

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**SCHEME OF EXAMINATION & SYLLABUS FOR M. TECH (CAD/CAM) FOUR SEMESTER COURSE**

**First Semester Course Scheme**

Sub. Code	Name of Subject	Teaching Scheme (Clock hours / week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs
		L	T	P/ D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
1PGCC01	Data Structures & Algorithms	3	1	-	4	70	30	100	50	-	-	-	-	3
1PGCC02	CIM	3	1	-	4	70	30	100	50	-	-	-	-	3
1PGCC03	Elective –I	3	1	-	4	70	30	100	50	-	-	-	-	3
1PGCC04	Computer Graphics for CAD/CAM	3	1	2	6	70	30	100	50	25	25	50	25	3
1PGCC05	CNC & Robotics	3	1	2	6	70	30	100	50	25	25	50	25	3
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>4</b>	<b>24</b>	<b>350</b>	<b>150</b>	<b>500 *</b>	<b>-</b>	<b>50</b>	<b>50</b>	<b>100 *</b>	<b>-</b>	<b>Total (T+P) = 600*</b>

**Elective – I :- (i) Materials Engineering (ii) Image Processing (iii) Engineering Management (iv) Total Quality System & Engineering**

## First Semester Syllabus

### **1PGCC01-Data Structures and Algorithms**

Review of basic Concepts of OOPs, objects, classes, polymorphism, inheritance, application in CAD/CAM codes.

Introduction to Data Structures, abstract data types, array as an ADT, using one-dimensional arrays, arrays as parameters, character string operations, multi-dimensional arrays, structures and classes.

Stack and its Application, Definition and Examples, Primitive Operations, Recursion, Fibonacci sequence, Binary Search, Recursive Chains, Recursive Definition of Algebraic Expressions

Queues and Lists, The Queues representation Insert Operation, Priority Queue, Array Implementation of a Priority queue, Linked Lists, Inserting and removing Nodes from a List, Linked Implementation of Stacks, Linked Implementation of Queues, Linked List as a data structure, Non integer and Non homogeneous Lists, Dynamic and Array Implementation of Lists, Simulation Using Linked Lists simulation process, data structures, Other List Structures, Circular Lists, Doubly Linked Lists , Multiple Linked lists.

Trees, Binary Trees Operations, Applications Representations of Binary Tree. Internal and External Nodes, Implicit Array Representation of Binary Trees, Choosing a Binary Tree Representation, Binary Tree Traversals, Heterogeneous Binary Trees,

Sorting, Efficiency Considerations, O Notation, Efficiency of Sorting, Exchange Sorts, Bubble sort, Quicksort, Selection and Tree Sorting, Straight Selection Sort, Binary Tree sorts, Heapsort, Insertion Sorts, Simple Insertion, Shell Sort,

Searching, Basic Search Techniques, Algorithmic Notation, Sequential Searching, Reordering a List Searching an Ordered Table, Indexed Sequential Search, Binary Search, Interpolation Search, Tree Searching, Inserting/deleting in a Binary Search Tree,

### **Books for Reference:**

1. Langsam Y., Augenstein M. J. And Tenenbaum A. M., “Data Structures Using C and C++”, Prentice Hall of India Pvt. Ltd.
2. Trembly J. P. And Sorenson P. G., “An Introduction to Data Structures with Applications”, Tata McGraw Hill Pub. Co. Ltd.
3. Horowitz E. And Sahani S., “Fundamentals of Computer Algorithms”, Galgotia Publications Ltd.

## **1PGCC02-CIM (COMPUTER INTEGRATED MANUFACTURING)**

Concept and scope of CIM, components of CIM, benefits, limitations.

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 , Production flow analysis , Machine cell design , Benefits.

Introduction & Components of FMS , Application work stations , Computer control and functions , Planning, scheduling and control of FMS , Scheduling , Knowledge based scheduling , Hierarchy of computer control , Supervisory computer.

Manufacturing data systems , data flow , CAD/CAM considerations , Planning FMS database.

Automated material handling systems, AS/RS, general considerations , selection, evaluation and control .

Inspection and Quality control, CAQC ,CMM types, working, applications.

Process Planning in the Manufacturing cycle , Process Planning and Production Planning Process Planning and Concurrent Engineering, CAPP, Variant process planning , Generative approach , Forward and Backward planning, Input format,

Logical Design of a Process Planning , Implementation considerations ,manufacturing system components, Totally integrated process planning systems , An Overview , Modulus structure , Data Structure, operation , Report Generation, Expert process planning.

Agile manufacturing , Nano Manufacturing

### **Books for Reference:**

1. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, 1996.
2. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt. Ltd., New Delhi, 2002
3. Jha, N.K., "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.
4. Burbidge, J.L. "Group Technology in Engineering Industry", Mechanical Engineering pub. London, 1979.
5. Askin, R.G. and Vakharia, A.J., "G.T Planning and Operation, in The automated factory-HandBook: Technology and Management", Cleland, D.I. and Bidananda, B (Eds), TAB Books, NY, 1991.
6. Irani, S.A. "Cellular Manufacturing Systems", Hand Book.
7. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), " Planning, design and analysis of cellular manufacturing systems" , Elsevier, 1995.
8. Gideon Halevi and Roland D. Weill, " Principles of Process Planning", A logical approach, Chapman & Hall, 1995.

## 1PGCC03-ELECTIVE- I

### (i) Materials Engineering

Elasticity in metals and polymers , Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals , Strengthening mechanisms, work hardening, solid solutions, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviors , Super plasticity , Deformation of non crystalline material.

Griffith's theory, stress intensity factor and fracture toughness , Toughening mechanisms , Ductile, brittle transition in steel , High temperature fracture, creep , Larson-Miller parameter , Deformation and fracture mechanism maps , Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law , Effect of surface and metallurgical parameters on fatigue , Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

Motivation for selection, cost basis and service requirements , Selection for mechanical properties, strength, toughness, fatigue and creep , Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing , Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications.

Dual phase steels, Micro alloyed, 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 crystalline materials.

Advanced structural ceramics, WC, TiC, TaC, Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub>, CBN and diamond , properties, processing and applications.

### Books for Reference:

1. Thomas H. Courtney, “ Mechanical Behaviour of Materials “, (2nd Edition), McGraw-Hill, 2000.
2. Charles J.A., Crane, F.A.A and Furness, J.A.G., “ Selection and use of Engineering Materials “, (3rd Edition ), Butterworth-Heinemann, 1977.
3. Flinn, R.A. and Trojan, P.K., “ Engineering Materials and their Applications”, (4th Edition), Jaico, 1999.
4. George E.Dieter, “ Mechanical Metallurgy”, McGraw Hill, 1988.
5. Metals Hand Book, Vol.10, “ Failure Analysis and Prevention”, (10th Edition), 1994.

## (ii) Image Processing

Fundamental concepts of digital image processing, analysis and understanding, including modelling, algorithms, hardware components and system architectures Theoretical topics to include digital image acquisition (sampling).

Characteristics of gray-level digital images Discrete sampling model, Noise processes, Image attributes Segmentation Thresholding and thresholding algorithms Region growing and region adjacency graph (RAG), Split and merge algorithms Boundary coding

Morphological operation ,Introduction to grey-level morphology

Feature Characterisation ,Calculation of region properties and adaptive algorithms Moment features and Fourier descriptors

Image filtering, Linear and non-linear filtering operations Image convolutions

Edge detection, Alternative approaches Edge enhancement by differentiation Effect of noise, edge detection Corner detection, Image structure tensor Relationship to image auto-correlation Characterisation and Harris corner detector

Colour images, Representations of colour in digital images

Template matching, Similarity and dissimilarity matching metrics L2 metric and relationship to cross-correlation Image search 2D object detection, recognition, location Applications, Algorithm selection

Comparison of pixel-based and feature based algorithms Performance evaluation Application examples

### Books for Reference:

1. M. Sonka, V. Hlavac, R. Boyle, "Image Processing, Analysis, and Machine Vision". Chapman and Hall, 2nd Ed. 1999.
2. R. C. Gonzalez, R. E. Woods, "Digital Image Processing", Addison-Wesley.
3. A. K. Jain, "Fundamentals of digital Image Processing", Prentice-Hall.
4. M. Seul, "Practical Algorithms for Image Analysis: Descriptions, Examples, and Code"
5. Batchelor, B.G., Hill, D.A., and Hodgson, D.C., "Automated Visual Inspection", North Holland, 1985.
6. Haralick, R.M. and Shapiro, L.G., "Computer and Robot Vision", *Volume 1*, Addison-Wesley, 1992.
7. Jähne, Bernd," Digital Image Processing", Springer-Verlag, 1991.
8. Jain, Ramesh, Kasturi, R., and Schunck, B.G.," Machine Vision", McGraw-Hill, 1995.
9. Pavlidis, T., "Algorithms for Graphics and Image Processing", Computer Science Press, 1982.
10. Petrou, Maria and Bosdogianni, P., "Image Processing", John Wiley, 1999.
11. Schalkoff, R.J., "Digital Image Processing and Computer Vision", Wiley, 1989.
12. Stockman and Shapiro, "Computer Vision", Prentice Hall, 2001

### **(iii) Engineering Management**

Concepts / Definitions of Engineering, Management, Engineering Management, Engineering Manager, Management Engineers. scope of EM

Engineers – The Problem-Solvers, General Problem Solving Approach, PQT approach.

Managing the people – The six EM Functions , Planning, Organizing, Motivating, Delegating, Controlling, Communication , Definitions, Types, Importance, Characterization, Tools Styles, Effectiveness Evaluation

Leadership and Management, Leader and Manager, Leadership Styles

Development and Protection of Intellectual Properties

Simultaneous Engineering, Management of transnational projects

Project Management – people related issues, cultural diversity

Business Plan Development, Obtaining Venture capital

Case studies

#### **Books for Reference:**

1. D. Kocaoglu and Cleland “Engineering Management”
2. Daniel Babcock “Engineering Management”

### **(iv) Total Quality System & Engineering**

Principles of Quality Management , Pioneers of TQM , Quality costs , Quality system Customer Orientation , Benchmarking , Re-engineering

Leadership , Organisational Structure , Team Building , Information Systems and Documentation – Quality Auditing , ISO 9000 - QS 9000.QMS, Quality awards.

Single Vendor Concept , J.I.T. , Quality Function deployment , Quality Circles , KAIZEN , SGA POKA - YOKE , Taguchi Methods.

Methods and Philosophy of Statistical Process Control , Control Charts for Variables and Attributes

Cumulative sum and Exponentially weighted moving average control charts , Others SPC Techniques – Process Capability Analysis .

Acceptance Sampling Problem , Single Sampling Plans for attributes , double, multiple and sequential sampling,

Six sigma manufacturing concepts.

## **Books for Reference:**

1. Mohamed Zairi, "Total Quality Management for Engineers", Woodhead Publishing Limited 1991.
2. Harvid Noori and Russel, "Production and Operations mangament - Total Quality and Responsiveness", McGraw-Hill Inc, 1995.
3. N.Logothesis, "Managing for Total Quality", Prentice Hall of India Pvt .Ltd,1998
4. John Bank, "The Essence of Total Quality Management", Prentice Hall of India Pvt.Ltd., 1995.
5. Douglus C. Montgomery, "Introduction to Statistical Quality Control", 2nd Edition, John Wiley and Sons, 1991.
6. Grant E.L and Leavensworth, "Statistical Quality Control", McGraw-Hill, 1984. M. Imai, "Kaizen",

## **1PGCC04-Computer Graphics for CAD/CAM**

Role of Computer Graphics in CAD/CAM., Fundamentals of 2D graphics, Menu design and Graphical User Interfaces(GUI), Customisation and Parametric programming.

Vector representation of geometric entities, lines, circle, arc, conics. Homogeneous coordinate systems, Geometric transformations , 2D and 3D.Orthographic and Perspective projection. Hidden line removal algos. Planar and Space curve design, Analytical and Synthetic approaches, parametric and implicit equations. Surface of revolution, sweep surfaces, ruled and developable surfaces, Modelling of bi parametric freeform surfaces ,Coons, Bezier, B-spline, Rational B-Splines and NURBS surface patches, Surface manipulation techniques.

Geometric modelling techniques , Wireframe modelling. Solid Modelling, B-Rep, CSG and Hybrid modelers.

Feature based, Parametric and Variational modelling.

Introduction to product data standards and data structures, Data-base integration for CIM.

### **Books for Reference:**

1. Faux, I.D. and Pratt, M.J. "Computational Geometry for Design and manufacture", John Wiley & Sons, NY, 1979
2. Mortenson, M.E., "Geometric Modelling", John Wiley & Sons, NY, 1985.
3. Choi, B.K. "Surface Modeling for CAD/CAM", John Wiley & Sons, NY, 1991
4. Martti Mantilya, "An Introduction to Solid Modeling" Computer Science Press
5. Ibrahim Zeid, "CAD/CAM" TMH
6. Rogers D F I and Adams J A, "Mathematical Elements for Computer Graphics", McGraw-Hill, 1996
7. Multineux, "CAD -Computational Concepts and Methods", Kogan Page Ltd, 1984
8. Ding Q and Davies B J , "Surface Engineering Geometry for Computer-Aided Design and Manufacture", Ellis Horwood, 1987
9. Hiroaki C, Solid Modelling with Design base, Addison Wesley Publishing Co., 198
10. Hoschek J, Dieter L, "Fundamentals of Computer Aided Geometric Design", A K Peters, 1997



## **1PGCC05-CNC and Robotics**

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.

Programming CNC machines, Part print analysis and Process planning, Advanced Programming features , Canned cycles, Subroutines, Macros, special cycles etc. APT part programming using CAD/CAM, Parametric Programming.

Manual part programming for CNC turning, milling and machining center. Wire EDM machines. Computer assisted part programming techniques , Conversational and Graphics based software, Solids based part programming. Freeform surface machining. Simulation and Verification of CNC programs, Adaptive CNC control techniques. Integration of CNC machines for CIM.

Robotics, Basic concepts , Robot configurations , Basic robot motions , Types of drives , Applications Transformations and kinematics, Vector operations , Translational transformations and Rotational transformations , Properties of transformation matrices,

Homogeneous transformations and Manipulator , Forward solution , Inverse solution.

Controls and end effectors, Control system concepts , Analysis , control of joints , Adaptive and optimal control

End effectors ,Classification , Mechanical , Magnetic , Vacuum , Adhesive , Drive systems , Force analysis and Gripper design.

Robot programming, Methods , Languages ,Computer control and Robot Software – Programming Languages.

Sensory devices, Non optical and optical position sensors , Velocity and Acceleration , Range , Proximity , touch , Slip , Force ,Torque.

Machine vision , Image components , Representation , Hardware , Picture coding , Object recognition and categorisation

Integration of Robots with CNC machines for CIM.

### **Books for Reference:**

1. Krar, S., and Gill, A., “CNC Technology and Programming”, McGraw Hill publ Co, 1990.
2. Gibbs, D., “An Introduction to CNC Machining”, Casell, 1987.
3. Seames, W.S., “Computer Numerical Control Concepts and Programming”, Delmar Publishers, 1986.
4. Lynch, M., “Computer Numerical Control for Machining”, McGraw Hill, 1992.
5. Koren Y, “Computer Control of Manufacturing Systems”, McGraw, 1986.

6. Fu K.S., Gonzalez R.C., and Lee C.S.G., "Robotics control, sensing, vision, and intelligence", McGraw-Hill Book Co., 1987.
7. Klafter R.D., Chmielewski T.A. and Negin M., "Robot Engineering An Intergrated approach", Prentice Hall of India, New Delhi, 1994.
8. Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw-Hill Publishing Co.,Ltd., 1994.
9. Craig J.J., "Introduction to Robotics Mechanics and Control", Addison-Wesley, 1999.

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**SCHEME OF EXAMINATION & SYLLABUS FOR M. TECH (CAD/CAM) FOUR SEMESTER COURSE**

**Second Semester Course Scheme**

Sub. Code	Name of Subject	Teaching Scheme (Clock hours / week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs
		L	T	P/ D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
2PGCC01	Artificial Intelligence	3	1	-	4	70	30	100	50	-	-	-	-	3
2PGCC02	Modelling & Simulation	3	1	-	4	70	30	100	50	-	-	-	-	3
2PGCC03	Product Data Management	3	1	-	4	70	30	100	50	-	-	-	-	3
2PGCC04	FEM	3	1	2	6	70	30	100	50	25	25	50	25	3
2PGCC05	Elective - II	3	1	2	6	70	30	100	50	25	25	50	25	3
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>4</b>	<b>24</b>	<b>350</b>	<b>150</b>	<b>500 *</b>	<b>-</b>	<b>50</b>	<b>50</b>	<b>100 *</b>	<b>-</b>	<b>Total (T+P) = 600 *</b>

**Elective –II :- (i) Mechatronics (ii) Computer Aided Tool Design, (iii) Plastics & Composites (iv) CFD**

## Second Semester Syllabus

### **2PGCC01- Artificial Intelligence**

Human and machine intelligence, Artificial Intelligence (AI), Programming in AI environment, Natural Language processing (NLP)

Architecture of an Expert system, Knowledge base, inference engine forward and backward chaining, use of probability and fuzzy logic. Selection of inference mechanism.

Introduction, to Rule Based System, Conflict Resolution, Advantages and Drawbacks of Rule Based Systems Clausal Form Logic; Rule Base Verification, Refinement and Validation

Creating Knowledge Base, Knowledge Engineer and Domain Expert, Phases of Knowledge Engineering, Tools for Knowledge Engineering

Neural network applications, artificial neural network models, NN applications in Cellular manufacturing and other areas of mechanical Engg.

Fundamentals of OOP (Object oriented programming), creating structures and objects, object operations, invoking procedures, programming applications, Object oriented expert systems.

Semantic nets, structure and objects, ruled systems for semantic nets, certainty factors, automated learning;

### **Books for Reference :**

1. Addis, T.R., "Designing Knowledge Based System", Prentice Hall, 1985.
2. Rolston, D.W., "Principles of Artificial Intelligence and Expert Systems Development", McGraw Hill, 1988.
3. Maus, R. and Keyes, J., "Handbook of Expert Systems in Manufacturing", McGraw Hill, 1991
4. Robert Levine, "A comprehensive guide to artificial intelligence and expert systems",
5. Elaine Rich, "Artificial Intelligence",
6. Sasikumar, Ramani, et al, "Rule based expert systems".
7. Graham Winstanley, "Program Design for Knowledge Based Systems", Galgotia Publications.
8. Artificial Neural Networks", Zurada
9. V.B. Rao and H.V. Rao, "C++ : Neural Networks and Fuzzy Logic", BPB Publications.

## **2PGCC02- Modeling & Simulation**

Introduction to simulation as a tool, Areas of application, System model, Components of system, System environment, Types of system model, Steps in a simulation study.

Discrete event system simulation,

Event scheduling, Time advance mechanism, List processing - basic properties and operations, Dynamic allocation, linked lines.

Characteristics of queuing systems, Transient and steady-state behaviour, Long-run performance measures, Infinite-population steady-state models, Finite-population models.

Properties and generation of random numbers, Testing of generated random numbers. Random Variate Generation :

Exponential, Uniform, Weibull, Triangular, Empirical, Discrete distributions, Direct transformation for normal distribution, Convolution method, Acceptance-rejection technique

Data collection, Identifying distributions, Parameter estimation, Goodness-of-fit tests, Multivariate and time series input models.

Model building, Verification, Validation process, Verification of simulation models, Calibration and validation of models: Validation of assumptions, Input-output transformations, Validation of input-output using historical data and turning test.

Modeling manufacturing systems, Material handling system, Goals and performance measures, Modeling down times and failures, Trace-driven models, Case studies of manufacturing and Material Handling systems.

Statistical procedures for comparing real world observations and simulation output data.

Simulation Languages, introduction to SIMLIB, SIMAN, SIMSCRIPT, SLAM-II, Promodel

General description, Action times, Succession of events, Choice of paths, Simulation of Mfg. shop, Facilities & storages, Gathering statistics, Conditional transfers, Program control statements, GPSS examples.

### **Books for Reference:**

1. J. Banks “Discrete-Event System Simulation”, PHI.
2. S. Law ,”Simulation Modeling and Analysis”, McGraw Hill Publishing Co.
3. N. Deo , “Discrete Simulation using Digital Computers”,
4. J. Gordon , “System Simulation”, PHI
5. A.M.Law & W.D. Keltron, “Simulation Modeling & Analysis” , McGraw Hill International series.
6. Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall Of India Pvt. Ltd.

## **.2PGCC03- Product data Management**

Purpose of Database Systems; View of Data; Data Models; Database Languages; Database Users; Overall System Structure

Design Issues; Mapping Constraints; Keys; Entity-Relationship Diagram; Weak Entity Sets; Extended E-R Features; Design of an E-R Database Schema;

Structure of Relational Databases; The Relational Algebra; The Tuple Relational Calculus; The Domain Relational Calculus; Extended Relational Algebra Operations; Modifications of the Database; Views

Basic Structure; Set Operations; Aggregate Functions; Null Values; Nested Sub queries; Derived Relations; Views; Modification of the Database; Joined Relations; Data-Definition Language; Other Relational Languages - Query-by-Example; Quel; Datalog; Views

Domain Constraints; Referential Integrity; Assertions; Triggers; Functional Dependencies Views

Pitfalls in Relational-Database Design; Decomposition; Normalization Using Functional Dependencies; Views

New Database Applications; The Object-Oriented Data Model; Object-Oriented Languages; Persistent Programming Languages; Persistent C++ Systems; Object-Relational Databases Views: Indexing and Hashing Ordered Indices

Centralized Systems; Client-Server Systems; Parallel Systems; Distributed Systems; Network Types; Parallel Databases; Distributed Databases; Security and Integrity; Standardization Views

Expert Database Architectures; Semantic Data Models; Views

Decision-Support Systems; Data Analysis; Data Warehousing; Spatial and Geographic Databases; Multimedia Databases; Mobility and Personal Databases; Information-

Product Design Databases; CAD-CAM Data Management Requirements; Databases for Shop floor control and Factory information system; Enterprise Resource Planning; Database requirements of Computer Integrated Manufacturing Views:

### **Books for Reference:**

1. Abraham Silberschatz, Henry F. Korth, S.Sudarshan, "Database System Concepts", McGraw Hill International Editions, Third Edition
2. P. Beynon-Davies, "Expert Database Systems – A Gentle Introduction", McGraw Hill International; 1991
3. James Martin, "Database Management Systems",
4. Mark Swank and Drew Kittel, "Worldwide Web - Database Developer's Guide"
5. Fredrick H.Jones and Lloyd Martin "The AutoCAD Database Book - Accessing and Managing CAD Drawing Information"; Galgotia Publications, Third Edition.

## **2PGCC04- FEM**

Basics of FEM – review of finite difference method, Initial value and boundary value problems - weighted residual, Galerkin and Raleigh Ritz methods. Review of Variational calculus, Integration by parts - Basics of variational formulation.

Steps in FEA ,Discretization, Interpolation, derivation of element charecteristic matrix, shape function.

Assembly and imposition of boundary conditions - Solution and post processing - One dimensional analysis in solid mechanics and heat transfer.

Global and Natural co-ordinates - Shape functions for one and two dimensional elements - Three noded triangular and four noded quadrilateral element - Non linear analysis - Isoparametric elements – Jacobian matrices and transformations - Basics of two dimensional axi symmetric analysis.

Pre Processing, Mesh generation, element connecting, boundary conditions, input of material and processing characteristics –

Solution and post processing - Overview of application packages such as ANSYS.

Applications of FE analysis in metal casting, cutting tools, structural analysis of parts, heat transfer etc.

### **Books for Reference:**

1. O.C. Zienkiewicz ,”The Finite Element Method”.
2. C.S. Krishnamurthy, “Finite Element Analysis : Theory & Programming”, TMH Publishing Co.
3. S.S. Rao ,”The Finite Element Method in Engineering”, Pergamon Press.
4. J.N. Reddy , “Finite Element Method” , McGraw Hill Int.
5. Ozisik, “Heat Transfer”.

## 2PGCC05- Elective II

### (i) Mechatronics

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems -

Traditional design and Mechatronics Design.

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion – Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems.

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085

instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters - Applications

- Temperature control - Stepper motor control - Traffic light controller.

Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays

and counters - Data handling - Analog input / output - Selection of PLC.

Designing - Possible design solutions - Case studies of Mechatronics systems.

### Books for reference:

1. Michael B.Histand and David G. Alciatore, “ Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 1999.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, A.J., " Mechatronics ", Chapman and Hall, 1993.
3. Ramesh.S, Gaonkar, “Microprocessor Architecture, Programming and Applications”, Wiley Eastern,1998.
4. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics” , Prentice-Hall, 2000.
5. Ghosh, P.K. and Sridhar, “ Introduction to Microprocessors for Engineers and Scientists ”, Second Edition, Prentice Hall, 1995.



## **(ii) Computer Aided Tool Design**

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

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.

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.

Taylor's principles of gauge design. Design of limit gauges.

Forging in Plane strain - Forging of circular disc - Effect of friction - Forging equipment - defects in forged products-Causes & Remedies. Design of forging dies.

Mechanics of metal cutting. Design of single point tools. Design of multipoint cutting tools like drills, reamers, broaches, taps and milling cutters.

Design of tools for joining processes.

Design of tools for NC, CNC machines.

### **Books for reference:**

1. Donaldson, "Tool design"
2. ASTM, "Fundamentals of Tool design"
3. Pollock, "Fundamentals of Tool design"
4. Grant, "Unconventional Clamping Systems"
5. Kempster, "Fundamentals of Tool design"

### **(iii) Plastics and Composites**

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

Extrusion - Injection Moulding - Blow Moulding - Compression and Transfer Moulding - Casting – Thermo Forming.

General Machining properties of Plastics - Machining Parameters and Their effect - Joining of Plastics - Mechanical Fasteners - Thermal bonding - Press Fitting.

Fibres - Glass, Boron, Carbon, Organic, Ceramic and Metallic Fibers - Matrix Materials - Polymers, Metals and Ceramics.

Open Mould Processes, Bag Moulding, Compression Moulding with BMC and SMC - Filament winding - Pultrusion - Centrifugal Casting - Injection Moulding - Application of PMC's.

Solid State Fabrication Techniques - Diffusion Bonding - Powder Metallurgy Techniques - Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fibres - Liquid State Fabrication Methods - Infiltration - Squeeze Casting - Rheo Casting - Compocasting - Application of MMCS.

#### **Books for Reference:**

1. Harold Belofsky, Plastics , “Product Design and Process Engineering”, Hanser Publishers, 1995.
2. Bera, E and Moet, A, “High Performance Polymers”, Hanser Publishers, 1991.
3. Hensen, F, “Plastics Extrusion technology”, Hanser Publishers, 1988.
4. Johannaber F, “Injection Moulding Machines”, Hanser Publishers, 1983.
5. Rauwendaal, C, “Polymer extrusion”, Hanser Publishers, 1990.
6. Rosatao, D.V., “Blow Moulding Handbook”, Hanser Publisher, 1989.
7. Seamour,E.B., “Modern Plastics Moulding”, John Wiley.
8. John Dalmonte, “Plastics Moulding”, John Wiley.
9. Akira Kobayashi, “Machining of Plastics”, Mc-Graw Hill.
10. Krishan K.Chawla, “Composite Materials science and Engineering”, Springer-Verlag, 1987.
11. Agarwal. D. and Broutman L.J., “Analysis and Performance of Fiber Composites” , Wiley, 1990.
12. Mallick, P.K. and Newman, S.,“Composite Materials Technology”, Hanser Publishers, 1990.

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**SCHEME OF EXAMINATION & SYLLABUS FOR M. TECH (CAD/CAM) FOUR SEMESTER COURSE**

**Third Semester Course Scheme**

Sub. Code	Name of Subject	Teaching Scheme (Clock hours / week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs
		L	T	P/ D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
3PGCC01	Manufacturing System Integration & Management	3	1	-	4	70	30	100	50	-	-	-	-	3
3PGCC02	Product Design & Development	3	1	-	4	70	30	100	50	-	-	-	-	3
3PGCC03	Seminar on dissertation/Thesis research methodology	-	-	8	8	-	-	-	-	-	200	200	75	-
	<b>Total</b>	<b>6</b>	<b>2</b>	<b>8</b>	<b>16</b>	<b>140</b>	<b>60</b>	<b>200*</b>	<b>-</b>	<b>-</b>	<b>200</b>	<b>200*</b>	<b>-</b>	<b>Total (T+P) = 400 *</b>

## Third Semester Syllabus

### **3PGCC01- Manufacturing System Integration & Management**

Computer integrated Production management Systems-Master Production Schedule-Material Requirement Planning-Inventory Management-Manufacturing and Design Data Base-Capacity Planning-Shop Floor.

Control-Functions-Order Release-Order Scheduling-Order progress-Factory Data Collection.

Functions of inventory – Objectives – Inventory systems – Inventory models- Basic and Advanced Inventory Models.

Purpose, Characteristics – Aggregate Planning – Methods – Master Production Scheduling Functions- Time Purpose Of MRP – Inputs To MRP – MRP Logic- Planning Factors- Outputs From MRP-Recourse Planning-Capacity Planning. Manufacturing Resources Planning(MRP III) : Framework Of MRP II System , Elements Of MRP II, Resources Requirement Planning, Demand Management, Master Production Scheduling And Final Assembly Scheduling, Rough Cut Capacity Planning, Material Requirement Planning, Capacity Requirements Planning, Plant And Supplier Scheduling, Close The Look Approach Problems Associated With MRP II, Benefit And Prospects For MRP II.

Introduction To Group Technology, Limitations Of Traditional Manufacturing Systems, Characteristics In GT/CMS-Design Of CMS –Models, Traditional Approaches And Non-Traditional Approaches – Life Cycle Issue in GT/GMS.

Value Added Focus, Source of waste, JIT principles, The Meaning of JIT, Small Lot Production, Setup Time Reduction, Pull Production: Production Control Systems, Pull And Push System, Process Improvement, Necessary Conditions For Pull Production Systems, How To Achieve Pull Production, Mechanisms For Signal, To Pull or Production, Production Planning and Scheduling Under Different Circumstances Factory Coordination, Production Environment Design, Production Activity Control, Scheduling, Input Output Control, Plant Scheduling, Kanban, Production Reporting and Status, Measurement for Control, Order Deposition, Importance of SFC.

#### **Books for references:**

1. Bubidge, J.L. “Group Technology in Engineering Industry” Mechanical Engineering Pub, London, 1979.
2. Askin, R.G. and Vakharia, A. J. “G. T. Planning and Operation, in the Automated Factory- Hand book: Technology and Management” , cleland, D. I. And Bidananda, B (Eds), TAB Book, NY 1991.
3. Irani, S.A. “cellular Manufacturing Systems”, Hand Book
4. Kamrani, A.K. Pasaei,, H.R. And Liles, D.H. (Eds) “planning Design and Analysis of cellular manufacturing systems”, Elsevier, 12995
5. Nicholes John M. “Competitive Manufacturing Management” McGraw Hill International Editions
6. Khalid Shiakh, Manufacturing Resource Planning” Tata McGraw Hill Co. Ltd.
7. James M. Moore, Plant Layout and Design”, McMillan Publishing Company

## **3PGCC02- Product Design & Development**

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.

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

Process selection – Importance types of manufacturing processes and their classification, sources of information, selection criteria, Material and Process selection Methods- Expert systems, Computer Database Approach, Performance indices, decision matrix, AHP and fuzzy approach, introduction to material and process selection software.

Benchmarking – DFM, DFA, DFX, Early supplier involvement, robust design, QFD and concurrent engineering.

Mathematics of Time Value of Money, Cost Comparison, Depreciation, Taxes, Inflation, Profitability of Investment and Investment Decision Analysis Sensitivity Analysis. Methods of Cost Estimates. Industrial Engineering Approach, Parametric Approach, Introduction to Assembly Modelling, Top-Down and Bottom-Up Approaches of AM, Mating Conditions, Representation Schemes, Generations of Assembly Sequences. Product Development Cycle and Importance of Prototyping, Types of Prototypes, Principle and Advantages & Different Type of Generative Manufacturing Process, Viz, Stereolithography, FDM, SLS etc. Factors Concerning to RP: Consideration for Adoptions, Advantages, Accuracy and Economic Considerations.

### **Book for reference:**

1. Dieter George E. “Engineering Design”, McGraw Hill Pub. Company, 2000
2. Ulrich Karl T. and Eppinger Steven D., “Product Design and Development” McGraw Hill Pub. Company, 1995.
3. Bralla, James G., “Handbook of Product Design for Manufacturing” McGraw Hill Pub. Company, 1986
4. Ibrahim Zeid, “CAD/CAM”, Tata McGraw Hill Pub.
5. Martti Mantilya, “An Introduction to solid modeling”, Computer Science Press.
6. Rogers Adams, “mathematical aspects of Computer Graphics” McGraw Hill Pub.

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**SCHEME OF EXAMINATION & SYLLABUS FOR M. TECH (CAD/CAM) FOUR SEMESTER COURSE**

**Fourth Semester**

Sub. Code	Name of Subject	Teaching Scheme (Clock hours / week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs
		L	T	P/D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
4PGCC01	Dissertation / Thesis	-	-	20	20	-	-	-	-	400	-	400	200	-

**Note: -**

(a) Minimum passing marks is 50% in all subjects.

(b) Dissertation/Thesis marks will be given based on seminar & Viva voce.