COURSE SCHEME
EXAMINATION SCHEME
ABSORPTION SCHEME
&
SYLLABUS

Of
First, Second, Third & Fourth Semester
Choice Base Credit System (CBCS)

Of
Master of Technology (M.Tech)

In
CAD/CAM

Of
RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR
<table>
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<tr>
<th>Subject Code</th>
<th>Name of Subject</th>
<th>Teaching Scheme</th>
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Elective –I : (Discipline Specific):
1. Mechanical behavior of Engineering Materials
2. Design for Manufacturing & Assembly
3. Design of Hydraulic & Pneumatic Systems

Elective –II (Open): Can be chosen from other branches
1. Total Quality System & Engineering
2. Reliability Engineering
### 2nd Semester M. Tech. (CAD/CAM)

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#### Elective –III (Discipline Specific)
1. Computer Aided Tool Design  
2. Plastics and Composites  
3. Concurrent Engineering

#### Foundation Course-I
Research Methodology
## 3rd Semester M. Tech. (CAD/CAM)

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*Contact Hours per week per project

Elective –IV (Open): Can be chosen from other branches

Foundation Course-II: Project Planning & Management

## 4th Semester M. Tech. (CAD/CAM)

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*Contact Hours per week per project
Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur  
Faculty of Engineering and Technology  
M. Tech. (CAD/CAM)

ABSORPTION SCHEME  
1st SEMESTER M. Tech. (CAD/CAM)

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## ABSORPTION SCHEME

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# ABSORPTION SCHEME
## 3rd SEMESTER M. Tech. (CAD/CAM)

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Rashtrasant Tukadoji Mahraj Nagpur University, Nagpur
Faculty of Engineering and Technology
M.TECH. (CAD/CAM) FOUR SEMESTER COURSE
Syllabus
First Semester

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Course Objective: To study the application of computers in manufacturing sector, understand Concepts of GT & FMS. Various Process planning & Control systems concepts.

UNIT I

Unit II
Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT, Part families, classification and coding, Machine cell design, PFA.

UNIT III
Introduction to flexible manufacturing systems, Subsystems of FMS, Types of FMS layouts. Introduction to Automated inspection devices: Coordinate Measuring Machine (CMM), Inspection probes etc. Automated storage & retrieval systems.

UNIT IV

Manufacturing Production Planning: Aggregate Production planning, Master production schedule, Materials requirement planning, Capacity requirement planning, JIT Production system.

UNIT V
Manufacturing system control: Computerized statistical process control, Shop floor control, Shop floor data collection techniques, CAQC, Bill of materials. Business functions: Purchase orders receiving, Inventory management, Financial control, Job costing, Sales & Marking applications.
RECOMMENDED BOOKS

**Course Objective:** The students can understand the
Basics of computer Graphics like drawing line, arc etc., Drawing of spline curves, Creation of surfaces, Algorithms for 3D viewing, Available drawing standards

**UNIT I**

**UNIT II**
Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves B-splines rational curves

**UNIT III**
SURFACE MODELING: Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

**UNIT IV**

**UNIT V**
REFERENCES

Subject Code | Subject Name | Credits
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PGCC103T | CNC & Robotics | 04

**Course Objective:** Understand NC, CNC and DNC manufacturing and generate manual part program for CNC machining. Concept of Industrial robotics and its various applications.

**Unit I**

Concepts of NC, CNC, DNC. Classification of CNC machines, Machine configurations, Types of control, CNC controllers characteristics, Interpolators. Cutting tool materials, carbide inserts classification, qualified; semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices, of CNC Machines.

**Unit II**


**UNIT III**

Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. Robot activation and feedback components.

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.
UNIT - IV

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

UNIT - V

ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations. ROBOT LANGUAGES: Textual robot Languages, Generation, Robot language structures,


Books for Reference:

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<td>PGCC104T</td>
<td>1. Mechanical behavior of Engineering Materials</td>
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**Course Objective:** To study the structure and properties of engineering materials. To study the failure theories and studying methods to avoid failures with respect to fatigue, creep and fracture.

**UNIT I:**

STRUCTURE AND PROPERTIES: Structure of metals, Defects in crystals, Deformation, Relationship between structure and properties, Mechanical properties of metals, Strain hardening, Strengthening mechanisms.

**UNIT II:**

TENSION AND TORSION: Stress - Strain curve, Measures of yielding, Measures of ductility, Toughness, Flow curve, Effect of temperature on flow properties, Anisotropy, mechanical properties in torsion, Method of measuring shear stress, Types of torsion failures, Torsion test Vs Tension test, Hot torsion test.

**UNIT III:**

FATIGUE: Fatigue phenomena, Theories of fatigue failure, Evaluation of fatigue resistance, Methods of presenting fatigue data, Fatigue crack propagation, Parameters influencing fatigue, Cyclic stress strain behavior, Design against fatigue, Low cycle fatigue.

**UNIT IV:**

CREEP: Description of creep, Creep curve, Stress-rupture test, Creep mechanisms Dislocation glide, Diffusion flow, Dislocation and Diffusion, Creep in two phase alloys, Deformation Mechanism Maps, Materials aspects creep design, Estimates of creep behavior, Presentation of Engineering creep data Super plasticity.
UNIT V:

FRACTURE MECHANICS: Types of fracture, Theoretical strength of a solid, Griffith’s Theory, Irwin-Orowan Theory crack propagation Modes, Dislocation Theories of Brittle fracture, Ductile fracture, Analysis of crack propagation, Stress intensity factor, Crack opening displacement, J integrals - Fracture toughness measurement methods.

REFERENCES

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<td>PGCC104T</td>
<td>2. Design for Manufacturing &amp; Assembly</td>
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**Course Objective:** The course is aimed at developing students to acquire skills to analyze product design and be able to design products that are easier to manufacture, assemble, service and more friendly to environment, etc.

**UNIT I:**

**INTRODUCTION:** Design philosophy steps in Design process - General Design rules for manufacturability - basic principles of design Ling 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 - general design rules for machining - Dimensional tolerance and surface roughness - Design for machining - Ease -Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts. **METAL CASTING:** Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances – use of solidification simulation in casting design - product design rules for sand casting.

**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 - design of brazed joints. Forging - Design factors for Forging - Closed dies forging design -parting lines of die5 drop forging die design - general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking.
UNIT-IV

ASSEMBLE ADVANTAGES: Development of the assemble process, choice of assemble method assemble advantages social effects of automation. AUTOMATIC ASSEMBLY TRANSFER SYSTEMS : Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

UNIT-V:

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.

REFERENCES:


4. Computer Aided Assembly London/ A Delbainbre/.
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<td>PGCC104T</td>
<td>3. Design of Hydraulic &amp; Pneumatic Systems</td>
<td>04</td>
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Unit-I

**OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS**


Unit-II

**CONTROL AND REGULATION ELEMENTS**

Pressure, Direction and flow control valves, Relief valves, Non-return and safety valves, Actuation systems, Pressure switches.

Unit-III

**HYDRAULIC CIRCUITS**

Reciprocation, Quick return, Sequencing, Synchronizing circuits, Accumulator circuits, Industrial circuits, Press circuits, Hydraulic milling machine, Grinding, planning, copying, Hydraulic lift, Earth mover circuits, Design and selection of components, Safety and emergency mandrels.

Unit-IV

**PNEUMATIC SYSTEMS AND CIRCUITS**

Pneumatic fundamentals, Control elements, Position and pressure sensing, Logic circuits, Switching circuits, Fringe conditions modules and these integration, Sequential circuits, Cascade methods, Mapping methods, Step counter method, Compound circuit design, Combination circuit design.

Unit-V

**INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS**
Pneumatic equipments: Selection of components, Design calculations, Application, Fault finding, Hydro pneumatic circuits, Use of microprocessors for sequencing, PLC, Low cost automation, Robotic circuits.
Relevant Case studies

Books Recommended:
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<td>Computer Graphics for CAD/CAM</td>
<td>04</td>
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LIST OF PRACTICALS:
Minimum Six Practicals out of following on the standard CAD/CAE packages like NASTRAN/ UNIGRAPHICS/CATIA / PRO-E /AutoCAD any other suitable software:

1. Programs for generation of entities like Line, Circle, Ellipse using Bressenham’s algorithms.
2. Programs for 2-D & 3-D transformations
3. 2-D Geometric modeling of an Engineering object, demonstrating Boolean operations like add, subtract and PAN, ZOOM, ROTATE commands
4. 3-D Geometric Modeling of an Engineering object, demonstrating extrude, revolve and loft commands.
5. Generation of at least two simple solid models showing geometric properties using any CAD software.
6. Generation of any Assembly model along with animation.
7. Program for synthetic Curve generation like Bezier, spline etc
8. Program for generation of surface.
LIST OF PRACTICALS:

Minimum Six Practicals out of following

1. Concepts of NC, CNC, DNC. Classification of CNC machines, Machine configurations, Types of control, CNC controllers characteristics, Interpolators. Cutting tool materials, carbide inserts classification, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices, of CNC Machines.

2. At least 2 Practical based on part programming and operation of a turning center

3. At least 2 Practical based on part programming and operations of a machine center/milling machine


5. Practice in APT based NC programming languages

6. Fundamental of robot, anatomy, configuration, control, sensor, and gripper

7. Practice in robot programming and its languages

8. Preparation of various reports and route sheets.

9. At least two application of robot
Subject Code | Subject Name | Credits
-------------|-------------|--------
PGCC201T     | ADVANCED FINITE ELEMENT ANALYSIS | 04

**Course Objective:** Introduction to Engineering Analysis tool FEA its application in Linear static Analysis and 2D problems, Study of Finite Element modeling and simulation Techniques, Use of FEA in structural vibration and thermal Analysis, Study of Finite Element Software - ANSYS

**UNIT-I**

Introduction to FEM, basic concepts, historical background, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin’s Methods. Coordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain-displacement relations.

**UNIT-II**

1-D STRUCTURAL PROBLEMS: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.

ANALYSIS OF TRUSSES : Plane Trusses and Space Truss elements and problems


**UNIT-III:**


**UNIT-VI:**

UNIT-V:


REFERENCES:

2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
7. Finite Element Method – Krishna Murthy / TMH
UNIT I

Importance of product design, types of design, product definition, product specification, Phases of product development: conceptual, embodiment and detailed design, product and technology development cycle, concept generation and evaluation methods.

UNIT II

Material selection – Importance, classification, material performance characteristic, Selection criteria, Ashby Material selection chart


UNIT III


UNIT IV

UNIT V

Product Development Cycle and Importance of Prototyping, Types of Prototypes, Principle and Advantages & Different Type of Generative Manufacturing Process, Viz, Stereo lithography, FDM, SLS etc. Factors Concerning to RP: Consideration for Adoptions, Advantages, Accuracy and Economic Considerations.

Book for reference:


INSTRUCTIONAL OBJECTIVES

1. To study the sensors and transducers, used in mechanical engineering
2. To study how microprocessors can be used to do simple applications in mechanical engineering
3. To study about PLC and its applications

UNIT I:

UNIT II:

UNIT III:

UNIT IV:
Programmable logic controllers: Introduction - basic structure - input and output processing - programming - Mnemonics timers, internal relays and counters - data handling - analog input and output - selection of PLC.

UNIT V:
Design and mechatronics: Designing - Possible design solution - case studies of Mechatronics systems.
REFERENCES


WEB REFERENCE

Elective –III (Discipline Specific)

1. Computer Aided Tool Design
2. Plastics and Composites
3. Concurrent Engineering

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<td>PGCC204T / PGCADMA204T</td>
<td>1. Computer Aided Tool Design</td>
<td>04</td>
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UNIT I

Three dimensional stress pattern-true stress and true strain-Principal stresses-Yield criteria-Vos Mises criterion- Tresca's criterion-Von Mises Yield for plane strain Problems-Coloumb function and sticking friction.

UNIT II

Press working, Types of Presses, Types of dies, Computer aided design of cutting dies like simple die, compound die, progressive die and combination die. Forming dies like bending die, drawing die, flanging die, coining die, embossing die.

UNIT III

Jigs and fixtures, principles of location and clamping, unconventional clamping systems. Design of various types of jigs for various parts. Design of different types of fixtures.

UNIT IV


UNIT V

Mechanics of metal cutting. Design of single point tools. Design of multipoint cutting tools like drills,

Books for reference:

1. Donaldson, “Tool design”
2. ASTME, “Fundamentals of Tool design”
3. Pollock, “Fundamentals of Tool design”
4. Grant, “Unconventional Clamping Systems”
5. Kempster, “Fundamentals of Tool design”
UNIT I:

Chemistry and Classification of Polymers - Properties of Thermo Plastics - Properties of Thermosetting Plastics - Applications - Merits and Disadvantages.

UNIT II:


UNIT III:

Definition - Need-General characteristics, Applications, Fibers-Glass, Carbon, Ceramic and Aramid fibers. Matrices-Polymer, Graphite, Ceramic and Metal Matrices-Characteristics of fibers and matrices. Smart materials types and Characteristics.

UNIT IV:


UNIT V:

Books for Reference:

**Course Objective:** To familiarize with the basics of concurrent engineering, The tools and methodologies available in CE, Various approaches to CE, The other related aspects of CE

**UNIT I:**

**UNIT II:**

**UNIT III:**
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:**

**UNIT V:**
REFERENCES

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<td>PGCC201P/ PGCADMA201P</td>
<td>Advance Finite Element Methods</td>
<td>01</td>
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**Course Objectives:**

1. Equip the students with the Finite Element Analysis fundamentals,
2. Enable the students to formulate the design problems into FEA,
3. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS / NASTRAN (MSC Apex)/LSDYNA)
4. Enable the students to understand the ethical issues related to the utilization of FEA in the industry

**List of Practical:**

Students should be able to validate the manually calculated results with the results obtained from various analysis softwares (for e.g. ANSYS / NASTRAN (MSC Apex)/LSDYNA) for the following problems. The input data and output results of the problem solved using the computer programs should be included in the Journal.

1) Any two problem using bar element
2) Any two problems using truss element
3) Any two problems using CST element
4) Any one problem using axis symmetric element
5) Any one problem of free vibration analysis using bar element
6) Any one problem of Torsion of Prismatic bars.
7) Any one problem on Steady State Heat conduction.
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<td>PGCC203P/ PGCADMA203P</td>
<td>Lab for Mechatronics</td>
<td>01</td>
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LIST OF PRACTICALS:

Minimum Eight practical's out of the following areas shall be performed:

1. Identification & study of solid state electronic devices.
2. Identification, study & demonstration of different sensors.
3. Identification, study & demonstration of different actuators.
5. Demonstration of working of various digital to analog and analog to digital Converters-applications - temperature control - stepper motor control - traffic light controller.
6. Development of ladder diagram, programming using PLC for any of the following:
   a) Motor start and stop by using two different sensors.
   b) Simulation of a pedestrian traffic controller.
   c) Simulation of four road junction traffic controller.
   d) Lift / elevator control.
   e) Washing machine control.
   f) Tank level control.
   g) Soft drink vending machine control.
   h) Any other suitable application.
7. Trace, interpret and demonstrate working of electro pneumatic systems.
8. Trace, interpret and demonstrate working of electro hydraulic systems.