I

Cubic splines –I Definition, Explicit and implicit equations, parametric equations, Algebraic and geometric form of cubic spline, Hermite cubic spline, tangent vectors, parametric space of a curve, blending functions.

UNIT - II

Cubic Splines-II: Four point form, reparametrization, truncating and subdividing of curves. Graphic construction and interpretation, composite pc curves.

Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.

UNIT - III

B-Spline Curves: B-Spline basis, equations, knot vectors, properties, and derivatives.

UNIT – IV

Surfaces: Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.

UNIT – V

Solids: Tricubic solid, Algebraic and geometric form.

Solid modeling concepts: Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

TEXT BOOKS:

1. Elements of Computer Graphics by Roger & Adams Tata McGraw Hill.
2. Geometric Modeling by Micheal E. Mortenson, McGraw Hill Publishers

REFERENCE BOOK:

1. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers

Code: M17 CAD 1105

COMPUTATIONAL METHODS IN ENGINEERING
(ELECTIVE-I)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To know how to solve system of equations, ordinary differential equations
2. and partial differential equations numerically
3. To understand correlation and regression.
4. Approximating data using mathematical functions.

COURSE OUTCOMES:

Students will be able to

1. Find the solutions of system of linear and non linear equations.
2. Solve ordinary and partial differential equations numerically.
3. Find correlation coefficient and regression.
4. Use a computer language of their choice to solve problems using numerical methods covered in the course.

SYLLABUS

UNIT – I

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations. Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression -computer programs.

UNIT – II

Boundry value problems and charecteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

UNIT – III

Transformation Techniques: Continuous fourier series, frequency and time domains, laplace transform, fourier integral and transform, discrete fourier transform (DFT), Fast fourier transform (FFT).

UNIT – IV

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation –Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

UNIT – V

Partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria. Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale "Numerical Methods for Engineers" Tata Mc-Graw Hill
2. Curtis F.Gerald, Partick.O.Wheatly,"Applied numerical analysis"Addison-Wesley,1989.
3. Douglas J.Faires,Riched Burden"Numerical methods", Brooks/Cole publishing company,1998.Second edition.

REFERENCE BOOKS:

1. Ward Cheney and David Kincaid "Numerical mathematics and computing" Brooks/Cole publishing company1999, Fourth edition.
2. Riley K.F,. M.P.Hobson and Bence S.J,"Mathematical methods for physics and engineering", Cambridge University press,1999.
3. Kreysis, Advanced Mathematics

Code: M17 CAD 1106

THEORY OF ELASTICITY & PLASTICITY
(ELECTIVE-I)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To understand the theory of stress, strain and plasticity and enlighten the advances in plasticity and plastic strain analysis.
2. To obtain the stress strain relation within the elastic body and find the principle stress and strain for a different types of elastic body.
3. To known yield criteria for ductile metal and to understand the plastic stress-strain relations and learn Upper and lower bound theorems and corollaries.

COURSE OUTCOMES:

After Completion of this course students will be able to

1. Understand the stress and strain tensor field.
2. Understand the contact stresses analysis problem in bearing.
3. Understand advanced concepts of plasticity and plastic deformation analysis
4. Students can demonstrate Idealized stress-strain diagrams for different material models and demonstrate experimental verification of the Prandtl-Reuss equation.

SYLLABUS

UNIT-I

Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions. Problem in Rectangular Coordinates - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems. Problems in Polar Coordinates - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT-II

Analysis of Stress and Strain in Three Dimensions: Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain. General Theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

UNIT-III

Bending of Prismatic Bars: Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

UNIT-IV

Plasticity: Plastic deformation of metals - Structure of metals - Deformation - Creep stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of constant strain energy - Approximate equation of plasticity.

UNIT-V

Methods of Solving Practical Problems: The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

TEXT BOOKS:

1. Theory of Elasticity/Timoshenko S.P. and Goodier J.N./Koakusha Publishers
2. An Engineering Theory of Plasticity/E.P. Unksov/Butterworths
3. Applied Elasticity/W.T. Wang/TMH

REFERENCE BOOKS:

1. Theory of Plasticity for Engineers/Hoffman and Sacks/TMH
2. Theory of Elasticity and Plasticity/Sadhu Singh/ Khanna Publishers
3. Theory of Elasticity and Plasticity/Harold Malcolm Westergaard/Harvard University. Press

Code: M17 CAD 1107

NANO TECHNOLOGY
(ELECTIVE-I)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. This course introduces to the fundamentals of nano-scale engineering and manufacturing.
2. Current and future applications of nanostructured materials will be reviewed with respect to their impact in commercial products and technologies.
3. Well-established and novel synthesis/fabrication methods nanostructures will be discussed giving a broad overview of nanomanufacturing processes.
4. Standard characterization methods will be elucidated using various examples

COURSE OUTCOMES:

Upon successful completion of this course, students should be able to:

1. Understand the fundamental principles of nanotechnology and their application.
2. Apply engineering and physics concepts to the nano-scale and non-continuum domain.
3. Demonstrate a comprehensive understanding of nano-fabrication methods.
4. Evaluate processing conditions to engineer functional nanomaterials.
5. Practice and explain state-of-the-art characterization methods for nanomaterials, understanding and critiquing nanomaterial safety and handling methods required during characterization

SYLLABUS

UNIT-I

Introduction, Size and shape dependence of material properties at the nanoscale, scaling relations, can nanorobots walk and nanoplanes fly, Nano scale elements in conventional technologies, Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, nano machines, Nano fluidics, filtration, sorting, Molecular motors, Application of Nano Technology.

UNIT-II

Nano material Synthesis Techniques: Top-down and bottom-up nanofabrication, Synthesis of nano composites, The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, nano coatings and nano indentation, Electron beam lithography, Soft lithography: nanoimprinting and micro-contact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

UNIT-III

Imaging/characterization of nanostructures General considerations for imaging, Scanning probe techniques: XRD, SEM, TEM, AFM and NSOM.

UNIT-IV

Metal and semiconductor nanoparticles Synthesis, stability, control of size, Optical andelectronic properties, Ultra-sensitive imaging and detection with nano particles, bioengineering applications, Catalysis. Semiconductor and metal nanowires Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

UNIT-V

Carbon nanotubes, Structure and synthesis, Electronic, vibrational, and mechanical properties, How can C nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement?

TEXT BOOKS:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005).
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

REFERENCE BOOKS:

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003) Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing (2006).

Code: M17 CAD 1108

DESIGN FOR MANUFACTURING & ASSEMBLY
(ELECTIVE-II)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. Introduce design principles, properties of materials, fits and tolerances and datum features.
2. Understand the influence of materials on form design and able to select possible material and feasible design.
3. Introduce design features to facilitate machining and design for mach inability, economy, accessibility and assembly.
4. Know about redesign of castings, modifying the uneconomical design, group technology and applications of DFMA.
5. Understand the Environmental objectives and issues and to design considering them.

COURSE OUTCOMES

The students who attend to this course

1. Select the design principle, suitable material, mechanism, fit and tolerance for designing a product/component.
2. Select the appropriate material, proper working principle and a feasible design.
3. Design (optimum) a component which requires less material removal, easy to machine, assemble, access and cost effective.
4. Redesign the uneconomical casting design and know the applications of DFMA.
5. Incorporate the Environmental Objectives, issues and guidelines into the design.

SYLLABUS

UNIT - I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA,What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

UNIT - II

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT - III

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT - IV

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.

TEXT BOOKS:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla

REFERENCE BOOK:

1. ASM Hand book Vol.20

Code: M17 CAD 1109

MECHATRONICS
(ELECTIVE-II)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To develop an ability to identify, formulate, and solve engineering problems.
2. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
3. To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

COURSE OUTCOMES:

Upon completion of this course, students should able to:

1. Model and analyze electrical and mechanical systems and their interconnection.
2. Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.
3. Do the complete design building, interfacing and actuation of a mechatronic system for a set of specifications.

SYLLABUS

UNIT-I

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT-II

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

UNIT-III

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems, Mechanical actuating systems and electrical actuating systems.

UNIT-IV

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-V

System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

TEXT BOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008.
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.

REFERENCE BOOKS:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
3. Mechatronics System Design / Devdas shetty/Richard/Thomson.
4. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
5. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton
6. Mechatronics – Principles and Application Godfrey C. Onwubolu, Wlsevier, 2006 Indian print

Code: M17 CAD 1110

COMPUTER AIDED PROCESS PLANNING
(ELECTIVE-II)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

To make the student understand

1. Fundamentals of computer aided process planning, group technology and applications
2. Simulation of machining processes, importance of design and manufacturing tolerances
3. Role of optimal selection of machining parameters

COURSE OUTCOMES:

1. Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation.
2. Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence.
3. Predict the effect of machining parameters on production rate, cost and surface quality and determines the manufacturing tolerances.
4. Explain the generation of tool path and solve optimization models of machining processes.
5. Create awareness about the implementation techniques for CAPP

SYLLABUS

UNIT - I

Introduction to CAPP: Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.

UNIT - II

Generative CAPP system: Importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

Retrieval CAPP system: Significance, group technology, structure, relative advantages, implementation, and applications.

UNIT – III

Selection of manufacturing sequence: Significance, alternative manufacturing processes, reduction of total set-up cost for a particular sequence, quantitative methods for optimal selection, examples.

Determination of machining parameters: reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

UNIT –IV

Determination of manufacturing tolerances: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach**,** integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

UNIT –V

Generation of tool path: Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative methods.

Implementation techniques for CAPP: MIPLAN system, Computer programming languages for CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

TEXT BOOKS:

1. Computer Aided Process Planning – Joseph Tulkoff, SME Publications
2. Computer Aided Process Planning – Hsu-Pin Wang, Jian-Kang Li, Elsevier

REFERENCE BOOKS:

1. Automation , Production systems and Computer Integrated Manufacturing System – Mikell P.Groover.
2. Computer Aided Design and Manufacturing – Dr.Sadhu Singh.
3. Computer Aided Engineering – David Bedworth

Code: M17 CAD 1111

COMPUTER AIDED DESIGN LAB

Lab	**: 3 Periods**	**Int.Marks**	**: 50**
Exam	**: 3 Hrs**	**Ext. Marks**	**: 50**
		Credits	**: 2**

COURSE OBJECTIVES:

1. To impart training on SOLID WORKS for modelling of engine and automobile parts.
2. To impart training on ANSYS software for analyzing engineering problems.

COURSE OUTCOMES:

Students will be able to

1. Model the automobile parts using modelling package like SOLID WORKS
2. Analyze different engineering problems using ANSYS software

SYLLABUS

2D and 3D modelling and assembly modelling using modelling packages like AutoCAD, Auto Desk Mechanical desktop, Pro-Engineer, IDEAS.

Linear and non-linear static and dynamic analysis using any FEA package ANSYS / CAEFEM / NASTRAN.

REFERENCE BOOKS:

1. Solid Works Reference Guide by CADD Centre.
2. CAD/CAM Theory and Practice by Ibrahim Zeid.
3. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.
4. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
5. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R17)

M.TECH (CAD/CAM)

DEPARTMENT OF MECHANICAL ENGINEERING

(With effect from **2017-2018** Admitted Batch onwards**)**
Under Choice Based Credit System

II-SEMESTER

Code No.	Name of the Subject	Credits	Lec-ture Hrs	Tutorial Hrs	Lab Hrs	Contact Hrs/ Week	Internal Marks	External Marks	Total Marks
M17 CAD 1201	Modeling & Simulation of Manufacturing Systems	3	3	1	--	4	30	70	100
M17 CAD 1202	Optimization & Reliability	3	3	1	--	4	30	70	100
M17 CAD 1203	Computer Graphics	3	3	1	--	4	30	70	100
M17 CAD 1204	Finite Element Methods	3	3	1	--	4	30	70	100
#ELE-3	Elective-III	3	3	1	--	4	30	70	100
#ELE-4	Elective-IV	3	3	1	--	4	30	70	100
M17 CAD 1211	Computer Aided Manufacturing Lab	2	--	--	3	3	50	50	100
Total		**20**	**18**	**6**	**3**	**27**	**230**	**470**	**700**

	Course Code	Course
#ELE-3	M17 CAD 1205	Quality Engineering in Manufacturing
	M17 CAD 1206	Mechanical Vibrations
	M17 CAD 1207	Concurrent Engineering
#ELE-4	M17 CAD 1208	Mechanics & Manufacturing Methods of Composites
	M17 CAD 1209	Materials Technology
	M17 CAD 1210	Intelligent Manufacturing Systems

Code: M17 CAD 1201

MODELLING AND SIMULATION OF MANUFACTURING SYSTEMS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To provide knowledge on simulation, simulation steps, parameter estimation and hypothesis.
2. To provide knowledge on building simulation model how to validation and verification is done.
3. To provide knowledge on Generation of random variants, variable and some Simulation languages.
4. To provide knowledge on some Applications of Simulation

COURSE OUTCOMES:

1. Students gain knowledge on various types of simulation and simulation languages steps in simulation and applications of simulation.
2. Students gain knowledge on parameter estimation and hypothesis.
3. Students can build simulation model and also can validation and verify model.
4. Students can gain knowledge on Generation of random variants and variables.

SYLLABUS

UNIT-I

Introduction to System and simulation: Concept of system and elements of system, Discrete and continuous system, Models of system and Principles of modeling and simulation, Monte carlo simulation, Types of simulation, Steps in simulation model, Advantages, limitations and applications of simulation, Applications of simulation in manufacturing system.

UNIT-II

Review of statistics and probability: Types of discrete and continuous probability distributions such as Geometric, Poisson, Uniform, Geometric distribution with examples, Normal, Exponential distribution with examples.

UNIT-III

Random numbers: Need for RNs, Technique for Random number generation such as Mid product method, Mid square method, and Linear congruential method with examples Test for Random numbers: Uniformity - Chi square test or Kolmogorov Smirnov test, Independency-Auto correlation test Random Variate generation: Technique for Random variate generation such as Inverse transforms technique or Rejection method.

UNIT-IV

Analysis of simulation data: Input data analysis, Verification and validation of simulation models, Output data analysis Simulation languages: History of simulation languages, Comparison and selection of simulation languages Design and evaluation of simulation experiments: Development and analysis of simulation models using simulation language with different manufacturing systems.

UNIT-V

Queueing models: An introduction, M/M/1 and M/M/m Models with examples, Open Queueing and Closed queueing network with examples

Markov chain models and others: Discrete time markov chain with examples, Continues time markov chain with examples, stochastic process in manufacturing, Game theory.

TEXT BOOKS:

1. J.Banks, J.S. Carson, B. L. Nelson and D.M. Nicol, “Discrete Event System Simulation”, PHI, New Delhi, 2009.
2. A.M. Law and W.D.Kelton, “Simulation Modeling and Analysis”, Tata McGraw Hill Ltd, New Delhi, 2008.

REFERENCE BOOK:

1. N. Viswanadham and Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", PHI, New Delhi, 2007.

Code: M17 CAD 1202

OPTIMIZATION & RELIABILITY

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

1. Have a basic understanding of conventional, unconventional optimization algorithms and concepts of reliability.
2. Formulate engineering design problems as mathematical optimization problems and solve them by using suitable optimization technique(s).
3. Use mathematical software for the solution of engineering problems.
4. Several homework assignments delving on core concepts and reinforcing analytical skills learned in class.

SYLLABUS

UNIT - I

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions, merits and demerits of classical optimization techniques.

UNIT - II

NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods.

UNIT - III

GENETIC ALGORITHM (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

GENETIC PROGRAMMING (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

MULTI-OBJECTIVE GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems

UNIT – IV

APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

UNIT V

RELIABILITY: Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, hazard analysis.

TEXT BOOKS:

1. Engineering Optimization – S.S.Rao, New Age Publishers
2. Reliability Engineering by L.S.Srinath

REFERENCE BOOKS:

1. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
2. Multi objective genetic algorithm by Kalyanmoy Deb, PHI Publishers.

Code: M17 CAD 1203

COMPUTER GRAPHICS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. This course is designed to provide a comprehensive introduction to computer graphics leading to the ability to understand contemporary terminology, progress, issues, and trends.
2. A thorough introduction to computer graphics techniques, line clipping, polygon clipping, rendering, shading algorithms and computer animation.
3. The interdisciplinary nature of computer graphics is emphasized in the wide variety of examples and applications.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to

1. Understand the contemporary graphics hardware and terminology.
2. Implement graphics primitives, line clipping, polygon clipping, rendering and shading algorithms.
3. Design and implement an application which illustrates the use of output primitives and 3D viewing model.
4. Gain knowledge on computer animation and multimedia tools used for the computer representation of objects.

SYLLABUS

UNIT - I

Raster scan graphics: Raster scan and random scan architecture, Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.

Filling algorithms: polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

UNIT - II

Line CLIPPING: Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, midpoint sub division algorithm.

Polygon clipping: polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.

UNIT - III

Rendering: Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Zbuffer algorithm.

Shading algorithms: Constant intensity algorithm, Phong's shading algorithm, gourand shading algorithm, Comparison of shading algorithms.

UNIT - IV

Computer Animation: Design of animation sequence, general computer animation functions, raster animation, computer animation language, key frame system, motion specification.

UNIT – V

Introduction to Multimedia: Introduction, multimedia- systems, technology, architecture, trade-offs, contents, PC, Applications, data compressions, authoring system.

Multimedia Authoring Tools: Introduction, Types of authoring tools, Package based- in card authoring tools, Icon based authoring tools, Time based and presentation tools, object oriented authoring tools, author ware professional for windows (APW).

TEXT BOOKS:

1. Procedural elements for computer graphics-D.F.Rogers, Tata McGraw-Hill.
2. Computer graphics-Harrington.

REFERENCE BOOK:

1. Computer Graphics-Donald Hearn & M.P. Bakers.

Code: M17 CAD 1204

FINITE ELEMENT METHODS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To introduce the concepts of finite element method to solve engineering problems.

COURSE OUTCOMES:

Students will be able to

1. Apply variational and weighted residual methods to solve differential equations.
2. Analyze 1-D bar, truss, beam and heat conduction problems using finite element method.
3. Develop finite element formulations and solve 2-D structural problems using triangular and rectangular elements.
4. Analyze vibration problems for frequencies and mode shapes.

SYLLABUS

UNIT - I

Formulation Techniques: Methodology, Engineering problems and governing differential equations , finite elements, Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT – II

One-dimensional elements: Bar, trusses, beams and frames, displacements, stresses and temperature effects.

UNIT – III

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions.

UNIT – IV

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration, Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle, Patch test.

Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

UNIT – V

Finite elements in Structural Analysis: Static and dynamic analysis, eigen value problems, and their solution methods, case studies using commercial finite element packages.

TEXT BOOK:

1. Finite element methods by Chandrupatla & Belagundu.

REFERENCE BOOKS:

1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press,1994.
2. Zienckiwicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill,1983.
3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996.

Code: M17 CAD 1205

QUALITY ENGINEERING MANUFACTURING
(ELECTIVE-III)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

To make the student understand

1. Quality standards and need for standardization
2. Development and implementation of quality measurement systems
3. Application of six sigma approach to various industrial situations
4. Concept of Analysis of Variance, Orthogonal Arrays and statistical methodology.

COURSE OUTCOMES:

The student will be able to

1. Explain quality standards and need for standardization
2. Implement quality measurement systems in various applications
3. Implement six sigma approach for various industrial applications
4. Gain knowledge on Analysis of Variance, Orthogonal Arrays and statistical methodology.

SYLLABUS

UNIT - I

QUALITY VALUE AND ENGINEERING: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type,Stype and L-type)

UNIT II:

TOLERANCE DESIGN AND TOLERANCING: Functional limits, tolerance design for Ntype. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT – III

ANALYSIS OF VARIANCE (ANOVA): Introduction to ANOVA, Need for ANOVA, NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT - IV

ORTHOGONAL ARRAYS: Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT - V

SIX SIGMA AND THE TECHNICAL SYSTEM: Six sigma DMAIC methodology, tools for process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

TEXT BOOK:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill/ Intl. II Edition, 1995.

REFERENCE BOOKS:

1. Quality Engineering in Production systems by G. Taguchi, A. Elsayed et al, McGraw Hill Intl. Pub. 1989.
2. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi Prentice Hall Pvt. Ltd., New Delhi.

Code: M17 CAD 1206

MECHANICAL VIBRATIONS
(ELECTIVE-III)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To gain the knowledge of mathematical modeling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
2. To study the response of a vibrating system with periodic excitation and understand the principle of vibration isolation.
3. To develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.

COURSE OUTCOMES:

Students will be able to

1. Develop a mathematical model for a physical system and derive the governing differential equations.
2. Determine the natural frequencies of single and two degrees of freedom systems without and with damping.
3. Determine and analyze the response of machine members or structures in forced vibration with different excitation frequencies.
4. Apply the techniques of vibration isolation to minimize the transmission of vibrating forces.
5. Determine the natural frequencies and mode shapes of bars in elongation and torsion and beams in bending.

SYLLABUS

UNIT- I

Single degree of Freedom systems: Undamped and damped free vibrations: forced vibrations ; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation,Vibration isolation and transmissibility, Vibrometers, velocity meters & accelerometers.

UNIT- II

Response to Non Periodic Excitations: unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT-III

Multi degree freedom systems: Principal modes – undamped and damped free and forced vibrations; undamped vibration absorbers, Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems; Discrete-Time systems.

UNIT IV

Numerical Methods: Rayliegh's, Stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods

UNIT V

Application of concepts: Free vibration of strings – longitudinal oscillations of bars- transverse vibrations of beams- Torsional vibrations of shafts. Critical speeds without and with damping, secondary critical speed.

TEXT BOOKS:

1. Elements of Vibration Analysis by Meirovitch.
2. Mechanical Vibrations by G.K. Groover.

REFERENCE BOOKS:

1. Vibrations by W.T. Thomson
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S.P. Timoshenko.
4. Mechanical Viabrations – V.Ram Murthy.

Code: M17 CAD 1207

CONCURRENT ENGINEERING
(ELECTIVE-III)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To study about concurrent engineering.
2. To learn about applications of concurrent engineering in product design and manufacturing.
3. To learn about automation of assembly workstations & fabrication systems.

COURSE OUTCOMES:

Upon completion of this course, students should able to:

1. Understand the concepts of concurrent engineering and its application in design and manufacturing of a product
2. Know how to solve issues arising during design and manufacturing of a product
3. Understand the importance of tolerances in product design and manufacturing
4. Understand how to automate a work station & fabrication system.
5. Understand the importance of human resource management

SYLLABUS

UNIT I:

INTRODUCTION

Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development

USE OF INFORMATION TECHNOLOGY

IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

UNIT II:

DESIGN STAGE

Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design –Automated analysis idealization control - Concurrent engineering in optimal structural design -Real time constraints.

UNIT III:

MANUFACTURING CONCEPTS AND ANALYSIS

Manufacturing competitiveness - Checking the design process - conceptual design mechanism –Qualitative, physical approach - An intelligent design for manufacturing system

UNIT IV:

JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.

PROJECT MANAGEMENT

Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost

UNIT V

Concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

TEXT BOOKS:

1. Integrated Product Development / Anderson MM and Hein, L. Berlin, Springer, 1987.
2. Concurrent Engineering: Automation Tools and Technology / Andrew Kusaik, John Wiley.

REFERENCE BOOKS:

1. Design for Concurrent Engineering / Cleetus, J, Concurrent Engg. Research Centre, Morgantown, WV, 1992.
2. Concurrent Engineering Fundamentals: Integrated Product Development/ Prasad, Prentice Hall, 1996.
3. Successful Implementation of Concurrent Product and Process / Sammy G Sinha, Wiley, John and Sons Inc., 1998.

Code: M17 CAD 1208

MECHANICS & MANUFACTURING METHODS OF COMPOSITES

(ELECTIVE-IV)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. Study the types of fibers and their structure and behaviors.
2. Study the mathematical analysis of stresses acting on the composites.
3. Expose to the various manufacturing processes & testing methods of Composites.
4. Understand the design principles of composites

COURSE OUTCOMES:

After Completion of this course students will be able to

1. Gain knowledge on fiber characteristics and methods of production of fibers1
2. Identify the suitable composite manufacturing process when designing intricate and critical parts made of composites
3. Analyse the elastic behaviour of composites and composite laminated plates.
4. Gain knowledge on the failure of composites and the production of quality composites.

SYLLABUS

UNIT – I

Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites, Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT – II

Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

Coordinate transformations: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

UNIT – III

Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micro mechanical predictions of elastic constants.

UNIT – IV

Analysis of laminated composite plates

Introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

UNIT – V

Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, hand layup, pultrusion, RTM.

TEXT BOOKS:

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M.Daniel, Oxford University Press, 1994.

REFERENCE BOOKS:

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

Code: M17 CAD 1209

MATERIALS TECHNOLOGY

(ELECTIVE-IV)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVE:

1. To understand the relationship between the structure, properties, processing, testing and applications of strengthening mechanism, modern metallic, smart, non-metallic, advanced structural ceramic and composite materials so as to identify and select suitable materials for various engineering applications.

COURSE OUTCOMES:

Students will be able to

1. Gain knowledge on mechanism of plastic deformation and strengthening mechanism.
2. Learn the structure, properties and applications of modern metallic materials, smart materials non-metallic materials and advanced structural ceramics.
3. Understand the importance of advanced composite materials in application to sophisticated machine and structure of components.

SYLLABUS

UNIT I:

Elasticity in metals, mechanism of plastic deformation, slip and twinning, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, Yield criteria: Von-mises and Tresca criteria.

UNIT II:

Griffth's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller parameter, Deformation and Fracture mechanism maps.

UNIT III:

Fatigue, fatigue limit, features of fatigue fracture,Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis. Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep.

UNIT IV:

MODERN METALLIC MATERIALS: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides. Processing and applications of Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

UNIT V:

NONMETALLIC MATERIALS: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, A12O3, SiC, Si3N4, CBN and Diamond – properties, Processing and applications.

TEXT BOOKS:

1. Mechanical Behavior of Materials/Thomas H. Courtney/ McGraw Hill/2 nd Edition/2000
2. Mechanical Metallurgy/George E. Dicter/McGraw Hill, 1998.

REFERENCE BOOKS:

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.
2. Engineering Materials Technology/James A Jacob Thomas F Kilduff/Pearson
3. Material Science and Engineering/William D Callister/John Wiley and Sons
4. Plasticity and plastic deformation by Aritzur.
5. Introduction to Ceramics, 2nd Edition by W. David Kingery, H. K. Bowen, Donald R. Uhlmann.

Code: M17 CAD 1210

INTELLIGENT MANUFACTURING SYSTEMS
(ELECTIVE-IV)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To understand the importance of intelligence in manufacturing systems, so as to apply the artificial intelligence in the application of manufacturing.

COURSE OUTCOMES:

1. Students will get knowledge on Computer Integrated Manufacturing Systems and Manufacturing Communication Systems.
2. Students will be able to learn the Components of Knowledge Based Systems, Machine Learning and Knowledge Based System for Equipment Selection.
3. Students will be able to understand and solve the group technology problems by using knowledge based system.

SYLLABUS

UNIT I:

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: structure and functional areas of cim system- CAD, CAPP, **CAM,** CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP/TOP, OSI Model, Data Redundancy, Top-down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

UNIT II:

COMPONENTS OF KNOWLEDGE BASED SYSTEMS - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT III:

MACHINE LEARNING - Concept of Artificial Intelligence, Conceptual Learning, Artificial, Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT IV:

AUTOMATED PROCESS PLANNING - Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT V:

GROUP TECHNOLOGY: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

TEXT BOOKS:

1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ Yagna Narayana/PHI/2006.

REFERENCE BOOK:

1. Automation, Production Systems and CIM / Groover M.P./PHI/2007.

Code: M17 CAD 1211

COMPUTER AIDED MANUFACTURING LAB

Lab	**: 3 Periods**	**Int. Marks**	**: 50**
Exam	**: 3 Hrs**	**Ext. Marks**	**: 50**
		Credits	**: 2**

COURSE OBJECTIVES:

1. To give a job oriented training on the CNC Lathe and CNC Milling Machine.
2. To study programming and machining on CNC Lathe and CNC Milling.
3. To study select/apply/implement tooling, machine setting, work holding techniques etc. along with basic maintenance.

COURSE OUTCOMES:

Students will be able to

1. Illustrate the importance of NC and CNC technology in manufacturing industry.
2. Generate Part Programming with application of CAD/CAM systems in particular for complex models.
3. Identify and select proper NC toolings

SYLLABUS

Manual and computer assisted part programming exercises on CNC machine tools.
Surface generation, Tool selection, NC code generation and Tool path simulation for turning and milling operations using CAM packages like CATIA, Gibbs CAM, Master CAM.
Robot programming off-line and on-line.

REFERENCE BOOKS:

1. Numerical Control and Computer Aided Manufacturing by T.K. Kundra, P.N. Rao and N.K. Tewari, Tata McGraw-Hill Company Limited, New Delhi.
2. Numerical Control of Machine Tools by Yoram Koren and Joseph Ben-Uri, Khanna Publishers, Delhi.
3. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R17)

M.TECH (CAD/CAM)

DEPARTMENT OF MECHANICAL ENGINEERING

(With effect from **2017-2018** Admitted Batch onwards**)**
Under Choice Based Credit System

III-SEMESTER

Course Code	Course	Scheme of Examination	C	Int	Ext	Total
M17 CAD 2101	Comprehensive Viva-Voce	Viva-Voce	2	50	-	50
M17 CAD 2102	Seminar-I	Oral Presentation	2	50	-	50
M17 CAD 2103	Project Work Part-I	Review	16	50	-	50
		Total	20	150	-	150

1. The Viva-Voce for the Comprehensive Viva-Voce and Seminar-I shall be held with the Project Guide, PG coordinator, and Head of the Department. The marks shall be awarded in the ratio of 20, 10 and 20 Marks by the members respectively
2. Candidates can do their Project Work Part-I&II work within the department or in any industry/research organization for two semesters (i.e. 3rd and 4th semesters). In case of thesis done in an industry/research organization, one advisor (Guide) should be from the department and one advisor (Co-Guide) should be from the industry/research organization.
3. The Project Work Part-I should be submitted at the end of 3rd Semester and it will be evaluated through Review by a committee consisting of Head of the Department, PG coordinator and Project guide. The marks shall be awarded in the ratio of 20, 10 and 20 Marks by the members respectively.

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M.TECH (CAD/CAM)

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IV-SEMESTER

Course Code	Course	Scheme of Examination	C	Int	Ext	Total
M17 CAD 2201	Seminar-II	Oral presentation	2	50	-	50
M17 CAD 2202	Project Work Part-II	Viva-voce	18		100	100
		Total	20	50	100	150

1. The viva-voce for Seminar-II shall be held with the Project Guide, PG coordinator, and Head of the Department. The marks shall be awarded in the ratio of 20, 10 and 20 Marks by the members respectively.
2. A publication of a paper on the thesis work in a National/International Journal at the end of 4^{th} semester is mandatory for the submission of thesis work.
3. The Project Work Part-II should be submitted at the end of 4th semester and it will be evaluated through Viva–Voce examination by a committee consisting of External Examiner, Head of the Department, Project guide and PG coordinator. The marks shall be awarded in the ratio of 40, 20, 20 and 20 Marks by the members respectively.