M.Tech  COMPUTER INTEGRATED MANUFACTURING  
(CIM)  
Curriculum & Syllabus  
2013 – 2014  

FACULTY OF ENGINEERING AND TECHNOLOGY  
SRM UNIVERSITY  
SRM NAGAR, KATTANKULATHUR – 603 203
### M.Tech COMPUTER INTEGRATED MANUFACTURING (CIM)

**Curriculum 2013 – 2014**

*For students admitted from the academic year 2013 – 2014*

<table>
<thead>
<tr>
<th>Type of course</th>
<th>Credits to be earned</th>
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<td>Core courses</td>
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<td>Optional / Elective Courses (Program Electives)</td>
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#### Core courses

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<tr>
<td>ME2201 / ME2202</td>
<td>Computer Aided Design in Manufacturing (or) Finite Element Analysis in Manufacturing</td>
<td>3</td>
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<td>ME2207</td>
<td>Sensors for Intelligent Manufacturing and Condition Monitoring</td>
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**Other Courses**

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**Project Work**

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Guidelines for choosing courses

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CONTACT HOUR/CREDIT:

L: Lecture Hours per week       T: Tutorial Hours per week
P: Practical Hours per week     C: Credit
ME2201  COMPUTER AIDED DESIGN IN MANUFACTURING  

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Total contact hours – 75

**Prerequisites**
Nil

**PURPOSE**
To give clear idea about the role of computer aided design in manufacturing to students.

**INSTRUCTIONAL OBJECTIVES**
To introduce

1. The role of computers in design and manufacture.
2. Both the hardware and software of CAD/CAM systems together with the practical discussion of their use in engineering.
3. Computer graphics for drafting and analysis.
4. Integration of CAD, Simulation, Manufacturing, Production planning and control.

**UNIT I - HIERARCHY OF COMPUTERS IN MANUFACTURING**
(10 hours)


**UNIT II - CAD/CAM HARDWARE/SOFTWARE**
(9 hours)

Types of computer Systems, Devices and their functioning (work stations, PC’s, mouse, Floppy drive, digitizer, display devices, key board. etc.) - CAD/CAM Software- Operating System-Graphics Standards –Basic Definitions, modes of graphics operations-User interface-Software Modules-Software Development.

**UNIT III - TWO DIMENSIONAL AND THREE DIMENSIONAL TRANSFORMATIONS**
(9 hours)

2D-representation and Transformation of points- Transformation lines – Rotation, Scaling, Translation, reflection and combined transformations – 3D

UNIT IV - MODELLING AND ANALYSIS (9 hours)

UNIT V - COMPUTER INTEGRATED DESIGN (8 hours)
Design Phases – Standardization and Interchangeability of Machine Elements, Concurrent Engineering – meaning, scheme and design of concurrent engineering, design for assembly and modular construction – Concept of integration. Data base for CAD.

REFERENCES

<table>
<thead>
<tr>
<th>ME2202</th>
<th>FINITE ELEMENT ANALYSIS IN MANUFACTURING</th>
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L T P C

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PURPOSE
To present the basics of finite element analysis and its applications in Manufacturing to the students in a structured way.

INSTRUCTIONAL OBJECTIVES
To familiarize
1. Basic concepts and different methods used in finite element analysis.
2. Analysis of one dimensional and two dimensional problems using finite
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<table>
<thead>
<tr>
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<tr>
<td>3.</td>
<td>Applications of FEA in manufacturing.</td>
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<tr>
<td>4.</td>
<td>Computer implementation of FEM and application packages like ANSYS, DEFORM, etc.,</td>
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**UNIT I - INTRODUCTION TO FINITE ELEMENT ANALYSIS**  
(15 hours)

**UNIT II - FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEMS**  
(15 hours)
General procedure of FEM, skeletal and continuum structures, discretization of domain, basic types of elements, shape functions, formulation of element stiffness matrices, truss, beam elements,. One dimensional second order equations, shape functions for one dimensional and two dimensional elements -generalized coordinate approach, derivation of element equation-assembly of element equation- imposition of boundary conditions- solution of equation- Cholesky method- extension of the method to fourth order equation- time dependent problems from heat transfer and solid mechanics-heat transfer through simple fins, composite wall, bending of beams.

**UNIT III - FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS**  
(15 hours)

**UNIT IV - APPLICATION OF FEA IN MANUFACTURING**  
(15 hours)
FE analysis of Metal casting – latent heat incorporation, time stepping procedure, analysis of metal forming- sheet metal stamping, Analysis of Metal cutting, chip separation criteria, incorporation of strain rate dependency.
UNIT V - COMPUTER IMPLEMENTATION OF FEM (15 hours)
Preprocessing, mesh generation, element connecting, boundary conditions, input of material and processing characteristics, solution and post processing, Fundamentals of application packages like ANSYS, DEFORM and LS DYNA.

REFERENCES

7. www.DEFORM.com
8. www.ansys.com

<table>
<thead>
<tr>
<th>ME2203</th>
<th>PRINCIPLES OF COMPUTER INTEGRATED MANUFACTURING</th>
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Prerequisites
Nil

PURPOSE
To enable the students to understand the basic principles of CIM and its elements.

INSTRUCTIONAL OBJECTIVES
To familiarise
1. The basic components of CIM and its hardware and software
2. CAD/CAM and its integration with CIM
3. FMS and its applications
4. Principles of computer aided process planning, JIT and GT
5. Different monitoring systems used in CIM
6. Computer Aided Quality Control and FIS
UNIT I - INTRODUCTION TO CIM (15 hours)
Manufacturing - Types, Manufacturing Systems, CIM Definition, CIM wheel, CIM components, Evolution of CIM, needs of CIM, Benefits of CIM, basic components of NC system, NC motion control system, applications of NC, advantages and disadvantages of NC, computer Numerical control, advantages of CNC, functions of CNC, Direct Numerical Control, components of a DNC system, functions of DNC, advantages of DNC.

UNIT II - CAD (15 hours)
Development of computers, CIM Hardware & Software, Data-Manufacturing data, types, sources, Structure of data models, Data base and DBMS-requirement, RDBMS, SQL, Computer Aided Design - benefits, Graphic Standards, Interfaces, CAD software, Integration of CAD/CAM/CIM.

UNIT III - FLEXIBLE MANUFACTURING SYSTEMS (15 hours)
FMS concept, Components of FMS, FMS Layouts, FMS planning and implementation, Tool Management systems-Tool monitoring, Work holding devices- Modular fixuring, flexible fixturing, flexibility, quantitative analysis of flexibility, application and benefits of FMS, automated material handling system –AGVs, Guidance methods, AS/RS.

UNIT IV - AUTOMATED PROCESS PLANNING (15 hours)

UNIT V - MONITORING AND QUALITY CONTROL (15 hours)
Types of production monitoring system, process control & strategies, direct digital control - Supervisory computer control - computer aided quality control - objectives of CAQC, QC and CIM, contact, non-contact inspection methods, CMM and Flexible Inspection systems. Integration of CAQC with CIM.

REFERENCES
3 Scheer. A.W., 'CIM- Towards the factory of the future' Springer - Verlag, 1994

<table>
<thead>
<tr>
<th>ME2204</th>
<th>CNC MACHINING TECHNOLOGY</th>
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**PURPOSE**
To provide knowledge on principle, constructional features, programming, tooling and work holding devices in CNC machine tools

**INSTRUCTIONAL OBJECTIVE**
Upon completion of this subject, student will be able to:

1. Understand of CNC machine tools and machining centres
2. Describe constructional features of CNC machine tools
3. Explain drives and tooling systems used in CNC machine tools
4. Understand feedback and adaptive control of CNC machines
5. Write simple programs for CNC turning and machining centres

**UNIT I - INTRODUCTION TO CNC MACHINE TOOLS** (6 hours)
Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre-features and applications, Automatic tool changers and Multiple pallet system, types of control systems, CNC controllers, characteristics, interpolators.

**UNIT II - STRUCTURE OF CNC MACHINE TOOL** (10 hours)
CNC Machine building, structural details, configuration and design, guide ways –Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, rack and pinion, spindle assembly, torque transmission elements –
gears, timing belts, flexible couplings, Bearings. Swarf removal and safety considerations.

UNIT III - DRIVES AND TOOLING SYSTEMS (9 hours)
Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives – stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control,
Tooling requirements for turning and machining centres, Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts, classification- qualified, semi qualified and preset tooling, coolant fed tooling system, work holding devices for rotating and fixed work parts, modular fixtures.

UNIT IV - FEEDBACK SYSTEMS AND ADAPTIVE CONTROL (10 hours)

Adaptive Control – Adaptive control with constraints (ACC), Adaptive control with optimization (ACO), Geometric adaptive control (GAC)-basic concepts, Examples for ACC, ACO and GAC, Variable gain AC systems-stability problem, estimator algorithm, variable gain algorithm, Adaptive control of grinding process- grinding model, optimization strategy, design of adaptive control for grinding, sensors for adaptive control of CNC machine tools.

UNIT V - CNC PROGRAMMING (10 hours)
Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre .generation of CNC codes from CAM packages. Basics of APT.

PRACTICAL- 30 Hours

REFERENCES

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**Prerequisite**: Nil

**PURPOSE**
To highlight the concepts and elements of Manufacturing Information Systems

**INSTRUCTIONAL OBJECTIVE**
To familiarize
1. Study of MRP, MRP II with role of production organization
2. Concepts of database
3. Designing of database
4. Models in manufacturing
5. Computerised manufacturing information system with practical application

**UNIT I - INTRODUCTION**
(5 hours)
The Evolution of order policies from MRP to MRP II, Operations control, the role of production organization.

**UNIT II - DATABASE CONCEPTS**
(15 hours)
Data modeling for a database, records and files, abstraction and data integration. Three level architecture for DBMS, Components of DBMS, Advantages and disadvantages of DBMS.
UNIT III - DESIGNING DATABASE (20 hours)

UNIT IV - MANUFACTURING CONSIDERATION (20 hours)
The product and its structure, Inventory and process flow, Shop floor control, Data structure and procedure. Various models - The order scheduling module- Input/Output analysis module- Stock status database- Complete IOM database.

UNIT V --INFORMATION SYSTEM FOR MANUFACTURING (15 hours)
Computerised manufacturing information system- Case study.

REFERENCES

<table>
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<th>ME2206</th>
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PURPOSE
To highlight the basic concepts and procedure for simulation of manufacturing systems.

INSTRUCTIONAL OBJECTIVES
To familiarize
1. Basics of simulation and its types
2. Techniques for generation of random numbers
3. Design and evaluation of simulation experiments
4. Simulation languages
5. Concepts and simulation of discrete events
UNIT I – INTRODUCTION  
(10 hours)
Systems – discrete and continuous systems, general systems theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, Principle of computer modeling- Monte Carlo simulation, Nature of computer modeling, limitations of simulation, area of application.

UNIT II - RANDOM NUMBER GENERATION  
(15 hours)
Techniques for generating random numbers- mid square method, mid product method, constant multiplier technique, additive congruential method, linear congruential method. Tests for random numbers- Kolmogorov-Smirnov test, the Chi-square test.

UNIT III - DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS  
(15 hours)
Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow charts, starting condition, run size, experimental design consideration, output analysis, verification and validation of simulation models.

UNIT IV - SIMULATION LANGUAGES  
(15 hours)
Comparison and selection of simulation languages, study of any one simulation language

UNIT V - DISCRETE EVENT SIMULATION  
(20 hours)

REFERENCES


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<th>ME2207</th>
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Total contact hours – 75
Prerequisite
Nil

**PURPOSE**
To expose the students to different types of Sensors used in manufacturing and fundamentals of condition monitoring.

**INSTRUCTIONAL OBJECTIVES**
To familiarize
2. Different types of sensors in manufacturing.
3. Sensors in CNC machine tools

**UNIT I – INTRODUCTION TO SENSORS** (9 hours)
Introduction- Role of sensors in manufacturing automation – operation principles of different sensors - electrical, optical, acoustic, pneumatic, magnetic, photo -electric, electro-optical, vision, proximity.

**UNIT II - SENSORS IN MANUFACTURING** (9 hours)
Sensors in Manufacturing- Industrial sensors - Temperature sensors- Semiconductor absorption sensors, Non-contact sensors, Pyrometers, Pressure sensors-piezoelectric circuit, strain gauges, fiber optic pressure sensors, displacement sensors for robotic applications, Manufacturing of industrial sensors – Semiconductors, Fiber optics sensors and their principles and applications.

**UNIT III - SENSORS IN MACHINE TOOLS** (9 hours)
Sensors in CNC machine tools – Linear and Angular position sensors, Velocity sensors, Principles and applications.
Sensors in Robots-Position sensors, encoder and revolvers, potentiometers, range proximity touch – torque sensors, Machine vision, Smart sensors.
UNIT IV - CONDITION MONITORING (9 hours)

UNIT V - IDENTIFICATION TECHNIQUES (9 hours)
Automatic identification techniques for shop floor control, optical character and machine vision sensors, smart / intelligent sensors, integrated sensors, Robot sensors, Micro sensors, Nano sensors.

PRACTICAL – 30 Hours

REFERENCES

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**Total contact hours – 75**

**Prerequisite**

**Nil**

**PURPOSE**

To highlight the applications of computers in inspection and NDE.

**INSTRUCTIONAL OBJECTIVES**

To familiarize

1. Basics of computer aided inspection
2. Various computer aided inspection devices

**UNIT I - COMPUTER AIDED METROLOGY AND MEASURING MACHINES** (10 hours)


**UNIT II - LIQUID PENETRANT INSPECTION AND SHEAROGRAPHY** (8 hours)


**UNIT III - MAGNETIC PARTICLE INSPECTION AND ACOUSTIC EMISSION** (9 hours)

Principles of acoustic emission techniques, instrumentation, applications, advantages and limitations.

UNIT IV - RADIOGRAPHY INSPECTION (9 hours)

UNIT V - ULTRASONIC INSPECTION (9 hours)

PRACTICAL – 30 Hours

REFERENCES

7. www.ndt.org
ME2209 ADVANCED MATERIALS ENGINEERING

Total contact hours – 75

Prerequisite
Nil

PURPOSE
To highlight the materials used in manufacturing and their behaviour under service.

INSTRUCTIONAL OBJECTIVES
To familiarize
1. Mechanical behaviour of metals.
2. Fracture behaviour of metals and failure analysis.
3. Selection of materials and their applications with case studies.

UNIT I - MECHANICAL BEHAVIOUR
(15 hours)
Elastic – Plastic Behaviour in metals, Plastic deformation mechanism, Role of dislocations on plastic deformation, shear strength of perfect and real crystals - strengthening mechanisms – strain hardening / work hardening, Alloying / solid solutioning, Grain boundary strengthening, Poly phase mixture, Precipitation strengthening, Martensite strengthening, Fibre, particle and Dispersion strengthening, - Effect of Temperature, Strain, and Strain Rate on Plastic behaviour – super Plasticity.

UNIT II - FRACTURE BEHAVIOUR AND FAILURE ANALYSIS
(15 hours)

UNIT III - SELECTION OF MATERIALS
(15 hours)
between Material Selection and Processing - Case Studies in Material Selection for Aero, Auto, Marine, Machinery and Nuclear Applications.

UNIT IV- MODERN METALLIC MATERIALS (15 hours)
Dual Phase Steels, Micro Alloyed Steel, High Strength Low Alloy (HSLA) Steel, Transformation Induced Plasticity (TRIP) Steel, Maraging Steel, Intermetallics Ni and Ti Aluminides, Smart Materials, Shape Memory Alloys, Metallic Glass, Quasi Crystal and Nano Grystalline Materials.

UNIT V- NON METALLIC MATERIALS (15 hours)

REFERENCES

10. www.astm.org/labs/pages/131350.htm
OPTIONAL / ELECTIVE COURSES (PROGRAM ELECTIVES)

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Total contact hours – 45

Prerequisites
Nil

PURPOSE
To study the principles of concurrent engineering and how it can be applied.

INSTRUCTIONAL OBJECTIVES
1. To familiarize with the basics of concurrent engineering
2. The tools and methodologies available in CE
3. Various approaches to CE
4. The other related aspects of CE

UNIT I - INTRODUCTION (9 hours)

UNIT II- CONCURRENT ENGINEERING TOOLS (9 hours)

UNIT III IMPLEMENTATION OF CONCURRENT ENGINEERING (9 hours)
Implementing CE in an organization – concurrent Engineering Teams – their roles and responsibilities Organizational functions to support CE team environment. Setting Team goals, measuring performance of team & managing a CE Team, Limitations of team.

UNIT IV CONCURRENT APPROACHES TO DESIGN AND MANUFACTURE (9 hours)
UNIT V CONCURRENT APPROACHES TO OTHER ASPECTS OF ENGINEERING


REFERENCES


UNIT I- INTRODUCTION

Definitions, evolution, CAD for RPT. Product design and rapid product development. The cost and effects of design changes during conceptual
modeling, detail designing, prototyping, manufacturing and product release. Fundamentals of RPT technologies, various CAD issues for RPT. RPT and its role in modern manufacturing mechanical design. 3D solid modeling software and their role in RPT. Creation of STL or SLA file from a 3D solid model.

UNIT II - LIQUID AND POWDER BASED RP PROCESSES (9hours)
Liquid based process: Principles of STL and typical processes such as the SLA process, solid ground curing and others - Powder based process: Principles and typical processes such as selective laser sintering and some 3D printing processes.

UNIT III - SOLID BASED RP PROCESSES (9hours)
Principles and typical processes such as fused deposition modeling laminated object modeling and others.

UNIT IV - RAPID TOOLING (9hours)
Principles and typical processes for quick batch production of plastic and metal parts though quick tooling.

UNIT V - REVERSE ENGINEERING (9hours)
3D scanning, 3D digitizing and Data fitting,. High speed machining- Hardware and software - Applications: Evaluation, benchmarking and various case studies.

REFERENCES

ME2211  APPLICATIONS OF COMPUTERS IN MANUFACTURING  

3 0 0 3

Total contact hours – 45

Prerequisites
Nil

PURPOSE
To highlight different applications of computers in manufacturing

INSTRUCTIONAL OBJECTIVES
To familiarize
1. Applications of computers in process design
2. Applications of computers in precision machining and inspection
3. Applications of computers in communication as used in manufacturing

UNIT I - INTRODUCTION (5 hours)
Introduction – computer – Hardware and software – Types and system organization – Applications in Sales forecasting, Marketing – Cost and profit analysis.

UNIT II - PRODUCT CONCEPTS (10 hours)

UNIT III - PROCESS DESIGN AND ESTIMATION (10 hours)

UNIT IV - COMPUTER AIDED TECHNIQUES (10 hours)

UNIT V - COMMUNICATION AND DEVELOPMENTS (10 hours)

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**PURPOSE**
To expose the students to fundamentals of AI and Expert systems and its applications in manufacturing.

**INSTRUCTIONAL OBJECTIVES**
To familiarize

1. Fundamental concept of AI and expert system in manufacturing
2. Concepts of fuzzy logic, AI programming languages and applications of OOP
3. Speech and vision recognition systems for knowledge acquisition for the use of AI and expert system in manufacturing.

**UNIT I - INTRODUCTION**
(6 hours)
Introduction: History, Definition of AI, Emulation of human cognitive process, knowledge search tradeoff, stored knowledge, semantic nets. An abstract view of modeling, elementary knowledge. Computational logic, analysis of compound statements using simple logic connectives, predicate logic, knowledge organization and manipulation, knowledge acquisition.

**UNIT II - PROGRAMMING AND LOGICS IN ARTIFICIAL INTELLIGENCE**
(8 hours)
LISP and other programming languages- introduction to LISP, syntax and numerical function, LISP and PROLOG distinction, input output and local variables, Interaction and recursion, property list and arrays alternative languages, formalized symbolic logics- properties of WFRS, non-deductive inference methods.
Inconsistencies and uncertainties- Truth maintenance systems, default reasoning and closed world assumption, Model and temporary logics.

UNIT III - SEARCH METHODS AND KNOWLEDGE REPRESENTATION  
(9 hours)
Fuzzy logic - concepts, Introduction to Fuzzy logic with examples, probabilistic reasoning, Bayesian probabilistic inference, Dempster Shafer theory, possible world representation, Ad-Hoc methods.
Structure knowledge: Graph, frames and related structures, Object oriented representation- object classes, message and methods, simulation examples using OOPS programs, OOP languages.
Search and control strategies - Concepts, search problems, uniformed or Blined search, searching AND – OR graphs.

UNIT IV - KNOWLEDGE ORGANISATION AND COMMUNICATION IN EXPERT SYSTEMS  
(11 hours)

UNIT V - PATTERN RECOGNITION AND LEARNING TECHNIQUES  
(11 hours)
Pattern recognition system- understanding speech recognition, Image transformation, low level processing, medium and high level processing, vision system architecture, Rule based system architecture, knowledge acquisition and validation, knowledge system building tools, use of AI and ES in manufacturing and design, types of learning- general learning model, performance measures, learning automate genetic algorithm, learning by induction - LEX,ID3,INDUCE systems.

REFERENCES


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<th>ME2213</th>
<th>AUTOMATED MATERIAL HANDLING SYSTEMS</th>
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**Prerequisites**
Nil

**PURPOSE**
To highlight the concepts of automated material handling systems and their applications in manufacturing

**INSTRUCTIONAL OBJECTIVES**
To familiarize

1. Fundamentals of automation in material handling
2. Common material handling systems
3. Automated material handling systems like RGVs, AGVS, AS/RS, etc.,
4. Transfer mechanisms, conveyors, part feeding devices, robots in material handling

**UNIT I - INTRODUCTION**
(9 hours)
Introduction to work handling concepts in manufacturing – configuration, symbolic representation, work piece characteristics and their significance, Facilities planning process, Facilities design and diagrams, Storage facilities planning, Materials flow, Activity relationship, Space requirements, Facility lay out – computerized lay outs, Evaluation and selection of alternatives, Defined materials handling, Storage – open and closed storage systems, Bulk loading, Unloading, Shipping and Receiving systems and operations.

**UNIT II - COMMON MATERIAL HANDLING EQUIPMENTS**
(9 hours)
Concepts of Unit Loads, Material handling and Storage equipments operation and selection, Containers, Pallets, Conveyor systems, Industrial trucks, Wagon tipplers, Transporters, Stackers, Reclaimers, Silos & hoppers and their accessories, Ropeways, Ship loaders, Cable cranes, Container handling systems, Electric lifts & Hoists, EOT cranes, Elevators, Material handling equipments in Steel mills, Power plants, Mines, Automobile and Transport
UNIT III - AUTOMATION OF MATERIAL HANDLING  (9 hours)
Automated feeding arrangements for discrete parts, their design based in work piece requirements, orienting methods, one by one feeding, agonizing, stapling etc., - Feeding continuous material liquids, granules etc., - Automated assembly system, elements, configuration design, details and control – Special feeding mechanisms – Automated inspection and their design

UNIT IV - CLASSIFICATION OF AUTOMATED SYSTEMS  (9 hours)
Concepts of Unit Built Machines (UBM) – classification and elements, Power Units, self-contained and separate feed type, Change over UBMs, Transfer lines – classification and their components, Automated systems for handling and transfer of prismatic, axis symmetric parts and asymmetric parts in transfer lines, Case studies on transfer lines – interlocked, palletized and flexible inter linkage transfer lines, control systems – SWARF handling and disposal systems.

UNIT V - AUTOMATED MATERIAL HANDLING EQUIPMENTS  (9 hours)
Automated handling and storage systems in manufacturing environment, Rail Guided Vehicles (RGVs), Automated Guided Vehicles (AGVs), Applications of RGVs and AGVs, Automated Storage and Retrieval Systems (AS / RS), AS / RS in the Automated factory, Considerations for planning an AS /RS system, Applications of AS / RS, Principles of work holding devices – Modular fixturing, Flexible fixturing systems – Fixturing for FMS, Robots and their applications in handling and storage.

REFERENCES

ME2214  COMPUTER AIDED PROCESS PLANNING  

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Total contact hours – 45

Prerequisites

Nil

PURPOSE

To provide the importance of Computer Aided Process Planning and steps involved in its implementation

INSTRUCTIONAL OBJECTIVES

This subject impregnates

1. Concepts and to plan the various processes involved in manufacturing
2. Modern approaches in generative approach
3. AI and expert systems in planning the processes
4. Various process planning systems

UNIT I - INTRODUCTION  

(9 hours)

Process Planning, approaches to process planning, Study of a typical process planning, role of process planning in CAD / CAM integration, Concurrent Engineering.

UNIT II - PART DESIGN REPRESENTATION  

(9 hours)

Tolerance concepts, geometric tolerancing, drafting practices in dimensioning and tolerancing, geometric transformation, data Structure. GT coding - DCLASS, OPITZ system, MICLASS system

UNIT III - PROCESS PLANNING  

(9 hours)

Decision tables and decision Trees – process planning, variant process planning, generative process planning. Artificial intelligence in process planning, Geometric modeling for process planning – process capability analysis.

UNIT IV - COMPUTER AIDED PROCESS PLANNING SYSTEMS  

(9 hours)

Logical Design of Process Planning – Manufacturing System component, Production Volume, Production families – CAM I’s CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP
UNIT V - GENETIC ALGORITHM AND INTEGRATED PROCESS PLANNING SYSTEMS (9 hours)

REFERENCES

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<th>ME2215</th>
<th>DESIGN FOR MANUFACTURE AND ASSEMBLY</th>
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PURPOSE
To enable the students to understand the Design for manufacture and assembly

INSTRUCTIONAL OBJECTIVES
To familiarize
1. DFM approach and Processes
2. Selective assembly
3. Datum systems
4. Form design of castings and weldments

UNIT I - EMBODIMENT DESIGN (9 hours)
Steps, basic rule, principles, guidelines, design for ease of assembly, design for standards, design for maintenance; recycling; minimum risk; evaluating embodiment design. Design for minimum cost, DFM approach and Processes, DFM guidelines, DFMEA, PFMEA.

TOLERANCE ANALYSIS: Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk cost aspects, feature tolerances,
geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerances- sure fit law, normal law and truncated normal law.

UNIT II - SELECTIVE ASSEMBLY (10 hours)
Interchangeable past manufacture and selective assembly, deciding the number of groups- Model-I: Group tolerances of mating parts equal; Model- II: total and group tolerances of shaft equal. Control of axial play – introducing secondary machining operations, laminated shims, examples.

DATUM SYSTEMS: Degrees of freedom, grouped datum systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped datum system with spigot and recess pair and tongue – slot pair computation of translational and rotational accuracy, geometric analysis and applications.

UNIT III- TRUE POSITION THEORY (9 hours)
Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

UNIT IV- FORM DESIGN OF CASTINGS AND WELDMENTS (9 hours)
Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols.

TOLERANCE CHARTING TECHNIQUE:
Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. Design features to facilitate machining; datum features – functional and manufacturing. Component design – machining considerations, redesign for manufacture, examples.

UNIT V - CASE STUDIES (8 hours)
Redesign to suit manufacture of typical assemblies, tolerance design of a typical drive – system, example, design of experiments. Value analysis and design rules to minimize cost of a product. Computer Aided DFMA, Poke Yoka principle.
REFERENCES


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Total contact hours – 45

Prerequisites

Nil

PURPOSE
To enlighten the students about the fundamentals of design of experiment Techniques

INSTRUCTIONAL OBJECTIVES
At the end of this course the student should be able to understand the

1. Introduction about design of experiments
2. Response surface design
3. Factorial design
4. Taguchi design
5. ANOVA analysis
UNIT I - INTRODUCTION  
Design of experiments-Introduction, factor constraints, Interaction terms, Number of runs, enter data, analyze the data, level of factors, Custom designs-Introductions, examples, Screening design creation- Statistical Software introduction, demo using simple case studies.

UNIT II - RESPONSE SURFACE DESIGN  
Response surface design-Introduction, creation, Central Composite Design, Box Behnken design, Contour profile of response surface plot, Design table, analyze the data, using Statistical software simple case study examples- Evolutionary operation, Experiment with random factor-Simple case studies.

UNIT III - FACTORIAL DESIGN  
Basic definition, principles and advantages-Creating, Blocking in a factorial design, responses and factors, Simple case studies, 2-level fractional factorial design, Mixture design-Introduction, optimal mixture design, Simplex centroid design- examples, $2^k$ Factorial design, linear Regression analysis-error prediction, Full factorial design- Simple Case studies.

UNIT IV - TAGUCHI DESIGN  
Creating Taguchi design approach, Orthogonal array, S/N Ratio, Smaller is better, nominal is better and Larger is better, with simple case studies, analyze the data-Factor effect diagram, Levels of parameters, Confirmation test-Augmented design, simple case study problems.

UNIT V - ANOVA ANALYSIS  
Experimentation with single factor- Analysis of Variance-Sum of square - Determining sample size-Model adequacy checking-Regression approach-least square method-Non parametric method- Simple problems.

REFERENCES


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<th>ME2217</th>
<th>FLEXIBLE MANUFACTURING SYSTEMS</th>
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**PURPOSE**
To introduce the basics and components of FMS to the learners

**INSTRUCTIONAL OBJECTIVES**
To familiarize
1. Basic concepts and components of FMS
2. Automated material handling systems used in FMS
3. FMS control using computers
4. Software used in FMS & scheduling of FMS

**UNIT I - FMS INTRODUCTION** (9 hours)
Definition of an FMS-need for FMS, types and configuration, types of flexibilities and performance measures. Economic justification of FMS. Development and implementation of FMS- planning phases, integration, system configuration, FMS layouts, simulation.

**UNIT II - AUTOMATED MATERIAL HANDLING AND STORAGE** (9 hours)
Functions – types - analysis of material handling systems, primary and secondary material handling systems-conveyors, Automated Guided Vehicles-working principle, types, traffic control of AGVs. Role of robots in material handling.
Automated storage systems- storage system performance – AS/RS-carousel storage system, WIP storage systems, interfacing handling and storage with manufacturing.
UNIT III - COMPUTER CONTROL OF FMS (9 hours)
Planning, scheduling and computer control of FMS, Hierarchy of computer control, supervisory computer. DNC system- communication between DNC computer and machine control unit, features of DNC systems.

UNIT IV - COMPUTER SOFTWARE, SIMULATION AND DATA BASE OF FMS (9 hours)

UNIT V - SCHEDULING OF FMS (9 hours)
Scheduling of operations on a single machine- two machine flow shop scheduling, two machine job shop scheduling, - three machine flow shop scheduling- scheduling ‘n’ operations on ‘n’ machines, knowledge based scheduling, scheduling rules, tool management of FMS, material handling system schedule.

REFERENCES
**GROUP TECHNOLOGY AND CELLULAR MANUFACTURING**

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Total contact hours – 45

**Prerequisites**
Nil

**PURPOSE**
To emphasize the importance of group technology and cellular manufacturing systems and their significance & impact in manufacturing areas.

**INSTRUCTIONAL OBJECTIVES**
At the end of this course the student should be able to understand

1. Basics of Group technology
2. Concepts and applications of Cellular manufacturing systems
3. Traditional and non-traditional approaches of Problem solving
4. Implementation of CMS
5. Performance measurement and Human and economical aspects of CMS.

**UNIT I - INTRODUCTION TO GROUP TECHNOLOGY**
(7 hours)
Limitations of traditional manufacturing systems, Group technology - design attributes, manufacturing attributes, part families, characteristics and design of groups, PFA, FFA, benefits of GT and issues in GT.

**UNIT II - CELLULAR MANUFACTURING**
(8 hours)

**UNIT III - PLANNING AND DESIGN OF CELLULAR MANUFACTURING SYSTEM**
(10 hours)

**UNIT IV - IMPLEMENTATION OF GT/CMS**
(10 hours)
Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.
UNIT V- PERFORMANCE MEASUREMENT AND CONTROL

(10 hours)

Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework. Economics of GT/ Human aspects of GT/CMS.

REFERENCES


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<tr>
<th>ME2219 MACHINE VISION AND ITS APPLICATIONS</th>
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PURPOSE
To impart basic knowledge of Image processing and its application in manufacturing engineering.

INSTRUCTIONAL OBJECTIVES
To make the student

1. to understand Basic principle of machine vision concept and its role in industries
2. to understand Fundamentals of image processing, image enhancement,
3. to understand object recognition and texture detection
4. to understand Dynamic and 3D vision
5. to program to detect, localize and recognize image features
6. to understand Basic principle of machine vision concept and its role in industries
UNIT I - INTRODUCTION TO MACHINE VISION (6 hours)
The Nature of Vision- Advantages of Machine vision - Applications of machine vision- image acquisition Principles and Devices-Various lighting techniques-Key stages in Image Processing Techniques

UNIT II - IMAGE ENHANCEMENT (12 hours)

UNIT III - OBJECT RECOGNITION AND FEATURE EXTRACTION (9 hours)
Image segmentation- Edge linking-Boundary detection-Region growing- Region splitting and merging- Boundary Descriptors-Freeman chain code- Regional Descriptors- recognition-structural methods-Statistical and Model based analysis of Texture

UNIT IV - 3D AND DYNAMIC VISION (9 hours)
Photometric stereo. Dynamic Vision - Segmentation using Motion and Moving camera Motion

UNIT V - MACHINE VISION APPLICATION (9 hours)
The GM consight I system-National Bureau of standards vision system- SRI industrial vision system- Image Processing techniques implementation through Image Processing software-MATLAB/OPENCV.

REFERENCES
6  Richard D.Klafter, ThomasA.Chmielewski, Michael Negin,
ME2220 MANUFACTURING PLANNING AND CONTROL

Total contact hours – 45
Prerequisite
Nil

PURPOSE
To emphasis the importance of planning and control of different activities in manufacturing.

INSTRUCTIONAL OBJECTIVES
To understand
1. Acquisition of raw materials to delivery of completed products
2. Key management interfaces and activities
3. The various optimized production techniques

UNIT I - MANUFACTURING PLANNING AND CONTROL AND MRP (7 hours)
Frame work for the MPC system - the system and the frame work, Material flows, Individual firm. MRP in MPC: MRP and MRP II: Basic MRP record, Linking MRP records, Scheduled receipts versus planned order releases, MRP planner, MRP system output, MRP Database.

UNIT II - SHOP FLOOR CONTROL, JUST IN TIME AND MPS (9 hours)
Shop Floor Control Techniques – Basic Shop floor control concepts – Gantt charts. Just in Time – Major elements of JIT – JIT corner stones and the linkages to MPC, Master production scheduling techniques, Bill of material structuring for the MPS.

UNIT III - PRODUCTION PLANNING AND DEMAND MANAGEMENT (10 hours)
Production planning – Production planning and management, MPC systems – Routinizing Production& Game planning – Controlling the production plan – operating production planning systems. Demand Management in MPC systems-Demand management and production planning, MPS,- Demand management techniques. Advanced concepts in MRP-Determination of
manufacturing order Quantities – EOQ, POQ, PPB, MOM. Two level master scheduling.

UNIT IV - FORECASTING SYSTEMS AND DRP (10 hours)

UNIT V - OPTIMISED PRODUCTION TECHNOLOGY AND IMPS SYSTEMS (9 hours)
Optimized Production Technology – Basic concepts of OPT, OPT and the MPC frame Work. IMPS system – Architecture - Relationships to MPC systems – IMPS netting logic – Expert systems.

REFERENCES

PURPOSE
To enlighten the students about the objectives and activities of Production and Operation management.

INSTRUCTIONAL OBJECTIVES
To familiarize
1. Basics of production and operations management
2. Forecasting, Facility location and layout
3. MPS and inventory control, scheduling and controlling project management
4. Modern production management tools

UNIT I - INTRODUCTION (9 hours)
Functional sub systems if organizations, Systems concept of production, Types of production systems, Productivity, Strategic management.
Product Design and Analysis: New product development, Process Planning and Design, Value analysis and Value Engineering, Standardization, Simplification, Make or Buy decisions, Ergonomic considerations in Product design.
Capacity Planning and Investment Decisions: Capacity planning and strategies, Investment formulas and comparisons of alternatives.

UNIT II - FORECASTING AND FACILITY LOCATION AND LAYOUT (9 hours)
Forecasting: Introduction, Nature and use of forecasting, Measures of Forecasting, factors affecting forecasting, Types and models of forecasting.
Facility Location and Lay out: Factors influencing plant location, location evaluation methods, Different types of lay outs for operations and production, arrangement of facilities within the department, CRAFT, ALDEP, CORELAP etc.,

UNIT III - MPS AND INVENTORY CONTROL (9 hours)
Aggregate Planning and Master Production Scheduling: Nature of aggregate planning, Methods of aggregate planning, Approaches to aggregate planning – graphical, empirical and optimization, Development of MPS, MRPI and MRPII.
Inventory Analysis and Control: Definitions, ABC inventory systems, Inventory modals, EOQ models for purchased and manufactured parts, lot sizing techniques.

UNIT IV - SCHEDULING AND PROJECT MANAGEMENT (10 hours)
Scheduling and Controlling: Objectives in scheduling, Major steps involved, Information systems linkages in production planning and control, Production control in repetitive, batch / flow shop and job shop scheduling environment - SPT, EDD, WMFT.
Project Planning and Management: Phases of project planning, Evolution of network planning techniques - Critical Path Method (CPM) and Project Evolution and Review Technique (PERT), Crashing of project network, Project scheduling with constrained resources – RLT & RAT, Graphical Evolution and Review Technique (GERT), Project monitoring, Line balance.

UNIT V - MODERN PRODUCTION MANAGEMENT TOOLS (8 hours)
Just In Time (JIT) – Introduction, elements, pull and push method, KANBAN systems, Small lot size, quick inexpensive set up, Continuous improvement, optimized production technology, CIM and FMS, Benefits and Scope of TQM, Factors affecting quality and Quality control activities in product cycle and ISO 9000 series – Scope and Benefits.

REFERENCES

ME2222  ROBOTICS AND ROBOT APPLICATIONS  

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Total contact hours – 45

Prerequisite
Nil

PURPOSE
To enlighten the students about the engineering aspects of Robots and their applications.

INSTRUCTIONAL OBJECTIVES
At the end of this course the student should be able to understand

1. The basic concepts of robots
2. End effectors and control systems
3. Robot Transformations and Sensors
4. Robot programming
5. Robot Industrial applications

UNIT I - INTRODUCTION (9 hours)

UNIT II - END EFFECTORS AND ROBOT CONTROLS (9 hours)
End effectors- classification – mechanical, magnetic, vacuum and adhesive gripper- gripper force analysis and design. Basic robot motions -Point to point control, continuous path control. Robot control unit - non-servo and servo control of robot joints, adaptive and optimal control.

UNIT III - ROBOT TRANSFORMATIONS AND SENSORS (9 hours)
2D and 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensor devices, Types of sensors- position and displacement sensors, Force and torque sensors- Proximity and range sensors, acoustic sensors, Robot vision systems.

UNIT IV - ROBOT PROGRAMMING (9 hours)
Robot language classification – programming methods- off and on line programming, lead through programming- Coordinate systems of Robot, Robot controller functions, Interlock commands- using WAIT and SIGNAL
command for simple applications. VAL language commands-simple programs.

UNIT V - INDUSTRIAL APPLICATIONS (9 hours)

REFERENCES


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<tr>
<th>ME2223</th>
<th>SUPPLY CHAIN MANAGEMENT</th>
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PURPOSE

To introduce the basics of Supply Chain Management and its components in manufacturing industry

INSTRUCTIONAL OBJECTIVES

To familiarize

1. Concept of SCM, its logistics, basic tasks and various processes
2. Strategy resource management, manufacturing strategy and linking supply chain with customer
3. Structuring the supply chain
4. Organise supply chain with ERP, CRM, etc.,
5. Software used for SCM
UNIT I - SCM – AN INTRODUCTION  (10 hours)
Introduction to Supply Chain Management, Logistics- concept, definition, approaches, factors affecting logistics. Supply Chain – basic tasks of Supply chain – the new corporate model, The new paradigm, the modular company, the network relations, supply process, procurement process – distribution management.

UNIT II - STRATEGY RESOURCE MANAGEMENT  (10 hours)

UNIT III - SUPPLY CHAIN ACTIVITY SYSTEMS  (10 hours)
Structuring the supply chain, supply chain and new products, functional roles in supply chain, supply chain design frame work, collaborative product commerce, outsourcing – to make or to buy

UNIT IV - SCM ORGANIZATION AND INFORMATION SYSTEM  (10 hours)
The management task, logistics organization, the logistics information systems – topology of supply chain application, ERP, CRM, JIT, Warehouse management system, product data management.

UNIT V - COORDINATING SUPPLY CHAINS WITH E-BUSINESS  (5 hours)

REFERENCES
1 Schary, P.B., Lasen, T.S., ‘Managing the Global Supply Chain’, Viva Books, New Delhi 2000,
ME2224  SUSTAINABLE GREEN MANUFACTURING

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Total contact hours – 45

Prerequisite
Nil

**PURPOSE**
The course aims to introduce and explain the design concepts, methods, tools and technologies, and operations of sustainable lean and green manufacturing systems and processes.

**INSTRUCTIONAL OBJECTIVES**
After completion of this course, the students will obtain knowledge in

1. Green Manufacturing and Sustainable engineering concepts
2. Multi attributes decision making methods
4. Applications in green manufacturing

**UNIT I - INTRODUCTION TO GREEN MANUFACTURING**
(9 hours)


**UNIT II - GREEN MANUFACTURING TOOLS**
(9 hours)

Principles of green manufacturing and its efficiency, green manufacturing and sustainability, System model architecture and module, design and planning, control or tools for green manufacturing (Qualitative Analysis, Consumption Analysis, Life Cycle Analysis, Efficiency, Sustainability tools). Standards for green manufacturing (ISO 14000 and OHSAS 18000), waste stream mapping and application, Identify and apply the concepts of product and process design with environmental forethought, Design for environment and for sustainabilityDiscuss the Product Life Cycle of manufactured goods.

**UNIT III - ATTRIBUTES DECISION MAKING METHODS**
(9 hours)

Introduction to Multi attributes decision making methods, definition, structure, variants and analysis of different methods like Simple Additive Method (SAM), Weighted Product Method (WPM), Analytic Hierarchy
Process (AHP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Grey Relation Analysis (GRA), Elimination and Choice Expressing Reality (ELECTRE), and Vlsekriterijumska Optimizacija I KompromisnoResenje (VIKOR), problems based on different MADMs.

UNIT IV - CREATING LEAN AND GREEN ORGANISATION (9 hours)

Question wasteful practices, Gain lean and green endorsement, collaboration to achieve lean and green goals, track progress for environment and profits, creation of sustainable growth, Enabling techniques for assuring green manufacturing, Drivers of green manufacturing, impact, advantages and disadvantages of drivers, Green architecture and buildings, Sustainable manufacturing resources management, Carbon footprint analysis and management of manufacturing processes, Green Process Economics, Resource Recovery and Reuse.

UNIT V - CASE STUDIES IN GREEN MANUFACTURING (9 hours)

Design resources saving into product and processes, closed loop production system, Green manufacturing through clean energy supply, semi conductors manufacturing, green packaging and supply chain, Environmental implication of nano manufacturing.

REFERENCES


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<th>ME2225</th>
<th>TOTAL QUALITY SYSTEMS AND ENGINEERING</th>
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**Total contact hours – 45**

**Prerequisite**

**Nil**

**PURPOSE**

To explain basic quality concepts of TQM, its tools and techniques used in engineering.

**INSTRUCTIONAL OBJECTIVES**

To familiarize

1. Various theories about TQM
2. Planning and manufacturing for quality, its tools and techniques
3. Supporting tools and techniques for TQM
4. Human involvement for quality
5. Failure patterns and preventive maintenance
UNIT I - BASIC CONCEPTS (10 hours)

UNIT II - QUALITY PLANNING (9 hours)
Quality of design – concepts in design, Tasks of design, attributes of good design, approaches- Design procedure – product development and manufacturing for quality, process control, $C_{pk}$, 5S, Process capability, Data base approach.

UNIT III - SUPPORTING TOOLS AND TECHNIQUES (10 hours)
Affinity diagram, Bar chart, Block diagram, Brain storming, Cause and effect analysis, Customer supplier relationship checklist, Decision analysis flow charts, Force field analysis, Line graph/Run charts, Pareto analysis, Quality costing, DOE, EMA,QFD,TOPS-8D, Quality project approval and problem solving process.

UNIT IV - HUMAN DIMENSION AND SYSTEM DEVELOPMENT IN TQM (9 hours)
TQM Mindset, Participation style, Team work: Team development, quality circle, motivational aspects, change management. Documentation structure – Information system - ISO 9000, ISO 14000, QS 9000, Certification clauses, procedure.

UNIT V - TOTAL PREVENTIVE MAINTENANCE (TPM) (7 hours)

REFERENCES

SUPPORTIVE COURSES

MA2006 COMPUTATIONAL METHODS IN ENGINEERING

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Total contact hours – 45
Prerequisite
Nil

PURPOSE
To develop analytical capability and to impart knowledge in Mathematical and Statistical methods and their applications in Engineering and Technology and to apply these concepts in engineering problems they would come across.

INSTRUCTIONAL OBJECTIVES
At the end of the course, Students should be able to understand Mathematical and Statistical concepts and apply the concepts in solving the engineering problems.

UNIT I INITIAL AND BOUNDARY VALUE PROBLEMS
(9 hours)
Classification of Linear differential equation - solution of initial and boundary value problems. Laplace transform methods for one-dimensional wave equation - Displacements in a string. Fourier series methods for one-dimensional wave equation and one-dimensional heat conduction problems.

UNIT II PROBABILITY
(9 hours)
basic definition, conditional, Probability, Baye's theorem - Binomial, Poisson, Normal, Exponential, Rectangular, Gamma Distributions. Moment generating function, random variables, two dimensional random variables.

UNIT III PRINCIPLE OF LEAST SQUARES
(9 hours)
Fitting of Straight line and parabola - Correlation - Linear multiple and partial correlation - Linear regression - Multiple regression.
UNIT IV SAMPLING DISTRIBUTIONS (9 hours)
Tests based on t-distribution, chi-square and F-distributions - Analysis of variance - One-way and two-way classifications.

UNIT V TIME SERIES ANALYSIS (9 hours)

REFERENCES


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<th>MA2007</th>
<th>APPLIED MATHEMATICS FOR MECHANICAL ENGINEERS</th>
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Total contact hours - 45

Prerequisite
Nil

PURPOSE
To develop analytical capability and to impart knowledge in Mathematical and Statistical methods and their applications in Engineering and Technology and to apply these concepts in engineering problems they would come across.

INSTRUCTIONAL OBJECTIVES
At the end of the course, Students should be able to understand Mathematical and Statistical concepts and apply the concepts in solving the engineering problems.

UNIT I TRANSFORM METHODS (9 hours)
Laplace transform methods for one-dimensional wave equation - Displacements in a string - Longitudinal vibrations of an elastic bar - Fourier
transform methods for one-dimensional heat conduction problems in infinite and semi-infinite rod.

UNIT II ELLIPTIC EQUATIONS (9 hours)
Laplace equation - Fourier transform methods for Laplace equation - Solution of Poisson equation by Fourier transform method.

UNIT III CALCULUS OF VARIATIONS (9 hours)
Variation and its properties - Euler's equation - Functionals dependent on first and higher order derivatives - Functionals dependent on functions of several independent variables - Some applications - Direct methods - Ritz methods.

UNIT IV NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (9 hours)
Numerical Solution of Partial Differential Equations - Solution of Laplace's and Poisson equation on a rectangular region by Liebmann's method - Diffusion equation by the explicit and Crank Nicholson implicit methods - Solution of wave equation by explicit scheme.

UNIT V REGRESSION METHODS (9 hours)
Principle of least squares - Correlation - Multiple and Partial correlation - Linear and non-linear regression - Multiple linear regression.

REFERENCES

1. Sankara Rao K., Introduction to Partial Differential Equations, 4th printing, PHI, New Delhi, April 2003
ME2291  GLOBAL OPTIMIZATION ALGORITHMS

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Total contact hours - 45

Prerequisite
Nil

PURPOSE
To study the principles of optimization and various techniques which can be used for solving Mechanical Engineering optimization applications.

INSTRUCTIONAL OBJECTIVES
To study the following optimization techniques

1. Evolutionary Algorithms
2. Genetic Algorithms
3. Modern optimization techniques
4. Search Algorithms

UNIT I  - INTRODUCTION TO OPTIMIZATION ALGORITHMS  
(9 hours)


UNIT II  - GENETIC ALGORITHMS AND GENETIC PROGRAMMING  
(9 hours)


UNIT III  - MODERN OPTIMIZATION TECHNIQUES  
(9 hours)

Ant Colony Optimization - Areas of Application - River Formation Dynamics
Particle Swarm Optimization - Areas of Application
Hill Climbing - Areas of Application - Multi-Objective Hill Climbing - Problems in Hill Climbing - Hill Climbing with Random Restarts – GRASP - Raindrop Method, Random Optimization

UNIT IV - MODERN OPTIMIZATION TECHNIQUES (9 hours)
Simulated Annealing- Temperature Scheduling- Multi-Objective Simulated Annealing, Extremal Optimization, Tabu Search, Memetic and Hybrid Algorithms, Downhill Simplex (Nelder and Mead)

UNIT V - SEARCH ALGORITHMS (9 hours)
State Space Search - Uninformed Search - Breadth-First Search - Depth-First Search - Depth-limited Search - Iterative Deepening Depth-First Search - Random Walks
Informed Search - Greedy Search- A* search - Adaptive Walks

REFERENCES


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<th>ME2292</th>
<th>MECHATRONICS IN MANUFACTURING SYSTEMS</th>
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PURPOSE
To provide elements of mechatronics in manufacturing systems

INSTRUCTIONAL OBJECTIVES
To familiarize
1. Combined knowledge of mechanical, electronics and information systems
2. Sensors and actuation systems
3. Microprocessor systems
4. Electrical ladder diagrams and PLC applications
5. Mechatronics applications and case study
UNIT I - SENSORS AND ACTUATORS (9 hours)
Introduction to Mechatronics systems- measurement systems, sequential controllers & electric position sensors- limit switches- photoelectric sensors-proximity sensors- Inductive, capacitive, Magnetic sensors, pneumatic limit valve - electric actuators- Linear solenoids-linear induction motors-Rotary-stepper motors.

UNIT II - MICROPROCESSORS IN MECHATRONICS (10 hours)
The microprocessor systems (8085) – Architecture- Input and output peripheral circuits, the development of microprocessor systems-communications, A/D and D/A convertors.

UNIT III - RELAYS AND ELECTRIC LADDER DIAGRAM (9 hours)
Relays- electromechanical-solid state –ladder diagrams-sequence charts-Ladder diagram design – using sequence charts through cascade method-single path sequencing with and without sustained outputs- multi path sequencing systems- designing of ladder diagram for specific applications.

UNIT IV - PLC PROGRAMMING (9 hours)
Programmable Logic controllers(PLC)- construction and basic structure-programming units-Memory – input output modules-mnemonics – Timers – internal relays-counters –shift registers-Master and jump control and Data handling- analog input/ output – programming the PLC using ladder diagrams – simple examples of PLC applications- selection of PLC.

UNIT V - MECHATRONICS APPLICATIONS AND CASE STUDY (8 hours)
Time delay using PLC- Time delay using intel 555, Wind screen wiper using stepper motor control, Electronic washing machine.

CASE STUDIES
Pick and Place Robot – automatic camera- car engine management- bar code reader

REFERENCES

OTHER COURSES

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<th>ME2296</th>
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Students have to present a minimum of three seminar papers on the topics of current interest. The evaluation will be based on the knowledge of the student on the subject of presentation, their communication abilities, the method of presentation, the way questions were answered and his attention to the other students' seminars.

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Students can register for this course only after earning at least 12 credits in the core courses of their study.

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Students can register for this course only after earning at least 16 credits in the core courses of their study.
Students can enroll for this course only after completing Project Work-Phase I.

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