

**Post Graduate programme:**

**1. Title of the programme: M.E. Mechanical CAD/CAM**

**i. Curricula and Syllabi:**

**SYLLABUS  
PRESCRIBED FOR  
MASTER OF ENGINEERING (FULL TIME)  
MECHANICAL- CAD/CAM  
SEMESTER-I**

**1MCC1 COMPUTER AIDED DESIGN**

**Section-A**

Introduction to computer technology, Introduction to CAD systems, Computer Aided Design workstation and peripherals, Graphics input/output devices  
Design process and CAD models: Computers for design, benefits of CAD  
ICG: Configuration of graphic workstations, Vector and Raster displays, Geometric modeling and transformations.

**Section-B**

CAD software: Graphics system and functions of a graphics package, Graphics databases structure and handling, Operating features, wireframe, solid and surface modeling, approaches to solid modeling.

Computer aided drafting and documentation: Principles and concepts of automated drafting, drafting packages, Introduction to CADD packages like AutoCAD, SOLIDWORKS, CATIA. Graphics standards like GKS, PHIGS, IGES etc

Practical : Five practical based on above syllabus

**References:**

- 1) CAD/CAM by Groover and Zimmers
- 2) Computer Aided Design in Mechanical Engineering by V. Ramamurti
- 3) CAD by Krishnamoorthy and Rajiv
- 4) CAD Principles and Applications by Barr, Krimger and Lazaer
- 5) CAD/CAM Handbook by Teicholz

**1MCC2 COMPUTER AIDED MANUFACTURING**

**Section-A**

Numerical control (NC): Fundamentals of NC, merits and demerits of NC, classification of NC systems, basic components of NC systems, instructions, NC tape and coding, control units, features of machine tools and system devices.

Computer Numerical Control CNC: Problems in conventional NC, NC controller technology, computer numerical control, designing CNC systems. NC/CNC machine tools: Types and features, DDA integrator, DDA hardware interpolator, software interpolators, reference word interpolator, point to point, straight line and contouring control loops

**Section-B**

NC/CNC part programming: Introduction, computer-aided part programming (APT), CNC part programming

Ddirect numerical control (DNC), Types of DNC Systems. combined DNC/CNC systems,  
Adaptive control: ACC and ACO systems, optimization of AC

Practical: Five practical based on above syllabus

**References:**

- 1) Yoram Koren- Computer control of manufacturing, McGraw Hill.
- 2) Mikell P. Groover- CAD/CAM-Prentice-Hall of India pvt. Ltd.
- 3) Kunder T.K., Rao P.N., Tewari N.K.-Numerical control and computer aided manufacturing; Tata McGraw Hill.
- 4) D. Kochan- CAM Development in computer integrated manufacturing- Springer Verlag, Berlin

**1MCC3                    COMPUTER ASSISTED PRODUCTION MANAGEMENT****Section-A**

Computer aided process planning: Approaches to CAPP, basic part representation methods, shape producing capabilities, Process economics

Computer assisted QC: co-ordinate measuring machines-construction and types, automated dimensional gauging and in-process gauging

Capacity planning: Roll of capacity planning in manufacturing, planning and control systems, hierarchy of capacity planning decisions links to other system modules, capacity planning and control techniques.

**Section-B**

Just in time: JIT in manufacturing planning and control, leveling the production, pull system introduction, product and process design, JIT applications

Computer aided inventory control: Computer aided purchasing procedure, simulation of inventory problems

Computer aided materials management: Material requirement planning, computer integrated materials management.

**References:**

- 1) Groover M.P.- Automation, Production Systems and CIM.
- 2) David Bedworth, M.R. Handerson & Philip Wilze- Computer Integrated Design and manufacturing

**1MCC4                    MECHATRONICS****Section-A**

**Introduction :** Scope, sensors, transducers, selection, contact & non contact optical types, performance, examples. **Actuators :** Principal, types-hydraulic, pneumatic, electrical, contact speed, multispeed, step and continuous variable, actuators with stepping motors.

**Computer process controls :** Computer process interface, interface hardware, direct digital control, supervisory computer control.

**Design of mechatronics elements:** Measuring system, control software and user interface, gauging, tool monitoring system, spindle drives, feed drives, servo principles, configuration CNC systems, interfacing, monitoring, diagnostics.

**Section-B**

Automatic loading and unloading devices, magazines, bunkers, orientors, feeders, separators, etc.

**Pneumatic systems:** different control components of pneumatic systems and there conversion valves, auxiliary devices, synchronizing, clamping, declamping, application to robotics.

**Hydraulic systems:** different control components of hydraulic systems, valves and auxiliary devices, design and analysis of hydraulic circuits sequencing, synchronizing, pneumo-hydraulic, CNC lubrication, machine tool applications.

**References:**

- 1) Mechatronics by HMT
- 2) Introduction to Mechatronics and Measurement Systems by Michal B. Histan & David G. Aciatore.
- 3) Industrial Automation by Turgam, Mir Publication.
- 4) Pneumatics and Hydraulics by Stewart.

1MCC5

**ELECTIVE-I**  
**(1) CONCURRENT ENGINEERING**

**Section-A**

**Introduction :** Principles, traditional versus concurrent approach, schemes and tools of concurrent engineering, Applications of computers in practice of CE

**Basic process issues :** Process models, types, importance, relation between models, specifications, technology, automation and process improvement.

Concurrent engineering approach in manufacturing systems: System design procedure, features, assembly resource alternatives, tasks assignments.

**Section-B**

**Concurrent automated fabrication systems :** Introduction, methodology, preliminary and details work content analysis, human resource considerations, 'Technical Economic' performance evaluation.

Assembly work stations: Strategic issues, technical issues, economic analysis.

Case studies of concurrent engineering practice.

**References:**

- 1) David Bedwarth, M.R. Handerson & Philip Wilze- Computer integrated Design and manufacturing.
- 2) J.L. Nevines and D.E. Whitney-Concurrent Design of Products and Processes.
- 3) Proceeding of the "Summer school on Application of Concurrent Engineering to Product Development" at P.S.G. College of Technology.

1MCC5

**ELECTIVE-I**  
**(2) ENGINEERING EXPERIMENTAL TECHNIQUES**

**Section-A**

Generalized measuring systems, different transducers for measurement of different mechanical parameters such as thickness (length), temperature, pressure, force, torque, etc., their design consideration, characteristics, limitation and uses.

Intermediate stage instrumentation, Impedance matching, selection of intermediate instrumentation equipments.

Terminating stage devices- characteristics, limitations

**Section-B**

Dynamic response of instruments, Effect of different instruments used in the measuring system on the accuracy, sensitivity and performance of the instrument designed to measure a particular mechanical parameter.

Experimental planning, parliamentary, intermediate and final stages, a experimental investigations, selection of instruments based on static, dynamic characteristics and allowable errors, analysis of experimental data, curve fitting, report writing.

**References:**

- 1) Experimental methods for engineering by J.P. Holman
- 2) Measurement System, Application and Design by E.D. Doeblein

1MCC5

**ELECTIVE-I**  
**(3) MANAGEMENT INFORMATION SYSTEMS**

**Section-A**

Objectives and cost benefits of Management Information Systems (MIS). Decision and MIS. A decision environment model, Decision strategies. Characteristics of information: Measurement and amount of Information, Information search, storage and retrieval, Information feed back systems. Planning techniques: Project proposals, reporting and controlling, Determination for information needs and sources, development of conceptual design, development of detailed design, selection of final design, design report, organization for implementation, training of operational personnel, forms and files for data collection, evaluation control and maintenance of information system.

### Section-B

Computer Based Information System, MIS and CBIS family, MIS in total CBIS environment, an MIS model and dimensions of MIS model, an overview of tele-processing system(TPS):Techniques for TPS processing models, MIS and TPS, decision support system : definition : characteristics of DSS difference in DSS and development of DSS and its applications, production of sub-systems : Marketing sub-systems, finance sub-systems, personnel sub-system, office automation system : definition, importance, planning and implementation of Automated computer based office communication system.

#### References:

- 1) Essentials of MIS by K.C. Laudon, J.P. Laudon; PH
- 2) Strategic Management and MIS: An Integrated Approach by W. Robson; Pitman Pub.
- 3) Information systems for Managers by G.W.Reynolds; West Pub.
- 4) IT for Management by Turban E and McLean E; John Wiley Pub.
- 5) Foundations of Information systems by Zwass V; Irwin/ McGraw Hill

### SEMESTER-II

#### 2MCC1

#### FINITE ELEMENT ANALYSIS

##### Section-A

**Introduction:** Discretization, going from part to whole approach, Conventional Numerical methods- finite difference method , method of least squares Ritz method, boundary value problems, displacement method, the equilibrium method, the mix method of solid mechanics, Finite element formulation, variational methods.

Finite Elements- types: triangular, rectangular, quadrilateral, sector curved, isoparametric elements

General procedure of FEM: Discretization, element shapes, interpolation functions, shape functions, element stiffness matrix, global stiffness matrix, application of boundary conditions, solutions.

##### Section-B

FEA of 2-D single variable problems, application of Heat transfer, fluid mechanics, solid mechanisms, plane elasticity, analysis of structural vibrations

**Applications:** Free vibration of thin plates, cylindrical shells, transient heat conduction, torsion of prismatic shafts, motion of fluid in flexible container, flow of ideal fluids, viscous fluids, sheep structures.

Softwares in FEM: Introduction and study of FEM packages like ASKA, SAP, NASTRAN, ANSYS, COSMOS, NISA, ANIDA

**Practical:** Five practical based on above syllabus

#### References:

- 1) Introduction to Finite Element Methods by C.S. Desai & J.F. Abel.
- 2) Concept and application of Finite element analysis by Robert Cook.
- 3) Finite element analysis by C.S. Krishnamoorthy.
- 4) Finite element methods by J.N. Reddy.

#### 2MCC3

#### ROBOTICS AND ROBOT APPLICATIONS

##### Section-A

**Introduction:** Definition, need, robot classification, terminology and systems, benefits and limitations.

Robot system: Robot physical configuration, basic robot motions, end effectors work cell control and interlocks.

Robot sensors: Vision tactile and proximity, voice, robot control, kinetics and necessary control systems.

### **Section-B**

**Robot applications:** General considerations and problems, material transfer, machine loading, welding, spray coating, processing operations, assembly, inspection, robot in FMS and automation.

Robot arm kinematics: Homogenous transformation matrix.

#### **References:**

- 1) Handbook of Industrial robotics.
- 2) Aures R.U. & Miller S.M.- Robotics applications and social implications.
- 3) Tanner W.R. – Industrial Robots Vol.-1 & Vol.-2.
- 4) Groover M.P. and Zimmer E.W.- Computer Aided Design and Manufacturing

## **2MCC4**

### **INDUSTRIAL PRODUCT DESIGN**

#### **Section-A**

An approach to industrial design, Technical requirements, Ergonomic requirements, Aesthetic requirements.

Ergonomic and industrial design Man- Machine relationship, Anthropometric data, Ergonomical design aspects of M/c tools testing M/cs, Instruments, automobile process equipment, etc.

**Aesthetic concepts:** Concepts of unity, concept of order with variety, concept of purpose, style and environment, Aesthetic continuity, proportions, rhythm, radiance.

#### **Section-B**

Design for Producibility, design for Assembly & Disassembly, Design for Maintenance

Computer aided Product Design

**Industrial Design in Graphics:** general design situations, Specifying design requirements, rating the importance of Industrial Design.

Design & development for Generative Manufacturing Processes.

Product Patenting.

#### **References:**

- 1) Industrial Design for Engineers by W.H. Mayali.
- 2) Design Engineering by John Diwan .
- 3) Problems of Product Design development by C.Hearn Bucle Pergaman Press.
- 4) Product Design & Manufacture by John Lindbeck , Prentice Hall International.
- 5) Integrated Product & Process Design by Edward Magrab, RC Press.

## **2MCC5**

### **ELECTIVE-II**

#### **(1) FLEXIBLE MANUFACTURING SYSTEMS**

##### **Section-A**

FMS an overview: types and configuration, concept, types of flexibility and performance measures, functions of FMS, FMS host and area controller function distribution.

Development and implementation of FMS: Planning phases, integration, system configuration, FMS layout, FMS project development steps.

##### **Section-B**

Automated material handling and storage: Functions- types- analysis of material handling equipments design on conveyors and AGV systems.

**Automated Storages:** Storage system performance- AS/RS- carausal storage system- WIP storage system- interfacing handling, storage with manufacturing.

**Modeling and Analysis of FMS:** Analytical, heuristic, queuing, simulation and petrinet modeling techniques- scope, applicability and limitations

#### **References:**

- 1) Groover M.P.- Automation, Production Systems and CIM.
- 2) Ranky P.G.- The Design and Operation of FMS.
- 3) Parrish D.J.- Flexible Manufacturing.

**2MCC5**

**ELECTIVE-II  
(2) VIRTUAL MANUFACTURING**

**Section-A**

Virtual reality in engineering, rapid prototyping and near net shape manufacturing, visualization, environment construction technologies, modeling technologies, metamodeling, integrated infrastructure and architecture, simulation, integration of legacy data, manufacturing characterization, verification, validation and measurement, work flow, cross functional trends.

**Section-B**

Design centered and production centered VM, CAD data translation, manufacturing resource models for distributed manufacturing, design of production systems, Virtual manufacturing over INTERNET, IMACS (interactive manufacturability analysis and critiquing system), optimal selection of partner in Agile Manufacturing, Virtual reality modeling languages.

**References:**

- 1) Considine D.M. and Considine G.D. – Standard Handbook of Industrial Automation.
- 2) Kusiak A.- Intelligent Manufacturing Systems.
- 3) Fundamentals of Industrial Automation by Turgan.

**3MCCS**

**SEMESTER-III  
Seminar  
Project**

**4MCCP**

**SEMESTER-IV  
Project (Dissertation and viva-voce)**

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Two Year Post Graduate Degree Course in Mechanical Engineering  
Master of Engineering (CAD/CAM)  
(Full-Time)

**FIRST SEMESTER**

Sr. No.	Name of the Subject		Hours / Week			Theory			Examination Scheme				
			L	P		Max. Marks	Maximum Marks	Total	Min. Pass Marks	Max. Marks	Max. Marks	Total	Min. Pass Marks
1.	1MCC1	Computer Aided Design	4	2	3	80	20	100	50	25	25	50	25
2.	1MCC2	Computer Aided Manufacturing	4	2	3	80	20	100	50	25	25	50	20
3.	1MCC3	Computer Assisted Production Management	4	-	3	80	20	100	50	—	—	—	—
4.	1MCC4	Mechatronics	4	-	3	80	20	100	50	—	—	—	—
5.	1MCC5	Elective-I	4	-	3	80	20	100	50	—	—	—	—
<b>TOTAL</b>			<b>20</b>	<b>4</b>	<b>-</b>	<b>—</b>	<b>—</b>	<b>500</b>			<b>100</b>		

TOTAL : 600

**SECOND SEMESTER**

1.	2MCC1	Finite Element Analysis	4	2	3	80	20	100	50	25	25	50	25
2.	2MCC2	Simulation Theory and Applications	4	2	3	80	20	100	50	25	25	50	25
3.	2MCC3	Robotics and Robot Applications	4	-	3	80	20	100	50	—	—	—	—
4.	2MCC4	Industrial Product Design	4	-	3	80	20	100	50	—	—	—	—
5.	2MCC5	Elective-II	4	-	3	80	20	100	50	—	—	—	—
<b>TOTAL</b>			<b>20</b>	<b>4</b>	<b>-</b>	<b>—</b>	<b>—</b>	<b>500</b>			<b>100</b>		

TOTAL : 600

**THIRD SEMESTER**

Sr. No.	Name of the Subject		Hours / Week		Examination Scheme			Min. Pass Marks	
			L	P	External	Internal	Total Marks		
1.	3MCCS	Seminar Project	-	-	2	50	50	100	50
<b>TOTAL</b>					<b>4</b>			<b>100</b>	

TOTAL : 100

**FOURTH SEMESTER**

Sr. No.	Name of the Subject		Hours / Week		Examination Scheme			
			L	P	External	Internal	Total Marks	
1.	4MCCP	Project(Dissertation and Viva-Voce)	-	4	200	100	300	150
<b>TOTAL</b>			<b>-</b>	<b>4</b>			<b>300</b>	

GRAND TOTAL : 1600

List of Electives :-

Elective-I

1. 1 MCC 5 Concurrent Engineering
2. 1 MCC 5 Engineering Experimental Techniques
3. 1 MCC 5 Management Information System

Elective-II

1. 2 MCC 5 Flexible Manufacturing System
2. 2 MCC 5 Virtual Manufacturing

### **Semester III**

Seminar 1: Seminar to be delivered on proposed topic of dissertation, to be evaluated by 3 member committee headed by H.O.D. wherein guide should be one of the member. Marks will be given out of 50. External 50 marks will be based on viva voce by external examiner at the end of 4 semester.

Dissertation : Title of the dissertation work to be submitted to the University on or before 15 Sept. (For regular examination) and 15th of March for supplementary exam.)

Title modified /rejected by the sanctionary authority to be conveyed to the concern within a month.

Guide will evaluate the work carries out at the end of third semester.

### **Semester IV**

Seminar 2: will be delivered on the complete work of dissertation, to be evaluate by 3 member committee leaded by H.O.D. wherein guide should be one of the member.

Dissertation : Internal assessment of diss. to be carried out by guide for 100 marks Viva by external examiner on dissertation out of 200 marks.

Note : Thesis of dissertation work must be submitted to the University on or before 30th April (for regular exam. ) and 30th November ( for supplementary exam.)

Note : Student should be fill the examination form in the begining of 3rd semester jointly for 3rd & 4th semester.

2. Single marksheet for 3rd & 4th sem together will be given to the student.

- **Laboratory facilities exclusive to the PG programme:** Shared with UG

**Special Purpose Software, all design tools in case:**

<b>S. No.</b>	<b>Particulars</b>	<b>Availability</b>	
1.	No. of Computer Terminals	<b>61</b>	
2.	Hardware Specification	P-IV / Latest Configuration	<b>18</b>
		P-III	<b>34</b>
		Others	<b>9</b>
3.	No. of Terminals on LAN/WAN	30	
4.	Relevant Legal Software	Application Software	<b>MasterCAM9.1, SolidWorks 2001, CATIA V5 R11 ED2, Autodesk Inventor 9, Ansys 9.1 VIDWAN MS Office MATLAB<sup>+</sup> Visual Studio<sup>+</sup> Oracle<sup>+</sup> WITNESS</b>
		System Software	<b>Windows 98 Windows XP</b>
5.	Printers	<b>Total 6 (DMP 132-2No.; DMP 80-2No Deskjet-1 No.; LaserJet- 2 No.)</b>	
6.	Internet Accessibility (in Kbps & hrs)	<b>Broadband: 24 hours</b>	

- **Research focus:** Computer Aided Design and Manufacturing  
**List of typical research projects:**
  1. Simulation and Analysis of Internal High Pressure Tube Hydroforming
  2. Design, Fabrication and Testing of Air Flow Grid of Pitot Tubes for Measuring Total Flow Rate by using Computational Fluid Dynamics
  3. Design of Exhaust Fan Volute using CFD
  4. Design and Analysis of the Machining Fixture for Shifter Rod
  5. Design and Fabrication of Human Powered Water Lifting Device.
- **Industry Linkage:** Some projects are sponsored by industries.

- **Publications (if any) out of research in last three years out of masters projects:**  
15
- **Placement status:** Almost all the students are placed off campus
- **Admission procedure:** Written Test followed by Interviews for Non-Gate Candidates
- **Fee Structure: Rs.45000/-** (Rs. 36000/- Tuition Fee, Rs. 5000/- Dev. Fee and Rs. 4000/- Other Fess)
- **Hostel Facilities: Available**
- **Contact address of co-ordinator of the PG programme:**

Name: **Prof. S.G.Bahaley**

Address: Department of Mechanical Engineering, College of Engineering, Anjangaon Bari Road, Badnera-Amravati, Dist Amravati (MS) Pin. 444 607

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