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

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur

Faculty of Engineering & Technology

Course and Examination Scheme of Master of Technology

Choice Base Credit System(CBCS)

1st Semester M. Tech. (CAD/C A M)

Subject Code	Name of Subject	Teaching Scheme		No. of Credits	Marks			
		Hours per week			Internal	Univ Exam	Total	Passing
		L	P					
PGCC101T/ PGCADMA101T	Computer Integrated Manufacturing	4	--	4	30	70	100	50
PGCC102T/ PGCADMA102T	Computer Graphics for CAD/CAM	4	--	4	30	70	100	50
PGCC103T/ PGCADMA103T	CNC & Robotics	4	--	4	30	70	100	50
PGCC104T	Elective -1 (Discipline Specific)	4	--	4	30	70	100	50
PGOPEN105T	Elective -II (Open)	4	--	4	30	70	100	50
PGCC102P/ PGCADMA102P	Computer Graphics for CAD/CAM	--	2	1	50	50	100	50
PGCC103P/ PGCADMA103P	CNC & Robotics	--	2	1	50	50	100	50
	Total	20	4				700	
		24		22				

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/C A M)

Subject Code	Subject	Teaching Scheme			Marks			
		Hours per week		No. of Credits	Internal	Univ Exam	Total	Passing
		L	P					
PGCC201T/PGCADMA201T	Advance FEM	4	--	4	30	70	100	50
PGCC202T/PGCADMA202T	Product Design & Development	4	--	4	30	70	100	50
PGCC203T/PGCADMA203T	Mechatronics	4	--	4	30	70	100	50
PGCC204T / PGCADMA204T	Elective -III (Discipline Specific)	4	--	4	30	70	100	50
PGFD205T	Foundation Course - 1	4	--	4	30	70	100	50
PGCC201P/ PGCADMA201P	**Lab for Advance FEM**	--	2	1	50	50	100	50
PGCC203P/ PGCADMA204P	**Lab for Mechatronics**	--	2	1	50	50	100	50
	Total	20	4				600	
		24		22				

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/C A M)								
Subject Code	Subject	Teaching Scheme			Marks			
		Hours per week		No. of Credits	Internal	Univ Exam	Total	Passing
		L	P					
PGOPEN301T	**Elective -IV (Open)**	4	--	4	30	70	100	50
PGFD302T	Foundation Course -II	4	--	4	50	50	100	50
PGCC303P	Project Seminar	--	3*	8	200		200	
	Total	8	3					
		11		16				

*Contact Hours per week per project

Elective –IV (Open) : Can be chosen from other branches	**1. Manufacturing System Integration & Management** **2. Modeling & simulation** **3. Production and Operations Management**
Foundation Course-II:	Project Planning & Management

4th Semester M. Tech. (CAD/C A M)								
Subject Code	Subject	Teaching Scheme			Marks			
		Hours per week		No. of Credits	Internal	Univ Exam	Total	Passing
		L	P					
PGCC401P	Project	--	6*	16	--	400	400	200
	Total	--	6					
		6		16				

*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)

As per Non-Credit Base Scheme (Non-CBS)			**As Per Choice Based Credit Scheme (CBCS)**		
Subject Code	**Subject**	**Theory/ Practical**	**Subject Code**	**Subject**	**Theory / Practical**
1PGCC01	Data Structures & Algorithms	Theory	---	---	---
1PGCC02	CIM	Theory	PGCC101T/ PGCADMA101T	**Computer Integrated Manufacturing**	**Theory**
1PGCC03 Elective –I	Materials Engineering,	Theory	PGCC104T	Mechanical behavior of Engineering Materials	**Theory**
	Total Quality System & Engineering		PGOPEN105T	Total Quality System & Engineering	
1PGCC04	Computer Graphics for CAD/CAM	Theory	PGCC102T	Computer Graphics for CAD/CAM	**Theory**
1PGCC05	CNC & Robotics	Theory	PGCC103T	CNC & Robotics	**Theory**
1PGCC04	Computer Graphics for CAD/CAM	Practical	PGCC102P	Computer Graphics for CAD/CAM	Practical
1PGCC05	CNC & Robotics	Practical	PGCC103P	CNC & Robotics	Practical

ABSORPTION SCHEME
2nd SEMESTER M. Tech. (CAD/CAM)

As per Non-Credit Base Scheme (Non-CBS)			**As Per Choice Based Credit Scheme (CBCS)**		
Subject Code	**Subject**	**Theory/ Practical**	**Subject Code**	**Subject**	**Theory / Practical**
2PGCC01	Artificial Intelligence	Theory	**PGOPEN105T**	Artificial Intelligence	Theory
2PGCC02	Modelling & Simulation	Theory	PGOPEN301T	**Elective -IV (Open)** Modelling & Simulation	Theory
2PGCC03	Product Data Management	Theory	PGOPEN301T	**Elective -IV (Open)** Data Communication in CADMA	Theory
2PGCC04	FEM	Theory	PGCC201T	Advance FEM	Theory
2PGCC05 T (**Elective – II)**	Mechatronics	Theory	PGCC203T	Mechatronics	Theory
	Plastics & Composites	Theory	PGCC204T	Plastics & Composites	
	Computer Aided Tool Design	Theory	PGCC204T	Computer Aided Tool Design	
2PGCC04	FEM	Practical	PGCC201P	**Lab Advance FEM**	Practical
2PGCC05 P (**Elective – II)**	Mechatronics	Practical	PGCC203P	Mechatronics	Practical
	Plastics & Composites		----	**------**	
	Computer Aided Tool Design		-------	**--------**	

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

As per Non-Credit Base Scheme (Non-CBS)			**As Per Choice Based Credit Scheme (CBCS)**		
Subject Code	**Subject**	**Theory/ Practical**	**Subject Code**	**Subject**	**Theory / Practical**
3PGCC01	Manufacturing System Integration & Management	Theory	PGOPEN301T **Elective -IV (Open)**	Manufacturing System Integration & Management	Theory
3PGCC02	Product Design & Development	Theory	PGCC202T	Product Design & Development	Theory
3PGCC03	Seminar on dissertation/Thesis	Practical	PGCC303P	Project Seminar	Practical

Rashtrasant Tukadoji Mahraj Nagpur University, Nagpur

Faculty of Engineering and Technology

M . TECH. (CAD/CAM) FOUR SEMESTER COURSE

Syllabus

First Semester

Subject Code	Subject Name	Credits
PGCC101T	**Computer Integrated Manufacturing (CIM)**	04

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

UNIT I

9

Introduction: Fixed, Programmable and Flexible Automation, Classification of automated manufacturing systems based on product variety & production volume. Evolution of CIM, Segments of CIM - Computer aided Design, Computer Aided Manufacturing, Computer controlled business functions. Overview of CIM softwares.

Unit II

9

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

9

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

9

Manufacturing Process Planning: Automated process planning: Retrieval & Generative Expert process planning, Introduction to process planning softwares.

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

UNIT V

9

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

1. Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall publication 1997.
2. P.Radhakrishnan, “CAD, CAM, CIM”, New Age International Pvt. Ltd. and S.Subramanyam, Wiley Eastern Ltd.
3. David Bedworth, Etal, “Computer Integrated Design and Manufacturing, McGraw Hill Book Co., 1991.
4. Mikell P. Groover and Zimmers E.W, “Computer Aided Design and Manufacturing”, Prentice Hall Publication.

Subject Code	Subject Name	Credits
PGCC102T	**Computer Graphics for CAD/CAM**	04

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 **9**

Origin of computer graphics – interactive graphics display – display devices – pixels– algorithms for line and circle – Bresenham's algorithm – 2D and 3D transformations – translation, rotation, scaling – concatenation.

UNIT II **9**

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 **9**

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 **9**

Volume modeling: boundary representation, CSG, hybrid – viewing transformations – techniques for visual realism: clipping, hidden line removal, algorithms for shading and rendering.

UNIT V **9**

GRAPHICS STANDARDS: GKS – bitmaps – Open GL, Data exchange standards – IGES – STEP – CALS – DXF – STL Communication standards – LAN, WAN.

REFERENCES

1. Chris McMohan and Jimmi Browne, "*CAD/CAM Principles, Practice and Manufacturing Management"*, Pearson Education Asia,Ltd., 2000.
2. Donald Hearn and Pauline Baker M. "*Computer Graphics*", Prentice Hall, Inc., 1992.
3. Ibrahim Zeid "*CAD/Cam Theory and Practice*", McGraw Hill, International Edition, 1998.
4. Khandare S.S., "*Computer Aided Design*", Charotar Publishing House,India, 2001.
5. Newman, William M., & Sproull, Robert F., "*Principles of InteractiveComputer Graphics*", 2nd Ed., McGraw Hill, 1981.
6. Harington, Stevan, "*Computer Graphics: A Programming Approach*",McGraw Hill, 1983.
7. Plastock, Roy A., & Kally, "*Theory and Problems of Computer Graphics*", McGraw Hill, 1986.
8. Rogers. D.F., "*Procedural Elements for Computer Graphics*", McGraw Hill, 1985.
9. Foley, J.D. & Van dam, A., "*Fundamentals of Interactive Computer Graphics*", Addison – Wesley, 1982.

Subject Code	Subject Name	Credits
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.

9

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.

9

Unit II

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. Computer assisted part programming techniques , Conversational and Graphics based software, Solids

based part programming. Freeform surface machining. Simulation and Verification of CNC programs.

9

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.

9

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

9

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,

Elements in function. ROBOT APPLICATION: Material transfer, Machine loading/unloading. Processing operation,Assembly and Inspection, Feature Application.

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.

Elective –I : (Discipline Specific): **PGCC104T**	1. Mechanical behavior of Engineering Materials 2. Design for Manufacturing & Assembly 3. Design of Hydraulic & Pneumatic Systems

Subject Code	Subject Name	Credits
PGCC104T	1. Mechanical behavior of Engineering Materials	04

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. **9**

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.

9

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.

9

UNIT III:

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

9

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

1. George E. Dieter, "*Mechanical Metallurgy*", McGraw Hill,1988.

2. Thomas H. Courtney, "*Mechanical Behaviour of Materials*", McGraw Hill 2000

3. Joseph Marin, "*Mechanical Behaviour of Engineering Materials*", Prentice-Hall of India Pvt. Ltd., 1966

4. Kennedy, A.J., "*Process of Creep and fatigue of Metals*", Industrial Press, 1958

5. Forrest, P.G., "*Fatigue of Materials*", Pergaman Pross, 1961

6. Knott, J.F., " *Fundamentals of fracture mechanics*", Butter Worths, 1979

7. Parton, V.Z., and Morozor, E.M., "*Elastic and plastic Fracture Mechanics*", MIR Publishers, Moscow, 1978

Subject Code	Subject Name	Credits
PGCC104T	2. Design for Manufacturing & Assembly	04

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 friendlier 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:

1. Assembly Automation and Product Design/ Geoffrey Boothroyd/ Marcel Dekker Inc., NY, 1992.

2. Engineering Design - Material & Processing Approach/ George E. Deiter/McGraw Hill Intl.2nd Ed. 2000.

3. Hand Book of Product Design/ Geoffrey Boothroyd/ Marcel and Dekken, N.Y. 1990.

4. Computer Aided Assembly London/ A Delbainbre/.

Subject Code	Subject Name	Credits
PGCC104T	3. Design of Hydraulic & Pneumatic Systems	04

Unit-I

OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTU ATORS

Hydraulic Power Generators: Selection and Specification of Pumps, Pumps characteristics, Linear and Rotary Actuators: Selection, Specification and characteristics.

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:

1. Antony Espossito, “Fluid Power with Applications”, 6th Edition, Prentice Hall, 2002.

2. Dudley A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hal l, 1987.

3. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.

4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.

5. Parr Andrew, “Hydraulic and Pneumatic: A Technical and Engineering’s Guide”, Elsevier,1999.

Subject Code	Subject Name	Credits
PGCC102P/ PGCADMA102P	**Computer Graphics for CAD/CAM**	04

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.

Subject Code	Subject Name	Credits
PGCC103P/ PGCADMA103P	CNC & Robotics	01

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
4. Manual part program by using Sub routing and canned cycle.
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 back ground, 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

ANALYSIS OF BEAMS : Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT-III:

2-D PROBLEMS: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration. Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

3-D PROBLEMS: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT-VI:

SCALAR FIELD PROBLEMS: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT-V:

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

REFERENCES:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
4. Finite Element Method – Zincowitz / Mc Graw Hill
5. Introduction to Fininte element analysis- S.Md.Jalaludeen,Anuradha Publications, print-2012
6. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
7. Finite Element Method – Krishna Murthy / TMH

Subject Code	Subject Name	Credits
PGCC202T:	**Product Design and Development**	04

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

Process selection – Impotence 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.

UNIT III

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.

UNIT IV

Industrial Engineering Approach, Parametric Approach, Introduction to Assembly Modeling, Top-Down and Bottom-Up Approaches of AM, Mating Conditions, Representation Schemes, Generations of Assembly Sequences.

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:

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

Subject Code	Subject Name	Credits
PGCC203T	**MECHATRONICS**	04

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:

Introduction to Mechatronics- Systems - Mechatronics in products - Measurement systems - control systems - traditional design and Mechatronics Design**.**

UNIT II:

Introduction - performance terminology - displacement position and proximity - velocity and motion - fluid pressure - temperature sensors – light sensors - selection of sensors - signal processing - servo systems.

UNIT III:

Microprocessors in mechatronics**:** Introduction - Architecture - pin configuration - instruction set - programming of microprocessor 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

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

1. Michael B. Histan and David G. Alciatore, "*Introduction and Mechatronics and Measurement systems*", McGraw Hill International Edn. 1999.

2. Bradley, D.A., Dawson, D,Buru, N.C. and Loader, A.J. "*Mechatronics*", Chapman and Hall,1993.

3. Ramesh S. Gaonkar, '*Microprocessors 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 Srithar, P.R.8000 to 8085 *"Introduction to Microprocessors for Engineers and Scientists"* Second Edition Prentice Hall, 1995

WEB REFERENCE

1. http://www.cs.indiana.edu

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

Subject Code	Subject Name	Credits
PGCC204T / PGCADMA204T	1. Computer Aided Tool Design	04

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

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.

UNIT V

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. ASTME, “Fundamentals of Tool design”
3. Pollock, “Fundamentals of Tool design”
4. Grant, “Unconventional Clamping Systems”
5. Kempster, “Fundamentals of Tool design”

Subject Code	Subject Name	Credits
PGCC204T / PGCADMA204T	2. **Plastic and Composites**	04

UNIT I:

Chemistry and Classification of Polymers - Properties of Thermo Plastics - Properties of Thermosetting

Plastics - Applications - Merits and Disadvantages.

UNIT II:

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.

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:

MECHANICS AND PERFORMANCE: Characteristics of fiber-reinforced Lamina-Laminates-Interlaminar stresses- Static Mechanical Properties - fatigue and Impact properties – Environmental effects - Fracture Behavior and Damage Tolerance.

UNIT V:

MANUFACTURING: Open Mould Processes, Bag Moulding, Compression Moulding with BMC and SMC - Filament winding - Pultrusion - Centrifugal Casting - Injection Moulding - Application of PMC's. Quality Inspection method, 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 Kobyashi, “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

Subject Code	Subject Name	Credits
PGCC204T / PGCADMA204T	**3.CONCURRENT ENGINEERING**	04

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:

Introduction to Concurrent Engineering – Definitions – Historical Background – Goals of CE - need for CE – Development process with CE, Role of CAD/CAM in CE – Product life cycle.

UNIT II:

Concurrent Engineering Tools & Techniques – Quality function Deployment– Value function analysis – Failure Mode & Effect Analysis – Design for Manufacture & Assembly – Design for X – Taguchi's Robust Design, approach – Pugh process – customer Focused Design – rapid prototyping –simulation.

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:

Design for manufacture & Assembly – Design for economics – Design for X– Product Data Management – Agile manufacturing – rapid prototyping& simulation.

UNIT V:

Introduction JIT - Design, development & management for JIT –Implementation of JIT, supply product Life cycle management – Project time management – Techniques of time management. Collaborative product commerce simple case studies in CE

REFERENCES

1. Thomas A. “Concurrent Engineering”, Salomone, Maarcel Dekker Inc. New York, 1995.

2. Moustapha .I “Concurrent Engineering in product Design Development” New Age International (p) Ltd., 2003.

3. Prasad, “Concurrent Engineering fundamentals - Integrated Product Development”, Prentice Hall, 1996.

4. Sammy G. Sinha, “Successful implementation of concurrent product & process”, Wiley, John &Sons, Inc., 1998.

5. Anderson M.M. & Hein L. Berlin, “Integrated Product Development”, Springer Verlog, 1987

Subject Code	Subject Name	Credits
PGCC201P/ PGCADMA201P	Advance Finite Element Methods	01

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.

Subject Code	Subject Name	Credits
PGCC203P/ PGCADMA203P	**Lab for Mechatronics**	01

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.
4. programming of microprocessor using 8085 instructions
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.