R18

M.Tech. (ADVANCED MANUFACTURING SYSTEMS)

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.
(ADVANCED MANUFACTURING SYSTEMS)

M.TECH. (AMS)

PROGRAM EDUCATIONAL OBJECTIVES

PEO-I: Graduates will pursue their professional career in manufacturing domain meeting the needs of Indian and global/multinational organizations.

PEO-II: Graduates will demonstrate strong foundation in the manufacturing domain enabling them to visualize, analyze and solve practical problems with due consideration for economical, safety and environmental concerns.

PEO-III: Graduates will undertake research and engage in continuous upgradation of skills in the manufacturing domain

PEO-IV: Graduates will exhibit leadership qualities with demonstrable attributes in life-long learning to contribute to societal needs.

M.TECH. (AMS)

PROGRAM OUTCOMES

PO-1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO-2: An ability to write and present a substantial technical report/document.

PO-3: An ability to demonstrate a degree of mastery over the manufacturing systems and processes.

PO-4: An ability to design and develop a product or manufacturing system with due consideration for economical, safety, environmental and societal concerns.

PO-5: An ability to assimilate advancements and apply engineering judgment to solve problems in manufacturing.

PO-6: An ability to use skills, modern tools and techniques to solve engineering problems and understand the impact of solution in a global context with professional and ethical responsibilities.

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

(ADVANCED MANUFACTURING SYSTEMS)

I SEMESTER **R18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-I	18PC1AM01	Automation in Manufacturing	3	0	0	3
Professional Core-II	18PC1AM02	Advances in CAD/CAM	3	0	0	3
Professional Core-III	18PC1AM03	Precision Engineering	3	0	0	3
Professional Elective-I	18PE1AM01	Product Data Management	3	0	0	3
	18PE1AM02	Special Manufacturing Processes				
	18PE1AM03	Design for Manufacturing and Assembly				
Professional Elective -II	18PE1AM04	Mechatronics	3	0	0	3
	18PE1AM05	Non-Destructive Testing				
	18PC1CD03	Rapid Prototyping				
Professional Core Lab-I	18PC2CD01	Computer Aided Design Laboratory	0	0	3	1.5
Professional Core Lab-II	18PC2AM01	Automation and Robotics Laboratory	0	0	3	1.5
Project	18PW4AM01	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

(ADVANCED MANUFACTURING SYSTEMS)

II SEMESTER **R18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-IV	18PC1AM04	Advanced Manufacturing Processes	3	0	0	3
Professional Core-V	18PC1AM05	Modeling and Simulation of Manufacturing Systems	3	0	0	3
Professional Core-VI	18PC1AM06	Quality Engineering in Manufacturing	3	0	0	3
Professional Elective-III	18PE1AM06	Tool Design	3	0	0	3
	18PE1CD01	Product Design and Development Strategies				
	18PE1CD03	Flexible Manufacturing Systems				
Professional Elective-IV	18PE1AM07	Intelligent Manufacturing Systems	3	0	0	3
	18PC1CD01	Finite Element Analysis				
	18PC1CD06	Additive Manufacturing Processes				
Professional Core Lab-III	18PC2AM02	Manufacturing Processes and Simulation Laboratory	0	0	3	1.5
Professional Core Lab-IV	18PC2CD04	Computer Aided Machining Laboratory	0	0	3	1.5
Project	18PW4AM02	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

(ADVANCED MANUFACTURING SYSTEMS)

III SEMESTER **R18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Elective-V	18PE1AM08	Design for Hydraulic and Pneumatic Systems	3	0	0	3
	18PC1CD05	Industrial Robotics				
	18PE1CD07	Computer Integrated Manufacturing				
Open Elective	18OE1CN01	Business Analytics	3	0	0	3
	18OE1AM01	Industrial Safety				
	18OE1AM02	Operations Research				
	18OE1AM03	Composite Materials				
	18OE1PS01	Waste to Energy				
Project	18PW4AM03	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	18PW4AM04	Project Part - II	0	0	28	14
Total			**0**	**0**	**28**	**14**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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

(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

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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

(18PC1AM02) ADVANCES IN CAD/CAM

COURSE PRE-REQUISITES: Basic knowledge of CAD/CAM, Production Technology

COURSE OBJECTIVES:

- To comprehend the data exchange formats and know the different transformations in CAD modeling
- To understand parametric representation of synthetic entities
- To compare the different representation schemes and comprehend the applications of CAD
- To understand the NC Systems, NC part programming fundamentals & CNC Systems
- To understand the concept of Adaptive Control, and Computer Aided Inspection & Quality Control and implementation of CAD/CAM software and Post Processor

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

CO-1: Asses the various data exchange formats used and perform the transformations in geometric modeling techniques

CO-2: Derive and apply the parametric representation of synthetic curves and surfaces

CO-3: Validate the solid models through B-rep and CSG representation schemes and illustrate the applications of CAD

CO-4: Work on NC & CNC systems and program

CO-5: Apply the concepts of AC and CAI & QC and implement CAD/CAM software and Post Processor

UNIT-I:

Geometric Modeling: Wireframe modeling - Wire frame entities, Curve representation; Surface modeling - Surface entities, Surface representation; Solid modeling - Solid Entities, Solid Representation.

2D & 3D Transformations: Translation, Rotation, Scaling, Reflection, Shear; Homogenous and Concatenated transformations.

Graphics Standards: Graphics standards – IGES & STEP structure and implementation.

UNIT-II:

Parametric Representation of Synthetic Entities: Parametric representation: Hermite Cubic Spline, Bezier curve, B-Spline curve; Hermite Bi-cubic surface, Bezier surface, B- Spline surface, COONs surface

UNIT-III:

Representation Schemes: Boundary Representation (B-Rep), Constructive Solid Geometry (CSG)

Advanced Modeling Applications: Feature Based and Parametric Modeling, Assembly Modeling – Bottom-Up and Top-Down approach, Mass property calculations, Finite Element Analysis

UNIT-IV:

NC Systems: NC Coordinate systems, elements of NC systems, Classification of NC Systems, Advantages & Disadvantages of NC Systems.

NC Part Programming: 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

CNC Systems: CNC, Features of CNC, Functions of CNC, Advantages

UNIT-V:

Introduction to CAD/CAM Software: Computer assisted part programming, NC programming using CAD/CAM software, Tool path generation using CAD/CAM software, Technology of CAM

Post Processors for CNC: Introduction to post processors, necessity of a post processor, the general structure of a post processor, functions of a post processor

Tooling for CNC Machines: Tool pre-setting, Automatic Tool Changer, Modular fixturing

UNIT-VI:

Adaptive Control: Adaptive control with optimization, Adaptive control with constraints, Adaptive control in machining processes – turning and grinding

Computer Aided Inspection and Quality Control: CMM construction, Limitations of CMM, Computer Aided Testing, Optical inspection methods

TEXT BOOKS:

1. CAD/CAM Theory and Practice, Ibrahim Zeid, McGraw Hill International
2. Computer Aided Design Manufacturing, K. Lalit Narayan, K. Mallikarjuna Rao and M. M. M. Sarcar, Prentice Hall of India
3. Computer Control of Manufacturing Systems, Yoram Koren, McGraw Hill International

REFERENCES:

1. Mastering CAD-CAM, Ibrahim Zeid, McGraw Hill International
2. CAD/CAM, P. N. Rao, Tata McGraw Hill
3. Mathematical Elements for Computer Graphics, Roger D. F. and Adams A., McGraw Hill Inc, NY, 1989
4. Computer Aided Design and Manufacturing, Mikell P. Groover, EW Zimmers Jr., Prentice Hall of International
5. Computer Aided Manufacturing, T. C. Chang, Wysk, H. P. Wang, Pearson/ Prentice Hall International

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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

(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

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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

(18PE1AM01) PRODUCT DATA MANAGEMENT

COURSE PRE-REQUISITES: Production Process, CAD, CAM

COURSE OBJECTIVES:

- To understand process management, plan, and product development
- To understand approach for concept generation and implications of product architecture
- To understand about Robust design and Integration of CAE, CAD and CAM tools along with the principles of rapid prototype
- To understand Product Development Management process

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Develop a sequence for developing a product in a company
CO-2: Generate and select concepts, and understand the implications of product architecture
CO-3: Understand the concepts of robust design, Rapid prototyping
CO-4: Understand the concept of Product development

UNIT-I:
Introduction: Need for IPPD, Strategic importance of product development, Integration of customer designer material supplier and process planner, Competitor and Customer, Behavior analysis, Understanding customer, Promoting customer understanding, Involve customer in development and managing requirements, Organization – Process management and improvement, Plan and establish product specification.

UNIT-II:
Concept Generation and Selection: Task, Structured approaches, Clarification, Search externally and internally, Explore systematically, Reflect on the solutions and process, Concept selection, Methodology, Benefits

UNIT-III:
Product Architecture: Implications, Product change, Variety, Component standardization, Product performance, Manufacturability.

UNIT-IV:
Product Development Management: Establishing the architecture, Creation, Clustering, Geometric layout development, Fundamental and incidental interactions related system level design issues, Secondary systems, Architecture of the chunks, Creating detailed interface specifications.
Industrial Design: Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools - simulating product performance and manufacturing 'processing electronically - Need for industrial design - impact - design process.

UNIT-V:
Investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user - driven products - assessing the quality of industrial design.

UNIT-VI:
Design for Manufacturing and Product Development: Definition - Estimation of manufacturing cost - reducing the component/costs and assembly costs- Minimize system

complexity. Prototype basics - Principles of Rapid prototyping - planning for prototypes – Economic analysis - Understanding and representing tasks - baseline project planning - accelerating the project execution.

TEXT BOOKS:

1. Product Design and Development, Kari T. Ulrich and Steven D. Eppinger, McGraw Mill International Edns.,1999
2. Concurrent Engineering Integrated Product Development, Kemnneth Crow, DRM Associates

REFERENCES:

3. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992
4. Tool Design - Integrated Methods for Successful Product Engineering, Staurt Pugh, Addison Wesley NY, 1991

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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

(18PE1AM02) SPECIAL MANUFACTURING PROCESSES

COURSE PRE-REQUISITES: Manufacturing Technology, Non-conventional Machining Processes

COURSE OBJECTIVES:

- To make use of modern manufacturing operations, including their capabilities, limitations and how to design for lower cost
- To interpret the relationship between customer desires, functional requirements, product materials, product design and manufacturing process selection
- To utilize micro/nano fabrication processes for manufacturing of circuit boards
- To identify the important Rapid prototyping processes used for the fabrication of prototypes and components

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Select the suitable special manufacturing techniques
CO-2: Apply the relevant special manufacturing process as per the functional requirements
CO-3: Apply Micro and Nanofabrication processes in manufacturing Integrated circuit boards
CO-4: Apply rapid prototyping techniques to build a prototype or component

UNIT-I:
Surface Treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, Economics of coating. Electro forming, Physical Vapor Deposition, Chemical Vapor Deposition, Thermal Spraying, Ion Implantation, Diffusion coating, Diamond coating and Cladding.

UNIT-II:
Processing of Ceramics: Applications, Characteristics, Classification, Processing of Particulate Ceramics, Powder preparations, Consolidation, Drying, Sintering, Hot compaction, Area of Application, Finishing of Ceramics.
Processing of Composites: Composite Layers, Particulate and Fiber Reinforced Composites, Elastomers, Reinforced Plastics, MMC, CMC, Polymer matrix Composites.

UNIT-III:
Processing of Integrated Circuits: Overview of IC Processing - Processing Sequence, Clean Rooms, Silicon Processing- Production of Electronic Grade Silicon, Crystal Growing, Shaping of Silicon into Wafers, Lithography- Photolithography, Other Lithography Techniques.

UNIT-IV:
Microfabrication Processes: Silicon Layer Processes, LIGA Process, Other Micro fabrication Processes
Nanofabrication Processes: Top-Down Processing Approaches, Bottom-Up Processing Approaches

UNIT-V:
Advanced Manufacturing: E-Manufacturing, High Speed Machining, Micromachining, Nanomachining and Additive manufacturing.

UNIT-VI:
Prototyping: Need of Prototyping, Process of Prototyping and its Advantages, Rapid Prototyping and its working principles, Methods, Stereo-Lithography, Laser Smiting, Fused Deposition Method, Applications and Limitations.

TEXT BOOKS:

1. Manufacturing Engineering and Technology, Kalpak Jian, Adisson Wesley, 1995
2. Fundamentals of Modern Manufacturing, Mikell P. Groover, 4th Ed., John Wiley & Sons, Inc.

REFERENCES:

1. Advanced Machining Processes, V. K. Jain, Allied Publications
2. Process and Materials of Manufacturing, R. A. Lindburg, 11th Edition, PHI, 1990
3. Introduction to Manufacturing Processes, John A. Schey, McGraw Hill

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (AMS)	**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:

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

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (AMS)	**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

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

(18PE1AM05) NON-DESTRUCTIVE TESTING

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To know various methods of Non-Destructive Testing
- To understand the concept of non-destructive testing
- To describe the various types of NDT tests carried out on components
- To understand the applications of NDT in engineering

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Comprehend the theory of non-destructive testing and use visual methods
CO-2: Distinguish between the various NDT like Thermography, Eddy Current, Liquid Penetrant and Magnetic Particle methods
CO-3: Compare the NDT processes like Radiography, Ultrasonic and Acoustic Emission
CO-4: Apply knowledge of non-destructive testing to evaluate products of railways, automobiles, aircrafts, chemical industries etc.

UNIT-I:
Introduction: Fundamentals of destructive and non-destructive testing, Scope and limitations of NDT
Visual Tests: Visual examination methods - Unaided and aided.

UNIT-II:
Thermography and Eddy Current Testing
Thermography: Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentation and methods, Applications
Eddy Current Test: Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, Advantages, Limitations, Interpretation

UNIT-III:
Liquid Penetrant and Magnetic Particle Tests
Liquid Penetrant Tests: Characteristics of liquid penetrants, Different washable systems, Developers, Applications
Magnetic Particle Tests: Methods of production of magnetic fields, Principles of operation of magnetic particle test, Applications, Advantages and limitations

UNIT-IV:
Radiography: Principle, Interaction of X-Ray with matter, Imaging, Film and film square less techniques, Types and use of filters and screens, Geometric factors, Inverse square, Law, Characteristics of films – graininess, density, speed, contrast, characteristic curves; Penetrameters, Exposure charts, Radiographic equivalence; Fluoroscopy - Xero-radiography, Computed radiography, Computed Tomography

UNIT-V:
Ultrasonic and Acoustic Emission Techniques:
Ultrasonic Techniques: Production of ultrasonic waves, Different types of waves, General characteristics of waves, Pulse echo method - A, B, C scans
Acoustic Emission Techniques: Principles of acoustic emission techniques, Advantages and limitations, Instrumentation, Applications

UNIT-VI:

Industrial Applications of NDT

Span of NDT Activities: Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry; NDT of pressure vessels, castings, welded constructions.

TEXT BOOKS:

1. Non-Destructive Testing, Barry Hull and Vernon John, MacMillan, 1988
2. Practical Non-Destructive Testing, Baldev Raj, T. Jayakumar & M. Thavasimuthu, Norosa Publishing House, New Delhi, 2009
3. Non-Destructive Testing Techniques, Ravi Prakash, 1st Revised Edition, New Age International Publishers, 2010

REFERENCES:

1. Non-Destructive Testing, Louis Cartz, ASM International
2. Non-Destructive Evaluation and Quality Control, ASM Metals Handbook, Vol. 17, ASME
3. Introduction to Non-Destructive Testing: A Training Guide, Paul E. Mix, 2nd Edition, Wiley, New Jersey, 2005
4. Handbook of Non-Destructive Evaluation, Charles, J. Hellier, McGraw Hill, New York, 2001

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (AMS)	**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 System: 3D systems' SLA, Cubital's SGC, Sony's SCS, Other similar commercial RP systems, micro fabrication.

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

UNIT-IV:
Powder Based RP System: 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

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (AMS)	**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

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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

(18PC2AM01) AUTOMATION AND ROBOTICS LABORATORY

COURSE PRE-REQUISITES: Manufacturing Processes, Fluid and Electric Controllers, Robot Programming, Mathematics

COURSE OBJECTIVES:

- To comprehend the working of hydraulic, pneumatic, electric and electronic controls used in automation
- To understand the role of PLC's, microprocessor in automation
- To demonstrate the robotics manipulator motions using the robotic programming and simulation software

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Design hydraulic and pneumatic circuits
CO-2: Understand PLC ladder logic
CO-3: Control kinematic motions of robot

LIST OF EXPERIMENTS:

1. To design a pneumatic circuit to actuate a single acting pneumatic cylinder using 3/2 manual push button and roller lever type DCV's
2. To control double acting single hydraulic cylinder by manually operated DCV
3. To determine the torque vs. speed characteristics using VVVF Electrical drive system
4. To control single acting pneumatic cylinder using Cam Controller
5. To control a robot by applying direct and inverse kinematics using robot simulation software and actuate a robot with teach pendant
6. Demonstration on PLC with ladder logic
7. To observe the working of sensors like strain, optical filters for red, green color, angular measuring unit, LVDT, pressure sensor
8. Determination of Water level using capacitive transducer
9. Demonstration on microprocessor-based stepper motor
10. To compare an open loop and closed loop control system

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

(18PW4AM01) 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 (AMS)	**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 (AMS)	**L**	**T/P**	**C**
	3	**0**	**3**

(18PC1AM04) ADVANCED MANUFACTURING PROCESSES

COURSE PRE-REQUISITES: Basics of Manufacturing Technology

COURSE OBJECTIVES:
- To know the various advanced manufacturing processes
- To understand the working principle of advanced manufacturing processes
- To have an overview of the micro-manufacturing processes

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify and utilize the manufacturing processes like advanced casting, and advanced welding
CO-2: Identify and utilize the manufacturing processes like advanced forming and advanced machining
CO-3: Apply the advanced techniques for materials processing
CO-4: Relate to the different types of micro-manufacturing processes

UNIT-I:
Advanced Casting Processes: Construction & principle of operation, advantages, limitations and applications of - Metal mould casting, Continuous casting, Squeeze casting, Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting

UNIT-II:
Advanced Welding Processes: Construction & principle of operation, advantages, limitations and applications of - Electron beam welding (EBW), Laser beam welding (LBW), Ultrasonic welding (USW), Friction Stir welding (FSW)

UNIT-III:
Advanced Metal Forming Processes: Construction & principle of operation, advantages, limitations and applications of - High energy rate forming (HERF) process, Electro-magnetic forming, Explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming

UNIT-IV:
Advanced Machining Processes: Construction & principle of operation, advantages, limitations and applications of - Ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM), Electrochemical machining (ECM), Electro discharge machining (EDM), Electron beam machining (EBM), Laser beam machining (LBM)

UNIT-V:
Advanced Techniques for Materials Processing: Construction & principle of operation, advantages, limitations and applications of - Shape tube electrolytic machining, Electro jet machining, Electrolytic in-process dressing, Laser based heat treatment, Electrochemical grinding, Electrochemical etching

UNIT-VI:
Micro-Manufacturing Processes: Introduction to Micro-manufacturing processes, Overview of Micro-manufacturing processes like, Micro-EDM, Micro-electrochemical machining, Micro-milling, Micro-USM, Micro-forming – Laser assisted micro-forming, Micro-Bulk forming, Micro-Hydroforming, Micro-electrochemical machining, Laser Micro-structuring, Micro-Injection Molding, , Micro-mechanical Assembly, Laser Beam Micro Joining

TEXT BOOKS:

1. Advanced Machining Processes, V. K. Jain, Allied Publishers, 2010
2. Manufacturing Science, A. Ghosh and A. K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi

REFERENCES:

1. Materials and Processes in Manufacturing, E. P. DeGarmo, J. T. Black, R. A. Kohser, 8th Edition, Prentice Hall of India, New Delhi
2. Non-Traditional Manufacturing Processes, G. F. Benedict, Marcel Dekker, Inc. New York
3. Micro-Manufacturing Engineering and Technology, Yi Qin, Elsevier, 2010

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

(18PC1AM05) MODELING AND SIMULATION OF MANUFACTURING SYSTEMS

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To understand the basics of simulation modeling and its applications in manufacturing
- To evaluate the parameters, develop and validate simulation models
- To random number and random variate generation using different techniques
- To create awareness on various simulation languages and analyzing the output data

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Classify the types of models and summarize the applications of simulation
CO-2: Estimate the parameters through hypothesis testing
CO-3: Build and validate simulation model
CO-4: Generate random numbers and variates to execute a simulation model
CO-5: Analyze and interpret the output data of using simulation languages

UNIT-I:
Introduction: Simulation – advantages and disadvantages, System environment, Components of a system, Model of a system, Types of models, Steps in a simulation study
Applications of Simulation: Simulation of queuing system, Simulation of Inventory system, Simulation of manufacturing and material handling system

UNIT-II:
Parameter Estimation: Introduction, Estimator – properties, Estimate - Point estimate, Estimation of confidence interval, Hypothesis testing, Steps and errors in hypothesis testing, The Strong law of large numbers.

UNIT-III:
Building of Simulation Model and Validation: Verification, Credibility-their timing, Principles of valid simulation modeling, Techniques for verification, Statistical procedures for developing credible model, Modeling of stochastic input elements, Importance, Various procedures, Theoretical distributions and their suitability in modeling

UNIT-IV:
Generation of Random Variates: Factors for selection, Methods: Inverse transform, Composition, Convolution and acceptance-rejection, Generation of random variants for Uniform, Exponential, Weibull and Normal distributions, Generation of discrete random variants for Bernoulli, Binomial, Uniform and Poisson distributions

UNIT-V:
Output Data Analysis: Types of simulation with respect to output data analysis, Warm-up period, Welch algorithm, approaches for steady state analysis, Replication & batch means methods.

UNIT-VI:
Simulation Languages: Introduction, Comparison of simulation packages with programming languages, Classification of simulation software, Desirable software features, General purpose simulation packages

TEXT BOOKS:

1. Simulation Modelling and Analysis, Law A. M. & Kelton, McGraw-Hill, Edition, New York, 1991
2. Discrete Event System Simulation, Banks J. & Carson J. S., PH/Englewood Cliffs, NJ, 1984

REFERENCES:

1. A Course in Simulation, Ross, S. M., McMillan, NY, 1990
2. Simulation of Manufacturing Systems, Carrie A., Wiley, NY, 1990

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

(18PE1AM06) TOOL DESIGN

COURSE PRE-REQUISITES: Design Principles, Machine Tools, Process Engineering

COURSE OBJECTIVES:
- To list and inspect the properties of tool materials such as ferrous, non-ferrous, non-metallic materials and their heat treatment
- To interpret the single and multi-point cutting tools for various applications
- To build the sheet metal tools for blanking, piercing, bending, forming and drawing etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply an appropriate heat treatment process for the tools
CO-2: Evaluate the design and performance of single and multi-point cutting tools for various methods
CO-3: Examine the design of sheet metal tools for blanking, piercing, bending, forming and drawing

UNIT-I:
Tool Materials: Properties of materials- Tools steels, Cast Iron, Mild or low carbon steels, Nonmetallic and Nonferrous materials and its Heat treatment.

UNIT-II:
Design of Cutting Tools: Basic requirements of a cutting tool, Single Point cutting tools, Milling cutters, Drills, Determination of shank size for Single Point carbide tools, determining the insert thickness for carbide tools

UNIT-III:
Design of Jigs and Fixtures: Basic principles of location, Locating methods and devices, Basic principles of clamping, Jigs-Definition, Types, General considerations in the design of Drill jigs, Drill bushing, Fixtures- Vise fixtures, Milling, Boring, Lathe and Grinding fixtures.

UNIT-IV:
Design of Sheet Metal Blanking and Piercing Dies: Fundamentals of Die cutting operation, Power press types, General press information, Cutting action in Punch, Die operations, Die clearance, Die design fundamentals-Blanking and piercing die construction, pilots, stripper and pressure pads.

UNIT-V:
Design of Sheet Metal Bending, Forming and Drawing Dies: Bending dies, drawing dies, forming dies, drawing operations, Variables that effect metal flow during drawing. Determination of blank size, drawing force.

UNIT-VI:
Tool Design for Numerically Controlled Machine Tools: Cutting tools for numerical control, tool holding methods for numeric control, automatic tool changers and tool positioners.

TEXT BOOKS:
1. Tool Design, Donaldson, Tata McGraw Hill
2. Mechanical Metallurgy, George F. Dieter, Tata McGraw Hill

REFERENCES:
1. American Society for Metals, Taylour Altm, Sool Ik-Oh and Harold L. Gegel, 1983

2. Handbook of Metal forming, Kurt Lange, McGraw-Hill, 1987

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

(18PE1CD01) PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

COURSE PRE-REQUISITES: Engineering Drawing, Engineering Design, Manufacturing

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. II Semester (AMS)	**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, Kanban 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. Handbook 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, Groover M. P., Prentice Hall of India Pvt., New Delhi, 1996

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

(18PC1CD01) FINITE ELEMENT ANALYSIS

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

COURSE OBJECTIVES:
- Tnderstand 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 nonlinear 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 nonlinear 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 for 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 and hexahedra 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 Ed., Prentice Hall of India Pvt. Ltd. New Delhi
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley, New York, 4th Ed.

REFERENCES:
1. A First Course in Finite Element Method, Logan Deryl L., 5th Ed., 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.

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M.Tech. II Semester (AMS)	**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. Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Andreas Gebhardt, Hanser Publishers, 2013

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

(18PC2AM02) MANUFACTURING PROCESSES AND SIMULATION LABORATORY

COURSE PRE-REQUISITES: Knowledge of Manufacturing Processes & Simulation

COURSE OBJECTIVES:
- To understand the basics of various machining, casting and joining processes
- To learn the process of sand casting and molding processes
- To understand the fused deposition-based 3D printing process
- To design a simulation model
- To study simulation of queuing systems, inventory systems and Job shop systems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Experiment with machining operations like eccentric turning, facing, gear cutting, reaming, boring and grinding on various machine tools
CO-2: Perform operations on blow molding, TIG welding and casting processes
CO-3: Build 3D printed prototype of mechanical engineering components
CO-4: Develop and simulate queuing, inventory, planning and scheduling systems
CO-5: Model appropriate production system for a plant

MANUFACTURING PROCESSES

1. Lathe: Four Jaw Chuck Eccentric Turning and Facing of Square and Rectangular
   a. Block
2. Milling: Hexagonal Cutting and Spur Gear Cutting
3. Drilling: Reaming & Boring
4. Casting: Casting of Pulley using Induction Furnace
5. Welding: TIG Welding
6. Molding: Blow Molding
7. Grinding: Surface Grinding
8. 3D Printing: Prototype of mechanical component using Fused Deposition Modeling

MANUFACTURING SIMULATION

1. Simulation of Single Server Single Queue System
2. Simulation of Multiple Server Single Queue System
3. Simulation of Inventory System
4. Simulation of Flexible Manufacturing System
5. Simulation of Job Shop Production System

SOFTWARES: Flexsim

Note:
1. Processors, Operators, Conveyors, AGVS, Transporters, Racks, Robots, Cranes etc. may be used at appropriated places in the exercises
2. Exercises may include Material Handling Systems, AGV Planning, ASRS Simulation, MRP, Shop Floor scheduling, JIT System, Kanban flow.

REFERENCES:
1. A Textbook of Production Technology by P.C. Sharma, S. Chand, 2014
2. Manufacturing Technology-Vol. I and II by P.N. Rao, McGraw Higher Ed., 2017
3. Flexsim 2019 Help Manual

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

(18PC2CD04) COMPUTER AIDED MACHINING LABORATORY

PREREQUISITES: 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

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

(18PW4AM02) 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

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M.Tech. II Semester (AMS)	**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

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M.Tech. III Semester (AMS)	**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

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M.Tech. III Semester (AMS)	**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: 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. III Semester (AMS)	**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.

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M.Tech. III Semester (AMS)	**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

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M.Tech. III Semester (AMS)	**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 (AMS)	**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

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M.Tech. III Semester (AMS)	**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

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M.Tech. III Semester (AMSI)	**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, the student 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 (AMS)	**L**	**T/P**	**C**
	0	**16**	**8**

(18PW4AM03) PROJECT PART-I

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

(18PW4AM04) 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.