JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech in CAD/CAM
Effective from Academic Year 2017- 18 admitted batch

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Advanced CAD	25	75	4	0	0	4
PC-2	Computer Aided Manufacturing	25	75	4	0	0	4
PC-3	Advanced FEM	25	75	4	0	0	4
PE-1	1. Mechanical Behavior of Materials 2. Stress Analysis and Vibration 3. Additive Manufacturing Technologies	25	75	**3**	0	0	3
PE-2	1. Automation in Manufacturing 2. Computer Aided Process Planning 3. Performance Modeling and Analysis of Manufacturing Systems	25	75	**3**	0	0	3
OE-1	***Open Elective - I**	25	75	3	0	0	3
Laboratory I	Advanced CAD/CAM Laboratory	25	75	0	0	3	2
Seminar I	Seminar-I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Design for Manufacturing And Assembly	25	75	4	0	1	4
PC-5	Flexible Manufacturing Systems	25	75	4	0	1	4
PC-6	Industrial Robotics	25	75	4	0	1	4
PE-3	1. Intelligent Manufacturing Systems 2. Special Manufacturing Process 3. Optimization Techniques and Applications	25	75	**3**	0	0	3
PE4	1. Advanced Mechatronics 2. MEMS and Micro Systems **:** Design and Manufacture 3. Fuzzy Logic and Neural Networks	25	75	**3**	0	0	3
OE-2	***Open Elective - II**	25	75	3	0	0	3
Laboratory II	Manufacturing simulation & Precision Engineering lab	25	75	0	0	3	2
Seminar II	Seminar-II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review I	100	0	0	0	22	8
Total	**200**	**100**	0	**3**	22	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review II	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	200	0	0	0	16
Total	**100**	**200**	**0**	**0**	**24**	**24**

***Open Elective subjects must be chosen from the list of open electives offered by various departments.**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

ADVANCED CAD
(PC-1)

UNIT- I:

CAD Tools: Definition of CAD Tools, Graphics standards, Graphics software: requirements of graphics software, Functional areas of CAD, Efficient use of CAD software.

Basics of Geometric Modelling: Requirement of geometric 3odeling, Geometric models, Geometric construction methods, Modelling facilities desired.

UNIT- II:

Eometric modelling: Classification of wireframe entities, Curve representation methods, Parametric representation of analytic curves: line, circle, arc, conics, Parametric representation of synthetic curves: Hermite cubic curve, Bezier curve, B-Spleen curvewire, NURBS, Curve manipulations.

UNIT- III:

Surface Modeling : Classification of surface entities, Surface representation methods, Parametric representation of analytic surfaces: plane surface, ruled surface, surface of revolution, tabulated cylinder, Parametric representation of synthetic curves: Hermite cubic surface, Bezier surface, B-Spleen surface, Blending surface, Surface manipulations.

UNIT- IV:

Solid Modelling: Geometry and topology, Boundary representation, The Euler-Poincare formula, Euler operators, Constructive solid geometry: CSG primitives, Boolean operators, CSG expressions, Interior, Exterior, closure, Sweeping: linear and non-linear, Solid manipulations.

UNIT- V:

Transformations: @-D and 3-D transformations: translation, scaling, rotation, reflection, concatenation, homogeneous coordinates, Perspective projection, orthotropic projection, isometric projection, Hidden surface removal, shading, rendering.

Evaluation Criteria: Evaluation criteria of CAD software, Data exchange formats: GKS, IGES, PHIGS, CGM, STEP

Dimensioning and tolerances: Linear, angular, angular dimensions, maximum material condition (MMC), Least material condition (LMC), Regardless of feature size (RFS).

REFERENCES:

1. CAD/CAM Concepts and Applications/ Alavala/ PHI.
2. Mastering CAD/CAM / Ibrhim Zeid / McGraw Hill International.
3. CAD/CAM Principles and Applications/ P.N. Rao/TMH/3rd Edition
4. CAD/CAM /Groover M.P./ Pearson education
5. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
6. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
7. Computer Numerical Control Concepts and programming/ Warren S Seames/ Thomson.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

COMPUTER AIDED MANUFACTURING
(PC-2)

UNIT - I

Computer-Aided Programming: General information, APT programming, Examples Apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path generation.

UNIT - II

Tooling for CNC Machines: Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

UNIT - III

Post Processors for CNC:

Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor, th creation of a DAPP — Based Post Processor.

UNIT - IV

Micro Controllers: Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications, and Programming of Micro Controllers. Programming Logic Controllers (PLC' s): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

UNIT - V

Computer Aided Process Planning: Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.

REFERENCES:

1. P.N. Rao, N. K. Tewari, T K Kundra " Computer Aided Manufacturing" McGraw Hill
2. CAD/CAM Principles and Applications, P.N. Rao, TMH
3. Computer Control of Manufacturing Systems / Yoram Koren / McGraw Hill. 1983.
4. CAD / CAM / CIM, Radha krishnan and Subramanian, New Age
5. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

ADVANCED FINITE ELEMENT METHODS
(PC-3)

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. Co-ordinates, 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 BECAD/CAM: 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. Finite Element Methods: Basic Concepts and applications, Alavala, PHI.
2. Finite Element Method – Zincowitz / McGraw Hill
3. The Finite Element Methods in Engineering / SS Rao / Pergamon.
4. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
5. Introduction to Finite 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
8. Finite Element Analysis – Bathe / PHI

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I year I Sem. (CAD/CAM)

MECHANICAL BEHAVIOUR OF MATERIALS (PE – I)

UNIT-I:

Introduction to Deformation Behaviour: Concept of stresses and strains, engineering stresses and strains, Different types of loading and temperature encountered in applications, Tensile Test - stress-strain response for metal, ceramic and polymer, elastic region, yield point, plastic deformation, necking and fracture, Bonding and Material Behaviour, theoretical estimates of yield strength in metals and ceramics.

UNIT-II:

Elasticity Theory: The State of Stress and strain, stress and strain tensor, tensor transformation, principal stress and strain, elastic stress-strain relation, anisotropy, elastic behaviour of metals, ceramics and polymers.

Yielding and Plastic Deformation: Hydrostatic and Deviatoric stress, Octahedral stress, yield criteria and yield surface, texture and distortion of yield surface, Limitation of engineering strain at large deformation, true stress and true strain, effective stress, effective strain, flow rules, strain hardening, Ramberg Osgood equation, stress -strain relation in plasticity, plastic deformation of metals and polymers

UNIT-III:

Microscopic view of plastic deformation: crystals and defects, classification of defects, thermodynamics of defects, geometry of dislocations, slip and glide, dislocation generation - Frank Read and grain boundary sources, stress and strain field around dislocations, force on dislocation - self-stress, dislocation interactions, partial dislocations, twinning, dislocation movement and strain rate, deformation behavior of single crystal, critical resolved shear stress (CRSS), deformation of poly-crystals - Hall-Petch and other hardening mechanisms, grain size effect - source limited plasticity, Hall-Petch breakdown, dislocations in ceramics and glasses.

UNIT-IV:

Fracture: fracture in ceramics, polymers and metals, different types of fractures in metals, fracture mechanics - Linear fracture mechanics -KIC, elasto-plastic fracture mechanics - JIC, Measurement and ASTM standards, Design based on fracture mechanics, effect of environment, effect of microstructure on KIC and JIC, application of fracture mechanics in the design of metals, ceramics and polymers

UNIT-V:

Deformation under cyclic load - Fatigue: S-N curves, Low and high cycle fatigue, Life cycle prediction, Fatigue in metals, ceramics and polymers

Deformation at High temperature: Time dependent deformation - creep, different stages of creep, creep and stress rupture, creep mechanisms and creep mechanism maps, creep under multi-axial loading, microstructural aspects of creep and design of creep resistant alloys, high temperature deformation of ceramics and polymers.

REFERENCES:

1. G.E. Dieter, "Mechanical Metallurgy", McGraw-Hill, 1986.
2. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", John Wiley and Sons, 1976.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

STRESS ANALYSIS AND VIBRATION
(P E – I)

UNIT-I:
Two dimensional elasticity theory in Cartesian coordinates, plane stress problem in polar coordinates Thick cylinders, Rotating discs - stress concentration.

UNIT- II:
Torsion of non circular prismatic sections, rectangular and axisymmetric, Circular plates, introduction to shell theory — contact stresses.

UNIT- III:
Single degree freedom, two degree freedom system without and with damping - Free and forced vibrations.Transient vibrations.

UNIT- IV:
Transient vibrations of single and two degree freedom systems, multi-degree of freedom systems - applications of matrix methods , continuous systems.

UNIT -V:
Free and forced vibrations of strings bars and be CAD/CAM. Principle of orthogonality - classical and energy methods.

REFERENCES:

1. Theory of Elasticity/Timoshenko S.P. and Goodier J. N./ Koakusha Publishers
2. Advanced strength of materials / Den Hortog J.P./Torrent
3. Mechanical Vibrations/ Den Ilartog J.P./ Dover Publications
4. Theory of Vibrations with Applications/ Thomson W.T./ CBS Publishing
5. Mechanical Vibrations/ Rao S.S./ Addison Wesley Longman

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I year I Sem. (CAD/CAM)

ADDITIVE MANUFACTURING TECHNOLOGIES (PE – I)

UNIT-I

Introduction: Introduction to Prototyping, Traditional Prototyping Vs Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC and other related technologies, Classification of RP, Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3D View, etc., Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT,STEP.

UNIT-II

RP Processes:

a) **Photopolymerization RP Processes**:-Stereolithography (SL), SL resin curing process, SL scan patterns, Microstereolithography, Applications of Photopolymerzation processes.
b) **Power Bed Fusion RP Processes**:-Stereolithography (SL), SL resin curing process, SL scan patterns, Microstereolithography. Applications of Photopolymerization Processes.
c) **Extrusion Based RP Processes**: Fused Deposition Modelling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes
d) **Printing RP Processes**: 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modeling, Application of Printing Process
e) **Sheet Lamination RP Processes**: Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications
f) **Beam Deposition RP Processes**: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks.

UNIT-III

Rapid tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods

UNIT-IV

Reverse engineering: Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development

UNIT-V

Errors in RP processes and applications: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc., Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP

REFERENCE BOOKS:

1 Chua Chee Kai., Leong Kah Fai., Chu Sing Lim, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2010.
2 Ian Gibson., David W Rosen., Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
3 Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.
4 D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2011
5 Amit Bandyopadhyay, Additive Manufacturing, CRC Press 2015.
6 T.S. Srivatsan, T.S. Sudharshan, CRC Press 2015

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

AUTOMATION IN MANUFACTURING
(P E – II)

UNIT – I

Over View of Manufacturing and Automation: Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers.

UNIT – II:

Material Handling and Identification Technologies: Material handling, equipment, Analysis. Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Automatic identification methods, Barcode technology, RFID.

UNIT – III:

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells; Manual Assembly lines, line balancing Algorithms, Mixed model Assembly lines, Alternative Assembly systems. Automated production lines, Applications, Analysis of transfer lines.

UNIT – IV:

Automated Assembly Systems: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis.

UNIT – V:

Quality Control and Support Systems: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vsnon contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

REFERENCES:

1. Automation, production systems and computer integrated manufacturing/ Mikell. P Groover/PHI/3rd edition/2012.
2. Automation, Production Systems and CIM/ Mike J P. Grower/PHI
3. CAD/CAM/CIM/ P. **R**adha Krishnan **& S**. Subrahamanyarn and Raju /New Age International Publishers/2003.
4. System Approach to Computer Integrated Design and Manufacturing/ Singh/John Wiley /96.
5. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/ 2009.
6. Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser / Good Heart/Willcox Publishers.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

COMPUTER AIDED PROCESS PLANNING
(P E – II)

UNIT-I:

Introduction: The Place of Process Planning in the Manufacturing cycle-Process planning and production Planning-Process planning and Concurrent Engineering, CAPP, Group Technology.

UNIT-II:

Part Design Representation: Design Drafting-Dimensioning-Conventional Tolerance- Geometric Tolerance-CAD-input/output devices-Topology - Geometric transformation-Perspective transformation-Data Structure-Geometric modeling for process planning--GT Coding-The OPITZ system-The MICLASS System.

UNIT-III;

Process Engineering and Process Planning: Experience based planning-Decision table and Decision trees-Process capability analysis-Process planning-Variant process planning-Generative approach-Forward and backward planning, Input format, AI.

UNIT-IV

Computer Aided Process Planning Systems: Logical Design of process planning- Implementation considerations-Manufacturing system components, Production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT-V

An Integrated Process Planning Systems: Totally integrated process planning systems-An Overview-Modulus structure-Data Structure-Operation-Report Generation, Expert process planning

REFERENCE BOOKS:

1. Gideon Halevi and Roland D. Weill, "Principle of process planning- A Logical Approach", Chapman & Hall, 1995
2. Chang T. C. & Richard A.Wysk, "An Introduction to automated process planning systems", Prentice Hall 1985
3. Chang, T.C., "An Expert Process Planning System", Prentice Hall, 1985
4. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, 1996
5. Rao P.N., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS
(PE – II)

UNIT I:

Manufacturing Systems & Control: Automated Manufacturing Systems – Modeling – Role of performance modeling – simulation models-Analytical models. Product cycle – Manufacturing automation – Economics of scale and scope – input/output model – plant configurations. Performance measures – Manufacturing lead time – Work in process – Machine utilization – Throughput – Capacity – Flexibility – Performability – Quality Control Systems – Control system architecture – Factory communications – Local area network interconnections – Manufacturing automation protocol – Database management system.

UNIT II:

Manufacturing Processes: Examples of stochastics processes – Poisson process - Discrete time Markov chain models – Definition and notation – Sojourn times in states – Examples of DTMCs in manufacturing – Chapman – Kolmogorov equation – Steady-state analysis. Continuous Time Markov Chain Models – Definitions and notation – Sojourn times in states – examples of CTMCs in manufacturing – Equations for CTMC evolution – Markov model of a transfer line.Birth and Death Processes in Manufacturing – Steady state analysis of BD Processes – Typical BD processes in manufacturing.

UNIT III:

Queuing Model: Notation for queues – Examples of queues in manufacturing systems – Performance measures – Little's result – Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns – Analysis of a flexible machine center.

UNIT IV:

Queuing Networks: Examples of QN models in manufacturing – Little's law in queuing networks – Tandem queue – An open queuing network with feedback – An open central server model for FMS – Closed transfer line – Closed server model – Garden Newell networks.

UNIT V:

Petrinets: Classical Petri Nets – Definitions – Transition firing and reachability – Representational power – properties – Manufacturing models.
Stochastic Petri Nets – Exponential timed Petri Nets – Generalized Stochastic Petri Nets – modeling of KANBAN systems – Manufacturing models.

REFERENCES:

1. Performance Modelling of Automated Manufacturing Systems/ Viswanadham, N and Narahari, Y/ Prentice Hall of India, New Delhi, 1994
2. Probability and Statistics with Reliability, Queuing and Computer Science Applications/ Trivedi, K.S./ Prentice Hall, New Jersey, 1982.
3. Fundamentals of Mathematical Statistics/ Gupta S.C. & Kapoor V.K./ 3rd Edition, Delhi, 1988

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I year I Sem. (CAD/CAM)

ADVANCED CAD/CAM LAB

Features and selection of CNC turning and milling centers. Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles. Practice in part programming and operating a machining center, tool panning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming. Practice in Robot programming and its languages. Robotic simulation using software. Robo path control, preparation of various reports and route sheets, Simulation of manufacturing system using CAM software, controller operating system commands.