R18

M.Tech. (CAD/CAM)

M.Tech. R18 CBCS Curriculum

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous, ISO 9001:2015 & QS I-Gauge Diamond Rated Institute, Accredited by NAAC with 'A++' Grade
NBA Accreditation for B.Tech. CE, EEE, ME, ECE, CSE, EIE, IT Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH, NIRF 127 Rank in Engineering Category
Recognized as "College with Potential for Excellence" by UGC
Vignana Jyothi Nagar, Pragathi Nagar, Nizampet (S.O), Hyderabad – 500 090, TS, India.
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VISION OF THE INSTITUTE

To be a World Class University providing value-based education, conducting interdisciplinary research in cutting edge technologies leading to sustainable development of the nation

MISSION OF THE INSTITUTE

- To produce technically competent and socially responsible engineers, managers and entrepreneurs, who will be future ready.
- To involve students and faculty in innovative research projects linked with industry, academic and research institutions in India and abroad.
- To use modern pedagogy for improving the teaching-learning process.

DEPARTMENT OF

MECHANICAL ENGINEERING

VISION OF THE DEPARTMENT

To develop into a Centre of Excellence in Education and interdisciplinary research with cutting edge technologies in the field of Mechanical Engineering, consistent with the contemporary and future societal needs of the country

MISSION OF THE DEPARTMENT

- To impart high quality education by using modern pedagogical tools so as to make the students technically competent in their chosen fields.
- To inculcate quality research by developing linkages with Industry and R & D organizations in India & abroad for developing technically competent and socially responsible engineers, managers and entrepreneurs.

M.TECH.
(CAD/CAM)

M.TECH. (CAD/CAM)

PROGRAM EDUCATIONAL OBJECTIVES

PEO-I: To empower the students by providing necessary knowledge base, critical thinking and problem-solving capabilities in the field of Computer Aided Design & Computer Aided Manufacturing (CAD/CAM) and allied fields so that they can excel in their profession, in industry, higher studies and Research & Development.

PEO-II: To develop core competencies in the field of CAD/CAM, so as to conduct experiments, comprehend, analyze, design and use appropriate techniques and tools to provide optimal solutions for the industry related problems.

PEO-III: To inculcate the responsibility to the society at large by sensitizing regulatory and Intellectual Property related issues along with communication skills and to promote entrepreneurship with sufficient knowledge of project/ finance management techniques for ensuring their career success.

PEO-IV: To motivate the students not only to be excellent in academics, professional ethics, team work, leadership skills but also to be lifelong learners in upcoming technologies for successful professional career.

M.TECH. (CAD/CAM)

PROGRAM OUTCOMES

PO-1: Postgraduates will demonstrate their ability to acquire the state-of-the-art knowledge and to expand frontiers in the field of CAD/CAM Engineering.

PO-2: Postgraduates will demonstrate their abilities to analyze and evaluate complex engineering problems to make intellectual in CAD/CAM Engineering.

PO-3: Postgraduates will demonstrate the ability of problem-solving skills to find optimal solutions in the area of CAD /CAM Technologies including the considerations of public health, safety, cultural society and environmental problems.

PO-4: Postgraduates will demonstrate the ability to carry out literature survey, design, conduct of experiments and to analyze the results using appropriate research methodologies. They should also contribute scientific knowledge in CAD/ CAM areas either individually or in groups.

PO-5: Postgraduates will demonstrate ability to learn latest developments independently and continuously in the field of CAD/CAM Technology.

PO-6: Postgraduates shall acquire professional ethics and intellectual integrity in the consideration of impact of research outcomes for sustainable development of the society.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(CAD/CAM)

I SEMESTER **R18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-I	18PC1CD01	Finite Element Analysis	3	0	0	3
Professional Core-II	18PC1CD02	Advanced CAD	3	0	0	3
Professional Core-III	18PC1CD03	Rapid Prototyping	3	0	0	3
Professional Elective-I	18PE1AM03	Design for Manufacturing and Assembly	3	0	0	3
	18PC1AM01	Automation in Manufacturing				
	18PE1CD01	Product Design and Development Strategies				
Professional Elective -II	18PC1AM03	Precision Engineering	3	0	0	3
	18PE1CD02	Advanced Mechanisms and Analysis				
	18PE1AM04	Mechatronics				
Professional Core Lab-I	18PC2CD01	Computer Aided Design Laboratory	0	0	3	1.5
Professional Core Lab-II	18PC2CD02	Computer Aided Engineering Laboratory	0	0	3	1.5
Project	18PW4CD01	Technical Seminar	0	0	4	2
Audit	18AU5CS01	Research Methodology and IPR	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(CAD/CAM)

II SEMESTER **R18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-IV	18PC1CD04	Computer Aided Manufacturing	3	0	0	3
Professional Core-V	18PC1CD05	Industrial Robotics	3	0	0	3
Professional Core-VI	18PC1CD06	Additive Manufacturing Processes	3	0	0	3
Professional Elective-III	18PE1CD03	Flexible Manufacturing Systems	3	0	0	3
	18PE1CD04	Optimization Techniques				
	18PC1AM06	Quality Engineering in Manufacturing				
Professional Elective-IV	18PE1CD05	Computer Aided Process Planning	3	0	0	3
	18PE1CD06	Design of Experiments				
	18PE1AM07	Intelligent Manufacturing Systems				
Professional Core Lab-III	18PC2CD03	Digital Manufacturing Laboratory	0	0	3	1.5
Professional Core Lab-IV	18PC2CD04	Computer Aided Machining Laboratory	0	0	3	1.5
Project	18PW4CD02	Mini-Project	0	0	4	2
Audit	18AU5EN01	English for Academic and Research Writing	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. II YEAR COURSE STRUCTURE AND SYLLABUS

(CAD/CAM)

III SEMESTER **R18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Elective-V	18PE1CD07	Computer Integrated Manufacturing	3	0	0	3
	18PE1CD08	Reverse Engineering				
	18PE1AM08	Design for Hydraulic and Pneumatic Systems				
Open Elective	18OE1CN01	Business Analytics	3	0	0	3
	18OE1AM01	Industrial Safety				
	18OE1AM02	Operations Research				
	18OE1AM03	Composite Materials				
	18OE1PS01	Waste to Energy				
Project	18PW4CD03	Project Part - I	0	0	16	8
Total			**6**	**0**	**16**	**14**

IV SEMESTER **R18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Project	18PW4CD04	Project Part - II	0	0	28	14
Total			**0**	**0**	**28**	**14**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1CD01) FINITE ELEMENT ANALYSIS

COURSE PRE-REQUISITES: Numerical Methods, Engineering Mechanics, Solid Mechanics

COURSE OBJECTIVES:
- Understand the concept of Finite Element Method, Identify the areas of application of FEM and study the procedure
- Understand different methods of solving linear problems and differentiate them
- Understand the concept of FEM to solve basic non-linear problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the concepts of FEM to linear 1D, 2D and 3D problems.
CO-2: Solve simple non-linear problems numerically
CO-3: Perform analysis on a given problem using ANSYS

UNIT-I:
Introduction, Classification of problems – Dimensionality, time dependence, Boundary Value problems, Initial value problems, Linear/Non-linear, etc**,** Treatment of boundary conditions, Solution of system of equations

UNIT-II:
Differential equation as the starting point for FEM, steps in finite element method, discretization, types of elements used, Shape functions, Properties of stiffness matrix, Linear and quadratic Elements, Local and Global coordinates, Coordinate transformation and Gauss-Legendre scheme of numerical integration, Nodal degrees of freedom, Axially loaded members

UNIT-III:
Finite element formulation, variational, weighted residual and virtual work methods, 1-D and 2-D problems from Structural Mechanics – Bar, Beam, Plane stress and plane strain problems

UNIT-IV:
Axisymmetric problems – Axi-symmetric forces and geometry, Scalar field problems: 1-D Heat conduction, 1-D fin element, 2-D heat conduction, Problems, Introduction to Torsional problems.

UNIT-V:
Iso-parametric formulation, Quadrilateral element, sub parametric and super parametric elements. 3-D problems: Tetrahedron element, Jacobian matrix, Stiffness matrix, higher order elements, Computer implementation.

UNIT-VI:
FE formulation for 1D plasticity, Eigen-value problems, Natural vibration of bars and beams, Methods to find eigen-values and eigen-vectors.

TEXT BOOKS:
1. Introduction to Finite Elements in Engineering, Chandrupatla and Belegundu, 4th Edition, Prentice Hall of India Pvt. Ltd. New Delhi
2. Concepts and Applications of Finite Element Analysis, Cook R. D., 4th Edition, Wiley, New York

REFERENCES:

1. A First Course in Finite Element Method, Logan Deryl L., 5th Edition, Thomson Brook/Cole
2. The Finite Element Methods in Engineering, S. S. Rao, Pergamon, New York
3. An Introduction to Finite Element Methods, J. N. Reddy, McGraw Hill
4. The Finite Element Method in Engineering Science, O. C. Zienkowitz, McGraw Hill
5. Fundamentals of Finite Element Analysis, Hutton D. V.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1CD02) ADVANCED CAD

COURSE PRE-REQUISITES: Basic knowledge of CAD/CAM

COURSE OBJECTIVES:
- To understand the various tools & devices used in CAD modeling
- To apply the parametric representation & analysis of curves & surfaces
- To compare the different representation schemes and transformations
- To comprehend the data exchange formats & applications of CAD

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify the types of CAD tools and modeling techniques and utilize them
CO-2: Evaluate the parametric representation of synthetic curves and surfaces
CO-3: Validate the solid models through B-rep and CSG representation schemes and solve the transformations
CO-4: Asses the various data exchange formats and illustrate the applications of CAD

UNIT-I:
CAD Tools: Definition of CAD Tools, CAD/CAM system evaluation criteria, Brief treatment of input and output devices, Graphics standard, Functional areas of CAD, Modeling and Viewing, Software documentation, Efficient use of CAD software.

UNIT-II:
Geometric Modelling – 2D: Wireframe modeling – advantages, limitations and applications, Wire frame entities, Curve representation
Parametric Representation of Synthetic Curves: Hermite Cubic Spline, Bezier curve, B-Spline curve.

UNIT-III:
Surface Modeling: Surface modeling – advantages, limitations and applications, Surface entities, Surface representation, Analytics Surfaces - Plane surface, Ruled surface, Surface of revolution, Tabulated Cylinder.
Surface Manipulations: Displaying, Segmentation, Trimming, Intersection, Projection.

UNIT-IV:
Parametric Representation of Synthetic Surfaces: Parametric representation of Hermite Bi-cubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface, Sculptured surface.

UNIT-V:
2-D & 3-D Transformations: 2D and 3D transformations on Translation, Rotation, Scaling, Reflection, Shear; Homogenous and Concatenated transformations.
Geometric Modelling – 3D: Solid modeling – advantages, limitations and applications, Solid Entities, Solid Representation, Boundary Representation (B-Rep) scheme, Constructive Solid Geometry (CSG) scheme.

UNIT-VI:
Product Data Exchange: Introduction and need of product data exchange, Types of translators, IGES and STEP data exchange formats – structure and implementation.
Overview of Applications: Mass property calculations, Finite Element Analysis and Mechanical Assembly.

TEXT BOOKS:

1. CAD/CAM Theory and Practice, Ibrahim Zeid, McGraw Hill International

REFERENCES:

1. Mastering CAD-CAM, Ibrahim Zeid, McGraw Hill International
2. CAD/CAM, P. N. Rao, Tata McGraw Hill

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1CD03) RAPID PROTOTYPING

COURSE PRE-REQUISITES: Manufacturing Technology, Materials Technology, CAD/CAM

COURSE OBJECTIVES:
- To understand the various rapid prototyping and rapid tooling technologies
- To apply the knowledge to select appropriate technologies for product development purposes
- To evaluate the rapid prototyping process based on the actual design and fabrication of a part

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Classify the differences and of the application of a range of additive manufacturing processes
CO-2: Analyze the correct CAD formats in the manufacture of a 3D printed part
CO-3: Estimate and fabricate a 3D part using an additive manufacturing machine
CO-4: Measure the appropriate fabrication technology, or technologies, for a given prototyping task

UNIT-I:
Introduction: Historical Development, Fundamentals of RP, Advantages of RP, Classification of RP Processes, Process chain, 3D modeling, data conversion and transmission, checking and preparing, building, and post processing.

UNIT-II:
Liquid Based RP Systems: 3D systems' SLA, Cubital's SGC, Sony's SCS, Other similar commercial RP systems, micro fabrication.

UNIT-III:
Solid Based RP Systems: Helisys' LOM, Stratasys' FDM, 3D systems MJM, Other similar commercial RP systems.

UNIT-IV:
Powder Based RP Systems: DTM's selective laser sintering (SLS), MIT's 3D printing (3DP), BPM Technology's ballistic particle manufacturing (BPM)

UNIT-V:
Rapid Prototyping Data formats: STL format, STL file problem, Consequences of building a valid and invalid tessellated model, STL file repair, newly proposed formats.

UNIT –VI:
RP Applications: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.

TEXT BOOKS:
1. Rapid Prototyping: Principles and Applications, Chua Chee Kai, Leong Kah Fai, Lim Chu-Sing, World Scientific Pub. Co.
2. Rapid Manufacturing, D.T. Pham and S. S. Dimov, Springer Publication

REFERENCES:

1. Rapid Prototyping: Theory and Practice, Ali Kamrani, Emad Abouel Nasr (Editors), Springer Publication
2. Rapid Prototyping: Principles and Applications, Rafiq I. Noorani, Wiley
3. Rapid Prototyping, Andreas Gebhardt, Hanser Gardner Publications

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M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1AM03) DESIGN FOR MANUFACTURING AND ASSEMBLY

COURSE PRE-REQUISITES: Production Technology, Machine Tools, Material Technology

COURSE OBJECTIVES:

- To impart the knowledge on steps involved in design process and material selection
- To understand about the design rules involved in machining and casting
- To understand about the design rules involved in metal joining, forging, extrusion and sheet metal work
- To understand about the design principles involved in manual and automatic assembly transfer systems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the knowledge on steps involved in design process and material selection
CO-2: Apply the knowledge on design rules involved in machining and casting
CO-3: Analyze the design rules involved in metal joining, forging, extrusion and sheet metal work
CO-4: Design and analyze the principles involved in manual and automatic assembly transfer systems

UNIT-I:
Introduction: Design philosophy, Steps in Design process, General Design rules for manufacturability, Basic principles of designing for economical production, Creativity in design.
Materials: Selection of Materials for design, Developments in Material technology, Criteria for material selection, Material selection, Interrelationship with process selection, Process Selection charts.

UNIT-II:
Machining Process: Overview of various machining processes, Design rules for machining, Redesigning of components for machining ease with suitable examples
Metal Casting: Appraisal of various casting processes, General design considerations for casting, Overview of solidification simulation in casting design, Casting Defects.

UNIT-III:
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, Welding Defects, Design of brazed joints.

UNIT-IV:
Forging: Design factors for Forging, Extrusion & Sheet Metal Work: Design guidelines for extruded sections, Design principles for Punching, Blanking, Bending, Deep Drawing, Keeler Goodman Forming Line Diagram.

UNIT-V:
Assembly Advantages: Development of the assembly process, Choice of assembly method, Assembly advantages, Social effects of automation.
Automatic Assembly Transfer Systems: Continuous transfer, intermittent transfer, Indexing mechanisms and operator paced free transfer machine.

UNIT-VI:

Design of Manual Assembly: Design for assembly fits in the design process, General design guidelines for manual assembly, Development of the systematic DFA methodology, Assembly efficiency, Classification system for manual handling, Classification system for manual insertion and fastening, Effect of part symmetry on handling time, Effect of part thickness and size on handling time, Effect of weight on handling time, Parts requiring two hands for manipulation, Effects of combinations of factors, Effect of symmetry, Effect of chamfer design on insertion operations, Estimation of insertion time.

TEXT BOOKS:

1. Assembly Automation and Product Design, Geoffrey Boothroyd, Marcel Dekker Inc. NY, 1992
2. Engineering Design – Material & Processing Approach, George E. Dieter, 2nd Ed., McGraw Hill Intl., 2000

REFERENCES:

1. Handbook of Product Design, Geoffrey Boothroyd, Marcel and Dekker, NY, 1990
2. Computer Aided Assembly Planning, A. Delchambre, Springer London, 1992

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
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(18PC1AM01) AUTOMATION IN MANUFACTURING

COURSE PRE-REQUISITES: Industrial Engineering, Concepts of Manufacturing Technology

COURSE OBJECTIVES:
- To comprehend the basic principles of automation and analyze, automated flow lines
- To impart design and control aspects of automated flow lines
- To apply line balancing methods for assembly lines
- To analyze manufacturing cells and recognize applications of automated material handling systems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Implement concepts of a productive system in automation
CO-2: Apply the concepts and design technologies of automated flow lines
CO-3: Analyze automated flow lines and apply line balancing for assembly lines
CO-4: Analyze automated cells and recognize the applications of automated material handling systems

UNIT-I:
Fundamentals of Manufacturing Automation: Basic Principles of automation, Types of automated systems, Degrees of automation, Automation - reasons, Production operations and automation strategies, Plant Layout, Production concepts and mathematical models, Design the parts for automation, Automatic loading Systems, introduction to direction and flow control valves and PLC.

UNIT-II:
High Volume Production Systems: Automated flow lines, Methods of work flow, Workpart transfer mechanisms, buffer storage, Control functions, Automation for machining operations, Design and fabrication considerations.

UNIT-III:
Analysis of Automated Flow Lines: Analysis of transfer lines without storage, Partial automation, Automated flow lines with storage buffers, Implementation of automatic flow lines, Line balancing problems, Considerations in assemble line design.

UNIT-IV:
Assembly Systems and Line Balance; Manual assembly lines, Methods of line balancing, Ways to improve line balancing, Flexible manual assembly lines, automated assembly systems, Analysis of multi station assembly.

UNIT-V:
Manufacturing Cells: Single station automated cells, Analysis of Single Station Cells and applications

UNIT-VI:
Automated Material Handling: Types of equipment and functions, Design and analysis of material handling system, Conveyor system, Automated guided vehicle system, Components operation, Types, Design of automated guided vehicles and applications, Automated storage and Retrieval systems - Types, Basic components and Applications, Design for Automated Assembly, Communication Systems in Manufacturing

TEXT BOOKS:

1. Automation, Production Systems and CIM, Mikell P. Groover, PHI Pvt. Ltd., 1998
2. CAD/CAM/CIM, P. Radha Krishnan & S. Subrahamanyarn and Raju, New Age International Publishers, 2003
3. System Approach to Computer Integrated Design and Manufacturing, Singh, John Wiley 1996

REFERENCES:

1. Pneumatic and Hydraulic Systems, W. Bolton, Newnes, 1997

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M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD01) PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

COURSE OBJECTIVES:

- To comprehend the basic concepts of product design and development process
- To apply structural approach to concept generation, selection and testing in product development
- To analyze the product features and its architecture so as to incorporate them suitably in product
- To apply economic analysis in product development and recognize intellectual property issues

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Implement the product design and development process and the integrate customer requirements in product design
CO-2: Apply structural approach to concept generation, selection and testing
CO-3: Demonstrate the skills in creation of a product by considering various aspects like product architecture, industrial design and design for manufacture
CO-4: Evaluate the economics of product design and development and apply for intellectual property

UNIT-I:
Introduction: Introduction to product design and development, Characteristics of successful product development, Composition of product development team, Challenges of product development, Generic product development process and its adaptation, Process flows for various product developments, Product development organizations

UNIT-II:
Customer Needs: Raw data collection, Its interpretation in terms of customer needs, Organizing the needs into hierarchy, Establishing the relative importance of needs and its reflection on the results.
Product Specifications: Definitions, When to establish specifications, Establishing target specifications, Setting final specifications

UNIT-III:
Concept Generation, Selection & Testing: Activity of concept generation, Five step method, Introduction to concept selection, Benefits of structured method, Concept screening, Concept scoring, Concept testing methodology

UNIT-IV:
Product Architecture: Introduction, Its implications, Establishing the architecture, Platform planning, Design issues, DFE
Industrial Design: Industrial design process – Need, Impact, Management and Assessment

UNIT-V:
Design for Manufacturing & Prototyping: DFM defined, DFM process, Introduction to prototyping - Principles Technologies, Planning for prototypes.

UNIT-VI:
Economics of Product Development: Elements, Economic analysis process, Factors for success of project, Qualitative analysis
Intellectual Property: Introduction, Overview of patents, Invention disclosure process

TEXT BOOKS:

1. Product Design and Development, Karl T. Ulrich and Steven D. Eppinger, Tata McGraw-Hill
2. Product Design, Kevin Otto and Kristin Wood, Pearson Education

REFERENCES:

1. Engineering Design, George E. Dieter, Linda C. Schmidt, McGraw-Hill International Edition
2. Engineering Design Process, Yousef Haik, T. M. M. Shahin, Cengage Learning
3. Engineering Design: A Project-based Introduction, Clive L. Dym, Patrick Little, John Wiley & Sons

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M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
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(18PC1AM03) PRECISION ENGINEERING

COURSE PRE-REQUISITES: Accuracy and Tolerances, Geometric Dimensioning, Machine Drawing and Production Engineering

COURSE OBJECTIVES:

- To understand the concepts of GD&T, the datums, the grouped datum systems
- To understand the representation of Tolerance, and Cumulative effect of tolerances
- To understand Surface finish, the concept of accuracy and precision, process capability, quality costs, process sequencing of shaft type components,
- To understand nano- processing and measuring systems

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply knowledge of GD&T and datums in designing/ processing the Components, grouped datum systems to any sub-assembly to arrest the degrees of freedom

CO-2: Apply the knowledge of Apply the knowledge of Tolerancing and cumulative effect of to learning

CO-3: Able to understand the concept of surface finish, accuracy and precision, process capability, quality cost, and processing of shaft type components

CO-4: Able to understand the nano-processing methods & nano-measuring systems

UNIT-I:

Geometric Dimensioning and Tolerancing (GD&T): Tolerance Zone Conversions**;** Surfaces, features, Features of Size, Datum, Datum Features**;** Datum Targets; Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datums; Form controls, Orientation Controls

UNIT-II:

Datum Systems: Degrees of freedom; Grouped Datum System; Grouped datum system with spigot & recess, pin & hole; Grouped Datum system with spigot & recess pair and tongue & slot pair

UNIT-III:

Tolerances: Symbols for tolerances and deviation (tolerance grade & fundamental deviation only), Review of relationship between attainable tolerance grades and different machining process,

Cumulative Effect of Tolerances (Tolerance stacks): Sure fit law, Normal law and Truncated normal law.

UNIT-IV:

Surface Finish: Surface texture and surface roughness, influence of machining parameters on surface roughness.

Concepts of Accuracy: Difference between Accuracy and Precision

Process Capability: Process Capability, Mean, Variance, Skewness, kurtosis, Process Capability Metrics (Cp & Cpk),

UNIT-V:

Operation Sequencing: Operation Sequence for typical shaft type of components (turning and grinding), Preparation of Process drawings for different operations (turning and grinding)

Quality Costs

UNIT-VI: Nanotechnology

Nano-Machining or Processing Systems: Processing methods with atomic-bit and atom-cluster processing units; Nano physical processing of atomic bit units.

Nano-Measuring Systems: Mechanical measuring systems.

TEXT BOOKS:

1. Geometric Dimensioning and Tolerancing, James D. Meadows, Marcel Dekker Inc.,1995
2. Precision Engineering in Manufacturing, Murthy R. L., New Age International (P) Limited, 1996
3. Nano Technology, Norio Taniguchi , Oxford University Press, 1996

REFERENCES:

1. Dimensioning and Tolerancing, ASME Y14.5-2009
2. Geometric Dimensioning and Tolerancing, P. S. Gill, 1st Edition, Katson Books, 2005
3. Engineering Statistics Handbook
4. Statistical Process Control, John S. Oakland
5. Design for Manufacturability Handbook, James G. Bralla

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M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD02) ADVANCED MECHANISMS AND ANALYSIS

COURSE PRE-REQUISITES: Basic Knowledge of Kinematics of Machinery, Dynamics of Machinery and Engineering Graphics

COURSE OBJECTIVES:
- To understand the various type of motion & inflection circle for kinematics
- To apply the angular acceleration and momentum for four bar mechanism
- To analyse and synthesize mechanisms using graphical methods
- To analyse and synthesize mechanisms using Analytical methods

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Draw inflection circle for relative motion of two moving planes
CO-2: Evaluate the polode curvature for four bar mechanism
CO-3: Find function generation parameters by synthesizing mechanisms
CO-4: Synthesize mechanisms for path generation parameters

UNIT – I:
Advanced Kinematics of Plane Motion - I: Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Analytical and graphical determination of di , Bobillier's Construction, Collineation axis , Hartmann's Construction ,Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

UNIT – II:
Advanced Kinematics of Plane Motion - II: Polode curvature, Hall's Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Determination of the output angular acceleration and its Rate of change, Freudenstein's collineation –axis theorem, Carter –Hall circle, The circling – point curve for the Coupler of a four bar mechanism.

UNIT – III:
Introduction to Synthesis-Graphical Methods - I: The Four bar linkage, Guiding a body through Two distinct positions, Guiding a body through Three distinct positions, The Roto center triangle , Guiding a body through Four distinct positions, Burmester's curve.

UNIT – IV:
Introduction to Synthesis-Graphical Methods - II: Function generation- General discussion, Function generation: Relative – Roto center method, Overlay's method, Function generation-Velocity – pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT – V:
Introduction to Synthesis - Analytical Methods - I: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation, Path Generation

UNIT – VI:
Introduction to Synthesis - Analytical Methods - II: Synthesis of Four-bar Mechanisms for specified instantaneous condition, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

TEXT BOOKS:

1. Kinematics and Dynamics of Plane Mechanisms, Jeremy Hirschhorn, McGraw-Hill, 1962
2. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker Jr., McGraw-Hill, 1995
3. Theory of Mechanisms and Machines, Amitabh Ghosh and Ashok Kumar Mallik, E. W. P. Publishers

REFERENCES:

1. Kinematics and Linkage Design, Allen S. Hall Jr., PHI,1964
2. Kinematics and Dynamics of Machinery, Charles E. Wilson, 3rd Edition, Pearson

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1AM04) MECHATRONICS

COURSE OBJECTIVES:

- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Design, model and analyze electrical and mechanical systems and their interconnection

CO-2: Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems

CO-3: Analyze the programming of microcontrollers

CO-4: Design mechatronics system with the help of Microprocessor, PLC and other Electrical and Electronics Circuits

UNIT-I:

Introduction: Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

UNIT-II:

8085 Microprocessor and 8051 Microcontroller: Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram.

UNIT-III:

Programmable Peripheral Interface: Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT-IV:

Programmable Logic Controller: Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT-V:

Actuators: Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages.

UNIT-VI:

Mechatronic System Design: Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

TEXT BOOKS:

1. Mechatronics, Bolton, Prentice Hall, 2008
2. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh S Gaonkar, 5th Edition, Prentice Hall, 2008

REFERENCES:

1. Introduction to Mechatronics and Measurement Systems, Michael B. Histand and Davis G. Alciatore, McGraw Hill International Edition, 2007
2. Mechatronics, Bradley D. A., Dawson D., Buru N.C and Loader A. J., Chapman and Hall, 1993
3. Mechatronics Integrated Technologies for Intelligent Machines, Smaili A. and Mrad F., Oxford University Press, 2007
4. Mechatronics Systems Design, Devadas Shetty and Richard A. Kolk, PWS Publishing Company, 2007
5. Microprocessors & Microcontrollers, Krishna Kant, Prentice Hall of India, 2007

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(18PC2CD01) COMPUTER AIDED DESIGN LABORATORY

COURSE PRE-REQUISITES: Knowledge of CAD

COURSE OBJECTIVES:
- To comprehend the tools used in CAD software
- To perform sketching and modeling of parts
- To know the surface modeling and sheet metal working tools
- To demonstrate building of simple team project

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Construct 2D sketches and 3D part models
CO-2: Utilize the part models in creating assemblies
CO-3: Obtain the drafted views of assemblies, surface models and sheet metal parts
CO-4: Build an assembly of engineering application through teamwork

- **Modeling:**
  Introduction to CATIA software
  - Sketching
  - Modeling
  - Assembly
  - Drafting
  - Surface modeling
  - Sheet metal design

  Note: Each topic shall consist of atleast one exercise on engineering components

- **Demonstration of a simple team design project**

SOFTWARES: ***CATIA***

REFERENCES:
1. CATIA V5 Help Manual

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M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(18PC2CD02) COMPUTER AIDED ENGINEERING LABORATORY

COURSE PRE-REQUISITES: Knowledge of Finite Element Analysis and CAD

COURSE OBJECTIVES:
- To comprehend the tools used in analysis and simulation
- To perform stress analysis of various components
- To perform frequency analysis of 2D component and beams
- To perform simulation of mechanical systems

COURSE OUTCOMES: After completion of the course, students should be able to
CO 1: Perform stress analysis on plates, brackets, beams and axisymmetrical components
CO 2: Execute frequency analysis on beams and 2D components
CO 3: Analyze thermal stresses in 2D components
CO 4: Simulate mechanical systems and compute displacement, velocity, acceleration, range, angular displacement, angular velocity and frequency.

- **Analysis:**
  Introduction to ANSYS software
  - Stress analysis of a plate with a circular hole
  - Stress analysis of rectangular L bracket
  - Stress analysis of an axi-symmetric component
  - Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
  - Mode frequency analysis of a 2D component
  - Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
  - Harmonic analysis of a 2D component
  - Thermal stress analysis of a 2D component

- **Simulation:**
  Introduction to ADAMS software
  - Free falling body to find displacement, velocity, and acceleration
  - Projectile motion to compute range.
  - Pendulum to find angular displacement, angular velocity and frequency.

SOFTWARES: *ANSYS, ADAMS*

REFERENCES:
1. ANSYS User Guide
2. ADAMS Documentation

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M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**4**	**2**

(18PW4CD01) TECHNICAL SEMINAR

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify a research topic related to advanced/state-of-the-art technologies
CO-2: Collect the literature and comprehend/analyze critically the technological advancements
CO-3: Engage in effective oral communication through presentation of seminar
CO-4: Engage in effective written communication through report

COURSE OUTLINE:

- A student shall present a seminar on a technical topic during I semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on a technical topic of his / her choice, critically review the literature and submit it to the Seminar Review Committee (SRC) in a prescribed report form.
- The SRC shall consist of Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Student shall make an oral presentation before the SRC after clearing the plagiarism check.
- Prior to the submission of seminar report to the SRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The report shall be accepted for submission to the SRC only upon meeting the prescribed similarity index.

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M.Tech. I Semester (CAD/CAM)	**L**	**T/P**	**C**
	2	**0**	**0**

(18AU5CS01) RESEARCH METHODOLOGY AND IPR

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To introduce the characteristics of a good research problem
- To choose appropriate approaches of investigation of solutions for research problem
- To familiarize with basic Intellectual Property Rights
- To understand different Patent Rights

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand research problem formulation, analyze research related information and follow research ethics
CO-2: Realize the importance of ideas, concept, and creativity in the present-day context
CO-3: Recognize that when IPR would take such important place in growth of individuals and nation, it is needless to emphasize the need of information about IPR to be promoted among students in general and engineering in particular
CO-4: Appreciate IPR protection which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

UNIT-I:
Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT-II:
Literature Survey: Effective literature studies approaches, analysis. Plagiarism, Research ethics.

UNIT-III:
Effective Technical Writing: How to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of
Patenting and Development: technological research, innovation, patenting, development.
International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-VI:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR.

TEXT BOOKS:
1. Research Methodology: An Introduction for Science & Engineering Students, Stuart Melville and Wayne Goddard
2. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville

3. Resisting Intellectual Property, Halbert, Taylor & Francis Ltd., 2007

REFERENCES:

1. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, 2nd Edition
2. Research Methodology: Methods and Techniques, C. R. Kothari and Gaurav Garg, New Age International Publishers
3. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016
4. Intellectual Property Rights Under WTO, T. Ramappa, S. Chand, 2008

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M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1CD04) COMPUTER AIDED MANUFACTURING

COURSE PRE-REQUISITES: CAD/CAM, Manufacturing & Production Technology

COURSE OBJECTIVES:
- Understand the NC Systems, NC part programming fundamentals
- Understand the CNC systems, DNC systems APT programming language for 2D geometric shapes
- Understand the concepts of Tooling for CNC, Adaptive control, CAD/CAM software implementation, post postprocessor
- Understand the concept of Computer Aided Process Planning and Computer aided inspection & quality control

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply knowledge and work the NC systems & CNC systems and able to program
CO-2: Develop an optimal APT program for a given component (2D- milling & drilling)
CO-3: Able to understand Adoptive control systems, CNC Tooling systems, CAD/ CAM software, post processor
CO-4: Able to understand the concepts of CAPP and CAI & QC

UNIT-I:
NC Systems: NC Coordinate systems, elements of NC systems, Classification of NC Systems, Advantages & Disadvantages of NC Systems
NC Part Programming1: Manual Part Programming fundamentals - Word address format, Preparatory function , Feed, Speed, Tool Change functions, Dimensional words, Canned Cycles, Tool Offset, Tool Length Compensation, Tool nose radius compensation

UNIT-II:
CNC Systems: CNC, functions of CNC, Features of CNC, Advantages of CNC
DNC Systems: DNC Concepts, Objectives of DNC, Components of DNC, Types of DNC, advantages and disadvantages of DNC

UNIT-III:
APT Programming: Computer Assisted Part Programming, Computer Assisted NC Part programming Languages, APT Language & programming (statements & Programming), Examples of APT programming problems (2D machining- Milling & Drilling only)

UNIT-IV:
Adaptive Control: Adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, Grinding
Tooling for CNC Machines: Types of CNC tooling for cutting3 (brief introduction of preset, qualified, Interchangeable, coolant fed, and modular tooling systems); Tool presetting4; Automatic tool changers4; Work holding (modular fixturing)4 .

UNIT-V:
Introduction to CAD/CAM Software: NC programming using CAD/CAM software, Tool path generation using CAD/CAM software, Technology of CAM, Computer assisted part programming
Post Processors for CNC: Introduction to Post Processors, necessity of a Post Processor, general structure of a Post Processor, functions of a Post Processor

UNIT-VI:

Computer Aided Process Planning: CAPP system- Retrieval type CAPP System, Generative type CAPP system, Hybrid CAAP System

Computer Aided Inspection and Quality Control: CMM Construction, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods

TEXT BOOKS:

1. Computer Aided Design Manufacturing, K. Lalit Narayan, K. Mallikarjuna Rao and M. M. M. Sarcar, PHI
2. Computer Control of Manufacturing Systems, Yoram Koren, McGraw Hill
3. CAD/CAM Principles and Applications, P. N. Rao, McGraw Hill

REFERENCES:

1. Computer Aided Manufacturing, Shanmuga Sundar, T. Selwyn, C. Elanchezhian
2. Numerical Control Machine Programming and Software Design, C. H. Chang, M. A. Melkanoff, Prentice Hall
3. CAD/CAM Computer Aided Design and Manufacturing, Mikell P. Groover, E. W. Zimmers Jr.
4. Mastering CAD/CAM, Ibrahim Zeid, McGraw Hill
5. Computer Aided Manufacturing, T. C. Chang, Wysk, H. P. Wang, Pearson/ Prentice Hall International

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M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1CD05) INDUSTRIAL ROBOTICS

COURSE PRE-REQUISITES: Matrices, Signals and Linear Systems, Mathematics

COURSE OBJECTIVES:
- To understand the robot anatomy, different control systems and components to control the robot manipulator
- To study various types of drive systems, end effectors and sensors
- To impart knowledge in Robot Kinematics and Programming
- To study robot cell design and industrial applications of robots

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the knowledge of robot anatomy to choose the robot
CO-2: Analyze robot components, kinematics, drive and control systems
CO-3: Program the robot
CO-4: Build robot cell and choose robots for industrial applications

UNIT-I:
Fundamentals of Robot: Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT-II:
Robot Drive Systems and End Effectors: Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT-III:
Control System and Components: Basic concept and models, Controllers, Control system analysis, Robot actuators and feedback components, Position sensors, Velocity sensors, tactile sensors, Power transmission system.
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.

UNIT-IV:
Robot Kinematics: Introduction to manipulator kinematics, Joint coordinates and world coordinates, Forward and inverse Kinematics, Problems.

UNIT-V:
Robot Programming: Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT-VI:
Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot dell, Considerations in work cell design, Workcell control, Interlocks, Error detection, Work cell controller.

Robot Applications: Material transfer, Machine loading/unloading, Processing operation, Assembly Inspection, Future Applications.

TEXT BOOKS:

1. Robotic Engineering - An Integrated Approach, Klafter R. D., Chmielewski T. A. and Negin M., Prentice Hall, 2003
2. Industrial Robotics -Technology Programming and Applications, Groover M. P., McGraw Hill, 2001

REFERENCES:

1. Introduction to Robotics Mechanics and Control, Craig J. J., Pearson Education, 2008
2. Robotics Technology and Flexible Automation, Deb S. R., Tata McGraw Hill Book Co., 1994
3. Robotics for Engineers, Koren Y., McGraw Hill Book Co., 1992
4. Robotics Control, Sensing, Vision and Intelligence, Fu K. S., Gonzalz R. C. and Lee C. S. G., McGraw Hill Book Co., 1987
5. Robotics and Image Processing, Janakiraman P. A., Tata McGraw Hill, 1995

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M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1CD06) ADDITIVE MANUFACTURING PROCESSES

COURSE PRE-REQUISITES: Manufacturing Technology, CAD/CAM

COURSE OBJECTIVES:
- To remember the principle methods, areas of usage, possibilities and limitations as well as environmental effect of the additive manufacturing technologies
- To understand the characteristics of the different materials those are used in additive manufacturing
- To analyze the potential implications of AM technologies on product development and identify needs for new technologies to accelerate the advancement and impact of AM

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Demonstrate different methods to discuss the effects of the additive manufacturing technologies and analyze the characteristics of the different materials in additive manufacturing
CO-2: Identify a suitable material for Additive Manufacturing
CO-3: Analyze different Methods for post-processing of additive manufacturing parts
CO-4: Summarize the applications of Additive Manufacturing

UNIT-I:
Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of Additive manufacturing.
AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing.

UNIT-II:
Classification of AM Processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system.

UNIT-III:
Design for AM: Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

UNIT-IV:
Guidelines for Process Selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control

UNIT-V:
AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries

UNIT-VI:
Post Processing of AM Parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.
Future Directions of AM: Introduction, new types of products and employment and Digiproneurship.

TEXT BOOKS:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2010
2. Rapid Prototyping: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2003

REFERENCES:

1. Rapid Prototyping: Theory & Practice, Ali K. Kamrani, Emand Abouel Nasr, Springer, 2006
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D. T. Pham, S. S. Dimov, Springer 2001
3. Rapid Tooling and Rapid Manufacture, Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, Hanser Publishers, 2013

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M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD03) FLEXIBLE MANUFACTURING SYSTEMS

COURSE PRE-REQUISITES: Knowledge of Manufacturing, Supply Chain Management

COURSE OBJECTIVES:
- To understand the knowledge about the design, operation, and selection of Flexible Manufacturing Systems and their integration in today's production environments
- To understand the integration of components of FMS under different production management approaches
- To learn about simulation software and database of FMS
- To calculate performance measures, including throughput, in-process inventory, and meeting production commitments

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the concepts of Probability & Statistics to develop the manufacturing systems
CO-2: Plan, schedule and control a developed FMS
CO-3: Select suitable database and software required for FMS
CO-4: Apply preventive maintenance, Kan ban system effectively

UNIT-I:
Introduction to flexible manufacturing systems. Planning and scheduling and control of FMS, Knowledge based scheduling, Types of Productions, Types of FMS, Types of FMS Layouts, advantages and disadvantages of FMS.

UNIT-II:
Hierarchy of computer control. Supervisory computer. Components of FMS, Types of flexibility, trade off, computer control and functions, coordinate measuring machines, types, working and capabilities.

UNIT-III:
Software for simulation and database of FMS: System issues, types of software, specification and selection, trends, Application of simulation software.

UNIT-IV:
Cutting tools and tool management, work holding considerations, acceptance testing.

UNIT-V:
Manufacturing data systems data flow, CAD/CAM considerations. Planning FMS database, Just in time characteristics, Pull method, Quality small lot sizes, Work station loads, Close supplier ties, Flexible workforce – Line flow strategy, types of FMS softwares.

UNIT-VI:
Preventive maintenance, Kanban system, Implementation issues, value engineering, MRD JIT, lean manufacture, quality concepts, and Management.

TEXT BOOKS:
1. Hand Book of Flexible Manufacturing Systems, Jha N. K., Academic Press
2. Flexible Manufacturing Systems, Shivanad H. K., Benal M.M, Koti. V, New Age International (P) Limited, New Delhi, 2006

REFERENCES:

1. Production System Beyond Large Scale Production, Taiichi Ohno, Toyota, Productivity Press India Pvt. Ltd.
2. Flexible Manufacturing Systems: Recent Development, Raouf A. and Ben-Daya M., Editors, Elsevier Science, 1995
3. Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India Pvt., New Delhi, 1996
4. Handbook of Flexible Manufacturing Systems, Nand K. Jha (Eds.)

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M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD04) OPTIMIZATION TECHNIQUES

COURSE PRE-REQUISITES: Mathematics, Operation Research

COURSE OBJECTIVES:
- To understand the classification of optimization techniques and its practical use
- To understand about the optimization of one-dimensional optimization methods
- To knows about constrained minimization methods
- To understands geometric and dynamic programming

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Know the principles and classifications of optimization
CO-2: Know the algorithms
CO-3: Formulate an optimization problem
CO-4: Find the optimum solution of their problems using optimization techniques

UNIT-I:
Introduction to optimization, classification of optimization problems, classical optimization techniques.

UNIT-II:
Linear programming, simplex method, two phase simplex method, Duality in linear programming.

UNIT-III:
Sensitivity or Post-optimality Analysis: Changes in Right hand side Constants, cost Coefficients, constraint Coefficients, Addition of new Variables, Addition of Constraints, Karmarkar's methods.

UNIT-IV:
Non-Linear Programming: One dimensional minimization: Fibonacci method, Golden Section Method, Quadratic and Cubic Interpolation Methods, unconstrained and Constrained minimization, direct and indirect methods,

UNIT-V:
Introduction to Geometric programming, Posynomial, Unconstrained Minimization Problem, primal dual relationships and sufficiency conditions in the unconstrained case , constrained minimization .

UNIT-VI:
Introduction to Genetic Algorithms, Operators, applications to engineering optimization Problems.

TEXT BOOKS:
1. Operations Research, S. D. Sharma, Kedarnath Ramnath, Meerut, New Delhi
2. Engineering Optimization, S. S. Rao, New Age International Publications, 2014
3. Optimization for Engineering Design, Kalyanmoy Deb, Prentice Hall of India, New Delhi

REFERENCES:

1. Optimizing Performance of Energy Systems, S. S. Stricker, Battelle Press, New York, 1985
2. Introduction to Optimum Design, J. S. Arora, McGraw Hill, New York, 1989
3. Geometric Programming-Theory and Applications, R. J. Duffin, E. L. Peterson and C. Zener, Willey, New York, 1967
4. Linear Programming and Extensions, G.B. Dantzig, Princeton University Press, Princeton, N. J., 1963
5. Dynamic Programming, R. Bellman, Princeton University Press, Princeton, N.J. 1957

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M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1AM06) QUALITY ENGINEERING IN MANUFACTURING

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To comprehend the various quality tools and principles of Quality Loss Function
- To apply the robust design methodology in solving practical engineering problems
- To determine the variation in experimental data and analyze the residuals through regression

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Value the concept of quality, use quality tools and evaluate the quality loss
CO-2: Design & conduct the experiments using appropriate array for predicting optimal results
CO-3: Analyze & interpret the experimental data for variation using mean & S/N methods
CO-4: Develop regression models, assess the fit of regression model & implement strategy to correct model inadequacies
CO-5: Perform & interpret a proper response surface analysis using appropriate experimental designs

UNIT-I:
Quality Tools: Fishbone diagram, Brainstorming, Quality circles, Benchmarking, Six-sigma, ISO-9000 Quality system.
Quality Value and Engineering: Quality engineering in product design, design of production processes and production.
Loss Function and Quality Level: Quality Loss Function (QLF) for N-type, S-type and L-type characteristics, Use of QLF, Economic consequences of tightening tolerances as a means to improve quality

UNIT-II:
Orthogonal Arrays: Introduction, Degrees of Freedom, Linear Graphs & Interaction tables, Strategies in Experimentation - Typical, Better & efficient, Steps in designing, conducting and analyzing an experiment.

UNIT-III:
Analysis of Variance (ANOVA): No-way ANOVA, One-way ANOVA, Two-way ANOVA, Types of Errors, ANOVA for four level factors, Critique of F-test.
Interpretation of Experimental Results: Interpretation methods, Percent contribution.

UNIT-IV:
Tolerance Design: Functional limits, Tolerance design for N-type, L-type and S-type characteristics, Tolerance allocation for multiple components.
Parameter Design: Introduction to parameter design, Signal to noise ratios, Parameter design strategy, Case studies.

UNIT-V:
Regression Modeling: Introduction, Linear regression models, Estimation of linear regression models, Hypothesis testing and confidence intervals in multiple regression, Prediction of New Response Observations, Regression Model diagnostics.

UNIT-VI:
Response Surface Design: Introduction, Method of steepest ascent, Analysis of a second-order response surface, Experimental designs for fitting response surfaces.

TEXT BOOKS:

1. Taguchi Techniques for Quality Engineering, Philip Ross, McGraw Hill, 2005
2. Quality Engineering in Production Systems, G. Taguchi, El Sayed, T. C. Hsiang, McGraw Hill, 1989
3. Design and Analysis of Experiments, D. C. Montgomery, 8th Edition, Wiley & Sons, 2013

REFERENCES:

1. Quality Engineering using Robust Design, M. S. Phadke, Pearson Education, 2008
2. Taguchi's Quality Engineering Handbook, G. Taguchi, Subir Chowdhary, Yuin Wu, Wiley & Sons, 2005

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M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD05) COMPUTER AIDED PROCESS PLANNING

COURSE PRE-REQUISITES: CAD, CAM, Manufacturing Processes

COURSE OBJECTIVES:
- To understand process planning techniques
- To understand various manufacturing parameters effectively in production rate
- To understand Manufacturing tolerances in design and manufacturing process

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the concept of computer aided process planning
CO-2: Design appropriate tolerances in design and manufacturing and tool paths
CO-3: Implement techniques of CAPP

UNIT-I:
Introduction to CAPP: Introduction and definition of process planning, Scope of process planning, Information requirement for process planning system in CAD/CAM, Role of process planning, Advantages of conventional process planning over CAPP, Structure of Automated process planning system, Feature recognition, Methods.

UNIT-II:
Approaches of Process Planning: Manual approach, CAPP approaches.
Generative CAPP System: Importance, Principle of Generative CAPP system, Automation of logical decisions, Knowledge based systems, Inference Engine, Implementation, Benefits. Generative approach-Forward and backward planning,

UNIT-III:
Retrieval CAPP System: Significance, Group technology, Structure, Relative advantages, Implementation and applications. Examples of process planning system-CAM-I, Automated process planning, D-CLASS (CAPP). Logical Design of process planning.

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:
Knowledge-Based Process Planning: Knowledge-based systems. Languages and tools for knowledge-based expert systems. Important issues regarding knowledge-based system projects. Knowledge-based systems and process planning. Knowledge acquisition for process planning,

UNIT-VI:
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. Practical use of CAPP in real Manufacturing area

TEXT BOOKS:
1. Automation, Production systems and Computer Integrated Manufacturing System, Mikell P. Groover
2. Computer Aided Design and Manufacturing, Dr. Sadhu Singh

REFERENCES:

1. Computer Aided Process Planning, H. P. Wang & J. K. Li, 1st Edition, Elsevier Science & Technology Publishers, 1991
2. Computer Aided Engineering, David Bedworth
3. Principles of Process Planning-A Logical Approach, Gideon Halevi and Roland D. Weill, Chapman & Hall, 1995

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD06) DESIGN OF EXPERIMENTS

COURSE PRE-REQUISITES: Statistical Methods

COURSE OBJECTIVE:
- To prepare the orientation of the student towards planning and to understand the techniques in design of research and experimentation
- To analyze and interpret full factorial DOE results using ANOVA
- To recognize the main principles and benefits of robust design DOE

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Critically review basic concepts and models of experimental design
CO-2: Analyse the results of a designed experiment in order to conduct the appropriate statistical analysis of the data
CO-3: Interpret statistical result from an experiment and report them in non-technical language

UNIT-I:
Design of Experiments (DOE): Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles- replication, randomization, blocking, Guidelines for design of experiments, process of DOE.

UNIT-II:
Simple Comparative Experiments: Basic statistical concepts, random variable, sample mean and variance, degrees of freedom, standard normal distribution, statistical hypothesis, Two sample t test, P-value, Confidence Intervals, Paired comparison.

UNIT-III:
Single Factor Experiment: Analysis of Variance (ANOVA) for fixed effect model; Total, treatment and error sums of squares, Decomposition of total sum of squares, ANOVA for Randomized complete block design to control effects of nuisance factors.

UNIT-IV:
Two Factor Factorial Design: Basic definitions and principles, main effect and interaction, response surface and contour plots, Blocking, General arrangement for a two-factor factorial design; Models- Effects, means and regression

UNIT-V:
Taguchi Techniques for Experimental Design: Taguchi loss function, Average loss, nominal-the-best, smaller-the-best, larger-the-best, design process steps, selection of factors affecting-methods, factor levels, Test strategies- Full factorial experiment, fractional factorial experiment, Orthogonal arrays and their selection; Interaction effects

UNIT-VI:
Parameter Design: Control and noise factors and parameter design, signal to noise ratio, types, parameter design strategy, tolerance design, robust design

TEXT BOOKS:
1. Design & Analysis of Experiments, Montgomery Douglas C., 5th Edition, Wiley India Pvt. Ltd., 2007
2. Applied Statistics & Probability for Engineers, Montgomery Douglas C. & Runger George C., Wiley India Pvt. Ltd., 2007

REFERENCES:

1. Research Methodology- A Step-By-Step Guide for Beginners, Ranjit Kumar, Pearson Education, 2006
2. Research Methods, Trochim William M. K., 2nd Edition, Biztantra, Dreamtech Press, New Delhi), 2003
3. Research Methodology- Methods and Techniques, Kothari C. K., 2nd Edition, New Age International, New Delhi, 2004
4. Taguchi Techniques for Quality Engineering, Ross, Philip J., 2nd Edition, McGraw Hill, New York, 1996
5. Total Quality Management, Besterfield, Dale H., 3rd Edition, Pearson Education, New Delhi, 2005

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1AM07) INTELLIGENT MANUFACTURING SYSTEMS

COURSE PRE-REQUISITES: Mathematics, Machine Tools, Process Planning, Plant Layout, Material Handling

COURSE OBJECTIVES:

- To understand components, structures, function of CIM, computer system Architecture and data requirements
- To know about components of knowledge-based systems, machine learning, Artificial Intelligence and Neural Networks and their applications in manufacturing
- To analyze process planning and its automation, equipment selection and modeling techniques and apply them in manufacturing system design
- To define group technology algorithms and interpret knowledge Based Group Technology systems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Design and develop CIM system
CO-2: Apply concepts of neural networks in areas of manufacturing
CO-3: Analyze Group Technology models and algorithms for automated manufacturing cells
CO-4: Make use of group technology algorithms and create Knowledge Based systems for Automated Manufacturing System

UNIT-I:
Computer Integrated Manufacturing: Systems, Structure and functional areas of CIM system – CAD, CAPP, CAM, CAQC, ASRS- Advantages of CIM, CIM Models, 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.

UNIT-VI:

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, Andre Kusaic
2. Artificial Neural Networks, Yagna Narayana

REFERENCES:

1. Automation, Production Systems and CIM, Groover M.P
2. Neural Networks, Wassarman

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(18PC2CD03) DIGITAL MANUFACTURING LABORATORY

COURSE PRE-REQUISITES: Rapid Prototyping, Knowledge of Additive Manufacturing Processes

COURSE OBJECTIVES:
- To demonstrate the knowledge of 3D Printing Technology
- To understand about the CAD model conversion to STL file format and rectification of errors in STL file
- To explain about build parameters, support structures and part orientation involved in 3D Printing
- To demonstrate the knowledge of 3D Scanning
- To understand about the post processing methods of the scanned component data

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Develop CAD models and convert them to STL files and be in a position to rectify the STL errors
CO-2: Decide the print parameters, part orientations and its support structures involved in 3D Printing
CO-3: Apply the knowledge of 3D Scanning for scanning the components
CO-4: Perform post processing of the scanned components
CO-5: Build a 3D printed engineering component & analyze it for rectification of errors if any

- Overview of 3D Printing and introduction to FDM

3D PRINTING:
- Introduction to CAD modeling and preparation of CAD models of simple
- mechanical engineering components
- Conversion of CAD model to STL file format and correction of errors
- Definition of build parameters for 3D printing including support structures
- Working with build orientation for optimum printing time
- Verification of 3D mesh model before printing
- 3D printing of modeled components & its inspection

3D SCANNING:
- Introduction to 3D scanning
- Scanning of simple components using 3D Scanner
- Post-processing of point cloud data
- Verification of 3D mesh model before printing
- 3D printing of scanned component & its inspection

Demonstration of simple team design project

SOFTWARES: CATIA, Artec Studio, Autodesk Netfabb, Makerbot Makerware

REFERENCES:
1. CATIA V5 Help Manual
2. Autodesk Netfabb User Manual
3. Artec Studio User Guide
4. Makerbot User Manual

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(18PC2CD04) COMPUTER AIDED MACHINING LABORATORY

COURSE PRE-REQUISITES: Automation and Robotics, Machine Tools

COURSE OBJECTIVES:
- To analyze features of CNC machines and machining centres
- To create steps and commands in part programming and tool selection
- To evaluate the use of various CAM softwares

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Demonstrate part programming for CNC lathe and execute the same for the part production
CO-2: Integrate CAD and CAM to manufacture components
CO-3: Develop the manufacturing of components through CAM Software

LIST OF EXPERIMENTS:

1. Introduction to Manual part programming and features of CNC Turning and Milling Centres.
2. Preparation of manual part programme for Turning operations using point-to-point, Linear and circular interpolation Techniques.
   a) Facing, Plain Turning, Step turning, Taper turning
   b) Chamfering, Grooving, Knurling and Thread cutting
3. Preparation of manual part programme for Milling operations using point-to-point, Linear and circular interpolation Techniques.
   a) Face Milling, Slot milling and End milling
   b) Pocket Milling and Mirroring
4. Part programming using Fixed or Canned Cycles for Tapping and Thread cutting operations.
5. Generation of Tool path, NC code and its Simulation for Turning and Milling operations using CAM packages like EdgeCAM, MasterCAM and Off-line NC simulation softwares.
6. Computer Assisted Part Programme generation using APT language.
7. Machining of simple components on NC lathe machine by transferring NC Code from a CAM package through RS 232.
8. Machining of simple components on NC Milling machine by transferring NC Code from a CAM package through RS 232.

SOFTWARES: CNC Offline Simulation, EdgeCAM, MasterCAM

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**4**	**2**

(18PW4CD02) MINI-PROJECT

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the formulated industry / technical / societal problems
CO-2: Analyze and / or develop models for providing solution to industry / technical / societal problems
CO-3: Interpret and arrive at conclusions from the project carried out
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- A student shall undergo a mini-project during II semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on an allotted project topic of his / her choice, critically review the literature, carry out the mini-project, submit it to the department in a prescribed report form.
- Evaluation of the mini-project shall be done by a Project Review Committee (PRC) consisting of the Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Prior to the submission of mini-project report to the PRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The mini-project report shall be accepted for submission to the PRC only upon meeting the prescribed similarity index.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (CAD/CAM)	**L**	**T/P**	**C**
	2	**0**	**0**

(18AU5EN01) ENGLISH FOR ACADEMIC AND RESEARCH WRITING

COURSE OBJECTIVES:
- To understand the usage of appropriate vocabulary (Formal, Informal, Gender Insensitive etc.)
- To understand the features and processes of academic writing
- To identify the resources
- To understand standard documentation styles

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Use appropriate vocabulary (Formal, Informal, Slang, Gender Insensitive etc.)
CO-2: Employ processes of academic writing
CO-3: Identify the resources
CO-4: Understand standard documentation styles

UNIT- I:
Introduction to Research:
i. Identifying the topic
ii. Identifying Sources; Finding Sources
iii. Defining the broad area; Defining the specific area; Difference between a broad area and specific area
iv. Choosing a topic
v. Mechanics of Writing – Language, Tone, Style, Ethics

UNIT-II:
Referencing & Library Skills:
i. Literature Survey
ii. Writing Objectives
iii. Hypothesis
iv. Methodology
v. Prospects for Future Research

UNIT-III:
Academic Writing Skills:
i. Paraphrasing
ii. Summarizing
iii. Quoting
iv. Rewriting
v. Expansion

UNIT-IV:
Kinds of Academic Writing:
i. Essays
ii. Reports
iii. Reviews
iv. SOPs
v. Abstracts
vi. Proposals

UNIT-V:
Research Process:
i. Selection of Topic

ii. Formulation of Hypothesis
iii. Collection of Data
iv. Analysis of Data
v. Interpretation of Data
vi. Presentation of Data

UNIT-VI:

i. Title
ii. Abstract
iii. Introduction
iv. Literature Survey
v. Methodology
vi. Discussion
vii. Findings/Results
viii. Conclusion
ix. Documenting Sources

TEXT BOOKS:

1. Writing for Science, Goldbort R., Yale University Press (available on Google Books), 2006
2. Handbook of Writing for the Mathematical Sciences, Highman N., SIAM. Highman's Book, 1998

REFERENCES:

1. How to Write and Publish a Scientific Paper, Day R., Cambridge University Press, 2006
2. English for Writing Research Papers, Adrian Wall Work, Springer New York Dordrecht Heidelberg London, 2011
3. MLA Handbook for Research

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD07) COMPUTER INTEGRATED MANUFACTURING

COURSE PRE-REQUISITES: Computer Aided Design, Computer Aided Manufacturing, Machine Tools, Operations Research

COURSE OBJECTIVES:
- To understand planning required in manufacturing area now a days
- To learn the fundamentals of computer assisted numerical control programming
- To learn quality control and material handling
- To learn the guidelines and criteria for implementing CAD/CAM systems and assisted software's for manufacturing

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the basics of manufacturing and application of group technology
CO-2: Develop CAPP systems and derive production metrics based on testing
CO-3: Apply concept of quality control and material handling
CO-4: Design automated material handling and storage systems for a typical production system and balance the line

UNIT-I:
Introduction: Scope of computer integrated manufacturing, Product cycle, Production automation.
Group Technology: Role of group technology in CAD/CAM integration, methods for developing part families, classification and coding, Examples of coding systems, Facility design using group technology.

UNIT-II:
Computer Aided Process Planning: Approaches to process planning- Manual, variant, Generative approach, Process planning systems—CAPP, DCLASS, CMPP, Criteria for selecting a CAPP system, Part feature recognition.

UNIT-III:
Integrative Manufacturing Planning and Control: Role of integrative manufacturing in CAD/CAM integration, over view of production control—Forecasting, Master production schedule, rough cut capacity planning, M.R.P., order release, shop floor control, Quality assurance, Planning and control systems, Cellular manufacturing.

UNIT-IV:
Cellular Manufacturing Systems: Part Families, Parts Classification and Coding, Features of Parts Classification and Coding Systems, Opitz of Parts Classification and Coding Systems, Production Flow Analysis, Composite Part Concept, Machine Cell Design, Applications Of Group Technology, Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering, Arranging Machines in a GT Cell.

UNIT-V:
Computer Aided Quality Control: Terminology in quality control, contact inspection methods, Non- Contact inspection methods, Computer Aided Testing, Integration of CAQC with CAD/CAM

UNIT-VI:
Computer Integrated Manufacturing Systems: Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control Systems, FMS.

TEXT BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing, Mikell P. Groover, 3rd Edition, Prentice Hall Inc., New Delhi, 2007
2. Assembly Automation and Product Design, Geoffrey Boothroyd, Taylor and Francis
3. System Approach to Computer Integrated Manufacturing, Nanua Singh, Wiley & Sons Inc., 1996

REFERENCES:

1. Computer Aided Design and Manufacturing, David D. Bedworth, Mark R. Henderson, Philip M. Wolfe, McGraw-Hill Publishers
2. CAD/CAM, Mikel P. Groover, Emery W. Zimmer, PHI Ltd.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1CD08) REVERSE ENGINEERING

COURSE PRE-REQUISITES: CAD, Geometric modeling

COURSE OBJECTIVES:
- To understand the Reverse Engineering (RE) methodology
- To disassemble products and specify the interactions between its subsystems and their functionality
- TO understand Computer-Aided RE and Rapid Prototyping technology

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Basic understanding of engineering systems
CO-2: Understanding the terminologies related to re-engineering, forward engineering, and reverse engineering
CO-3: Understanding of reverse engineering methodologies
CO-4: Understanding of reverse engineering of systems

UNIT-I:
Introduction: Scope and tasks of RE - Domain analysis- process of duplicating

UNIT-II:
Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material - characteristics evaluation - software and application - prototyping - verification

UNIT-III:
History of Reverse Engineering – Preserving and preparation for the four stage process Evaluation and Verification - Technical Data Generation, Data Verification, Project Implementation

UNIT-IV:
Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components

UNIT-V:
Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics

UNIT-VI:
Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing –surface and solid members

TEXT BOOKS:
1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994

REFERENCES:

1. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
2. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
3. Co-ordinate Measurement and Reverse Engineering, Donald R. Honsa, American Gear Manufacturers Association, ISBN 1555897

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M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PE1AM08) DESIGN FOR HYDRAULIC AND PNEUMATIC SYSTEMS

COURSE PRE-REQUISITES: Computer Aided Design, Fluid Power Systems, Control Systems, Machine Tools, Operations Research

COURSE OBJECTIVES:
- To understand the industrial hydraulics and pneumatics, their parts, functions and their structure
- To demonstrate required information about hydraulics and pneumatics
- To understand fundamentals of hydraulic and pneumatic circuit design
- To understand hydraulic and pneumatic automation and basics of PLC controls

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply hydraulic and pneumatic system components and their applications
CO-2: Design hydraulic and pneumatic circuits
CO-3: Classify the similarities and differences of the electrical, pneumatic and hydraulic systems
CO-4: Interpret PLC applications in hydraulic and pneumatic circuits

UNIT-I:
Fluid Power Principles and Fundamentals: Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws.

UNIT-II:
Hydraulic System and Components: Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps, Hydraulic Actuators: Cylinders – Types and construction, Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Applications – Types of actuation.

UNIT-III:
Hydraulic Circuits: Industrial hydraulic circuits- Regenerative, Sequence, Reciprocation, Fail-safe, Speed control, Hydrostatic transmission, Accumulators, Electro hydraulic circuits.

UNIT-IV:
Pneumatic System: Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Pneumatic actuators, Pneumatic logic circuits, Time and pilot control.

UNIT-V:
Design of Hydraulic and Pneumatic Circuits: Design of circuits using the components of hydraulic system for Drilling, Planning, Shaping, Punching, Press, Sequential circuit design for simple application using cascade method, Electro pneumatic circuits, Selection criteria of pneumatic components.

UNIT-VI:
Application: Microprocessor and PLC- Applications in Hydraulic and Pneumatics- Low cost Automation – Hydraulic and Pneumatic power packs.

TEXT BOOKS:

1. Fluid Power with Applications, Anthony Esposito, PHI / Pearson Education, 2005
2. Hydraulic and Pneumatic Controls, Shanmuga Sundaram K., Chand & Co., 2006

REFERENCES:

1. Oil Hydraulics Systems – Principles and Maintenance, Majumdar S. R., Tata McGraw-Hill, 2001
2. Pneumatic Systems – Principles and Maintenance, Majumdar S. R., Tata McGraw-Hill, 2007
3. Power Hydraulics, Michael J., Pinches and Ashby J. G., Prentice Hall, 1989
4. Basic Fluid Power, Dudelyt A. Pease and John J. Pippenger, Prentice Hall, 1987
5. Hydraulic and Pneumatic Control, Srinivasan R., II Edition, Tata McGraw-Hill Education, 2012

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18OE1CN01) BUSINESS ANALYTICS

COURSE OBJECTIVES:

- To understand the role of business analytics within an organization and to analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making and to become familiar with processes needed to develop, report, and analyze business data
- To use decision-making tools/Operations research techniques and to manage business process using analytical and management tools
- To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply knowledge of data analytics
CO-2: Think critically in making decisions based on data and deep analytics
CO-3: Use technical skills in predicative and prescriptive modeling to support business decision-making
CO-4: Translate data into clear, actionable insights

UNIT-I:
Business Analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data Business Analytics Technology.

UNIT-III:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT-VI:

Recent trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business Analytics-Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics, James Evans, Pearson Education
3. Business Analytics, Purba Halady Rao, PHI, 2013

REFERENCES:

1. Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Gert H. N. Laursen, Jesper Thorlund, 2nd Edition, Wiley Publications
2. Business Analytics: Data Analysis & Decision Making, S. Christian Albright, Wayne L. Winston 5th Edition, 2015
3. Business Intelligence Guidebook: From Data Integration to Analytics, Rick Sherman Elsevier, 2014

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18OE1AM01) INDUSTRIAL SAFETY

COURSE PRE-REQUISITES: Elements of Mechanical, Civil, Electrical and Industrial Engineering

COURSE OBJECTIVES:

- To achieve an understanding of principles, various functions and activities of safety management
- To communicate effectively information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities
- To anticipate, recognize, and evaluate hazardous conditions and practices affecting people, property and the environment, develop and evaluate appropriate strategies designed to mitigate risk
- To develop professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards

CO-2: Communicate effectively on health and safety matters among the employees and with society at large

CO-3: Demonstrate the use of state-of-the-art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations

CO-4: Interpret and apply legislative / Legal requirements, industry standards, and best practices in accident prevention programmes in a variety of workplaces

UNIT-I:

Safety Management: Evaluation of modern safety concepts – Safety management functions – safety organization, safety department – safety committee, safety audit - performance measurements and motivation – employee participation in safety and productivity.

UNIT-II:

Operational Safety: Hot metal Operation – Boiler, pressure vessels – heat treatment shop - gas furnace operation-electroplating-hot bending pipes – Safety in welding and cutting. Cold-metal Operation- Safety in Machine shop-Cold bending and chamfering of pipes – metal cutting – shot blasting, grinding, painting – power press and other machines

UNIT-III:

Safety Measures: Layout design and material handling - Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety– Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in industrial hazards.

UNIT-IV:

Accident Prevention: Human side of safety – personal protective equipment – Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP – Training and development of employees – First Aid – Firefighting devices – Accident reporting investigation.

UNIT-V:

Safety, Health, Welfare & Laws: Safety and health standards – Industrial hygiene – occupational diseases prevention - Welfare facilities – History of legislations related to safety– pressure vessel act- Indian boiler act- The environmental protection act – Electricity act - Explosive act.

UNIT-VI:

Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers

TEXT BOOKS:

1. Safety Management, John V. Grimaldi and Rollin H. Simonds, All India Travellers Bookseller, New Delhi, 1989.
2. Safety Management in Industry, Krishnan N. V., Jaico Publishing House, 1996.

REFERENCES:

1. Occupational Safety Manual, BHEL
2. Industrial Safety and The Law, P. M. C. Nair Publisher's, Trivandrum
3. Managing Emergencies in Industries, Loss Prevention of India Ltd., Proceedings, 1999
4. Safety Security and Risk Management, U. K. Singh & J. M. Dewan, A. P. H. Publishing Company, New Delhi, 1996
5. Industrial Safety Management: Hazard Identification and Risk Control, L. M. Deshmukh, McGraw-Hill Education (India) Private Limited, 2005

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18OE1AM02) OPERATIONS RESEARCH

COURSE PRE-REQUISITES: Mathematics, Industrial Engineering

COURSE OBJECTIVES:
- To analyze linear programming models in practical and their practical use
- To apply the transportation, assignment and sequencing models and their solution methodology for solving problems
- To apply the theory of games, replacement, inventory and queuing models and their solution methodology for solving problems
- To evaluate the dynamic programming and simulation models

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply and solve the dynamic programming problems
CO-2: Apply the concept of non-linear programming
CO-3: Carry out sensitivity analysis
CO-4: Model the real world problem and simulate it

UNIT-I:
Introduction to Operations Research-Definitions of OR, Characteristics of OR, Scope of OR, Classification of Optimization Techniques, models in OR, General L.P Formulation, Graphical solution, Simplex Techniques.

UNIT-II:
Revised simplex method - duality theory - dual simplex method – sensitivity or post optimality analysis - parametric programming

UNIT-III:
Nonlinear programming problem - Kuhn-Tucker condition, min cost flow problem - max flow problem - CPM/PERT

UNIT-IV:
Scheduling and sequencing, Inventory models, deterministic inventory, models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:
Waiting line Models, Single and Multi-channel Problems, Dynamic Programming, Game Theory, Simulation.

UNIT-VI:
Introduction to Genetic Algorithms, Operators, applications to engineering optimization, Problems.

TEXT BOOKS:
1. Operations Research, S. D. Sharma, Kedarnath Ramnath, Meerut, New Delhi
2. Engineering Optimization, S. S. Rao, New Age International Publications, 2014
3. Introduction to Genetic Algorithms, S. N. Sivanandam, Springer

REFERENCES:
1. Operations Research-An Introduction, H. A. Taha, PHI, 2008
2. Principles of Operations Research, H. M. Wagner, PHI, Delhi, 1982
3. Introduction to Optimization: Operations Research, J. C. Pant, Jain Brothers, Delhi, 2008

4. Operations Research, Hitler Liebermann McGraw-Hill Pub., 2009
5. Operations Research, Pannerselvam, Prentice Hall of India, 2010

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18OE1AM03) COMPOSITE MATERIALS

COURSE PRE-REQUISITES: Maths, Physics, Chemistry, Engineering Mechanics, Mechanics of Solids

COURSE OBJECTIVES:
- To understand composite materials and their properties, relationship between them and manufacturing methods
- To understand the principles of material science applied to composite materials
- To study the equations to analyze problems by making good assumptions and learn systematic engineering methods to solve practical composite mechanics problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply fundamental knowledge of mathematics to modeling and analysis of composite materials
CO-2: Understand the manufacturing methods of various composite materials
CO-3: Analyze the failure modes of composites

UNIT-I:
Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT-II:
Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements.
Mechanical Behavior of Composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT-III:
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.
Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV:
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications, Introduction to Machining of Composites.

UNIT-V:
Elastic Behavior of Laminate: Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates

UNIT-VI:
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight

strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology, Vol. 13–Composites, R. W. Cahn – VCH, West Germany
2. Analysis and Performance of Fiber Composites, Third Edition, B. D. Agarwal, Wiley Publishers

REFERENCES:

1. Mechanics of Composite Materials, Second Edition. Robert M. Jones, Scripta Book Company
2. Materials Science and Engineering-An Introduction, W. D. Callister Jr., Adapted by R. Bala Subramaniam, John Wiley & Sons, NY, Indian Edition, 2007
3. Composite Materials, K. K. Chawla
4. Composite Materials Science and Applications, Deborah D. L. Chung
5. Composite Materials Design and Applications, Danial Gay, Suong V. Hoa and Stephen W. Tasi

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	3	**0**	**3**

(18OE1PS01) WASTE TO ENERGY

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To create awareness in students of energy conservation
- To identify the use of different types of Bio waste energy resources
- To understand different types of bio waste energy conservations
- To detect different waste conversion into different forms of energy

COURSE OUTCOMES: After completion of the course, students should be able to
CO1: Find different types of energy from waste to produce electrical power
CO2: Estimate the use of bio waste to produce electrical energy
CO3: Understand different types of bio waste and its energy conversions
CO4: Analyze the bio waste utilization to avoid the environmental pollution

UNIT-I:
Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW (Municipal solid waste) – Conversion devices – Incinerators, Gasifiers, Digestors

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III:
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion.

UNIT-VI:
Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:
1. Biogas Technology-Transfer and Diffusion, M. M. EL-Halwagi, Elsevier Applied Science Publisher, New York, 1984
2. Introduction to Biomass Energy Conversions, Sergio Capareda

REFERENCES:

1. Non-Conventional Energy, Desai Ashok V., Wiley Eastern Ltd., 1990
2. Biogas Technology - A Practical Handbook, Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw-Hill Publishing Co. Ltd., 1983
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

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M.Tech. III Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**16**	**8**

(18PW4CD03) PROJECT PART-I

M.Tech. IV Semester (CAD/CAM)	**L**	**T/P**	**C**
	0	**28**	**14**

(18PW4CD04) PROJECT PART-II

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify and formulate the problem (Industry/technical/societal)
CO-2: Analyze, design and develop a solution to industry/technical/societal problems
CO-3: Implement and execute the solution
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- M.Tech. project work shall be for a minimum duration of 40 weeks spread over two semesters i.e., Project Part-I in III semester and Project Part-II in IV semester.
- A student shall be permitted to register for the major project after satisfying the attendance requirement in all the courses, i.e., theory and practical courses.
- Project reviews namely Project Review I and Project Review II in III semester and Project Review III and Project Pre-submission Seminar in IV semester shall be conducted during the course of Project work.
- A Project Review Committee (PRC) consisting of the Head of the Department as Chairperson and PG Coordinator, Project Supervisor and one senior faculty member of the Department offering the M. Tech. programme as members shall evaluate the progress of project work.
- In Project Review I, a student, in consultation with his Project Supervisor, shall present the title, objective and plan of action of his/her project work to the PRC for approval within four weeks from the commencement of III semester.
- A student can initiate the project work only after obtaining the approval of the PRC.
- The work on the project shall be initiated at the beginning of the III semester.
- Project Review II shall be conducted and evaluated at the end of the III semester.
- Project Review III shall be conducted during IV semester to examine the overall progress of the project work.
- A project pre-submission seminar shall be conducted to decide whether or not the project is eligible for final submission.
- After approval from the PRC, a soft copy of the thesis shall be submitted for PLAGIARISM check to the Examination Branch.
- At the end of IV semester upon fulfilling the above conditions, project viva-voce shall be conducted.
- A student shall submit project progress in prescribed report format during each of the project reviews.