# Vidya Jyothi Institute of Technology (Autonomous)

*(Accredited by NBA, Approved By A.I.C.T.E., New Delhi, Permanently Affiliated to JNTU, Hyderabad)*

(Aziz Nagar, C.B.Post, Hyderabad -500075)

***R19 Regulations***

## M.Tech. (CAD, CAM)

### COURSE STRUCTURE AND SYLLABUS

**I Year – I Semester**

| Subject Code | Category | Course Title | Int. marks | Ext. marks | L | T | P,D | C |
|---|---|---|---|---|---|---|---|---|
| 19D3CS1101 | Core Course I | Advanced CAD | 30 | 70 | 4 | -- | -- | 4 |
| 19D3CS1102 | Core Course II | Computer Aided Manufacturing | 30 | 70 | 4 | -- | -- | 4 |
| 19D3CS1103 | Core Course III | Advanced FEM | 30 | 70 | 4 | -- | -- | 4 |
| 19D3E11101<br>19D3E11102<br>19D3E11103 | Core Elective I | 1. Mechanical Behaviour of Materials<br>2. Stress Analysis and Vibration<br>3. Additive Manufacturing Technologies | 30<br>30<br>30 | 70<br>70<br>70 | 3 | -- | -- | 3 |
| 19D3E21101<br>19D3E21102<br>19D3E21103 | Core Elective II | 1. Automation in Manufacturing<br>2. Computer Aided Process Planning<br>3. Performance Modeling and Analysis of Manufacturing Systems | 30<br>30<br>30 | 70<br>70<br>70 | 3 | -- | -- | 3 |
| 191EOE1102 | Open Elective I | 1. Optimization Techniques and applications | 30<br>30 | 70<br>70 | 3 | -- | -- | 3 |
| 19D3LB1101 | Laboratory I | Advanced CAD,CAM LAB | 30 | 70 | -- | -- | 3 | 2 |
| 19D3SM1101 | Seminar I | Seminar-I | 100 | -- | -- | -- | 3 | 2 |
| | **Total Credits** | | **310** | **490** | **21** | | **6** | **25** |

**I Year – II Semester**

| Subject Code | Category | Course Title | Int. marks | Ext. marks | L | T | P,D | C |
|---|---|---|---|---|---|---|---|---|
| 19D3CS1204 | Core Course IV | Design for Manufacturing And Assembly | 30 | 70 | 4 | -- | -- | 4 |
| 19D3CS1205 | Core Course V | Flexible Manufacturing Systems | 30 | 70 | 4 | -- | -- | 4 |
| 19D3CS1206 | Core Course VI | Industrial Robotics | 30 | 70 | 4 | -- | -- | 4 |
| 19D3E31101<br>19D3E31102<br>19D3E31103 | Core Elective III | 1. Intelligent Manufacturing Systems<br>2. Special Manufacturing Process<br>3. Optimization Techniques and Applications | 30<br>30<br>30 | 70<br>70<br>70 | 3 | -- | -- | 3 |
| 19D3E41101<br>19D3E41102<br>19D3E41103 | Core Elective IV | 1. Advanced Mechatronics<br>2. MEMS and Micro Systems : Design and Manufacture<br>3. Fuzzy Logic and Neural Networks | 30<br>30<br>30 | 70<br>70<br>70 | 3 | -- | -- | 3 |
| 191EOE1202 | Open Elective II | 1. Engineering Research and Methodology | 30<br>30 | 70<br>70 | 3 | -- | -- | 3 |
| 19D3LB1201 | Laboratory II | Computer Aided Modeling and Analysis Lab | 30 | 70 | -- | -- | 3 | 2 |
| 19D3SM1201 | Seminar II | Seminar-II | 100 | -- | -- | -- | 3 | 2 |
| | **Total Credits** | | **310** | **490** | **21** | | **6** | 25 |

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**II Year - I Semester**

| Subject Code | Course Title | Int. marks | Ext. marks | L | T | P,D | C |
|---|---|---|---|---|---|---|---|
| 19D3CS1207 | Technical paper writing | 100 | -- | -- | 3 | -- | 2 |
| 19D3CV2101 | Comprehensive Viva-Voce | -- | 100 | -- | -- | -- | 4 |
| 19D3PW2101 | Project work Review I | 100 | -- | -- | -- | 22 | 8 |
| | **Total Credits** | 200 | 100 | | | **22** | **14** |

**II Year - II Semester**

| Subject Code | Course Title | Int. marks | Ext. marks | L | T | P,D | C |
|---|---|---|---|---|---|---|---|
| 19D3PW2202 | Project work Review II | 100 | -- | -- | -- | 24 | 8 |
| 19D3PE2201 | Project Evaluation (Viva-Voce) | -- | 100 | -- | -- | -- | 16 |
| | **Total Credits** | 100 | 100 | **--** | **--** | **24** | **24** |

## ADVANCED CAD

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**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 Modeling:** Requirement of geometric modeling, Geometric models, Geometric construction methods, modeling facilities desired.

**UNIT- II:**

**Geometric Modeling:** Classification of wireframe entities, Curve representation methods, And Parametric representation of analytic curves: line, circle, arc, conics, Parametric representation of synthetic curves: Hermit cubic curve, Bezier curve, B-Spline curve, 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: Hermit cubic surface, Bezier surface, B-Spleen surface , Blending surface, Surface manipulations.

**UNIT- IV:**

**Solid Modeling:** 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:** 2-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, and STEP. Dimensioning and tolerances: Linear, angular, angular dimensions, maximum material condition (MMC), least material condition (LMC), Regardless of feature size (RFS).

**TEXT BOOKS:**

1. CAD, CAM Concepts and Applications, Alavala, PHI.
2. Mastering CAD, CAM, Ibrahim Zeid, McGraw Hill International.
3. CAD,CAM,Groover M.P, Pearson education.

**REFERENCES:**

1. CAD , CAM, CIM, Radhakrishnan and Subramanian, New Age
2. CAD,CAM Principles and Applications, P.N.Rao,TMH,3rd Edition
3. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

## COMPUTER AIDED MANUFACTURING

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**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 tools, 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, the 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.

**TEXT BOOKS:**

1. CAD, CAM Concepts and Applications, Alavala, PHI.
2. CAD,CAM Principles and Applications, P.N.Rao, TMH
3. CAD, CAM, Mikel P. Groover, Pearson Edu.

**REFERENCES:**

1. Computer Control of Manufacturing Systems,YoramKoren, McGraw Hill. 1983.
2. Computer Aided Design Manufacturing, K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI, 2008.
3. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

## ADVANCED FINITE ELEMENT METHODS

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**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-IV:**

**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.

**TEXT BOOKS:**

1. Finite Element Methods: Basic Concepts and applications, Alavala, PHI.
2. Finite Element Method, Zincowitz, McGraw Hill
3. Introduction to Finite element analysis, S.Md.Jalaludeen,Anuradha Publications, 2012

**REFERENCES:**

1. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice, Hall
2. A First Course in the Finite Element Method, Daryl L Logan, Cengage Learning, 5th Edition
3. Finite Element Analysis, Bathe, PHI

***R19 Regulations***

## MECHANICAL BEHAVIOUR OF MATERIALS

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**UNIT-I:**

**Introduction to Deformation Behavior:** 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 Behavior, 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 behavior 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, RambergOsgood 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.

**TEXTBOOKS:**

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.
3. Metal Forming ,R Narayanaswamy, Dhanpat Rai publisher

**REFERENCES:**

1. Mechanical Behavior of Materialsby Krishan Chawla and Marc A. Meyers, 1998, Cambridge.
2 Engineering Materials and Metallurgy ,UC Jindal,Pearson
3 Materials Science and Engineering ,Willium Callister , Wiley

## STRESS ANALYSIS AND VIBRATION

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**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.

**TEXTBOOKS:**


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, Rao S.S, Addison Wesley Longman


**REFERENCES:**


1. Mechanical Vibrations, Den Ilartog J.P, Dover Publications
2. Theory of Vibrations with Applications, Thomson W.T, CBS Publishing
3. Mechanical vibrations, seto, Schaum's Outlines, McGraw Hill.

## ADDITIVE MANUFACTURING TECHNOLOGIES

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**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, Surgi Guide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, Solid View, 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 Modeling (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

**TEXTBOOKS:**

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. Amit Bandyopadhyay, Additive Manufacturing, CRC Press 2015.

**REFERENCES:**

1. RafiqNoorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.
2. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2011
3. Wholers report 2000-Terry Wholers, Wholers Associates, 2000.

## AUTOMATION IN MANUFACTURING

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**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 Vs non-contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

**TEXTBOOKS:**


1. Automation, production systems and computer integrated manufacturing, Mikell.PGroover, 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.

**REFERENCES:**

1. System Approach to Computer Integrated Design and Manufacturing, Singh,John Wiley ,96.
2. Computer Aided Manufacturing,Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Pearson, 2009.
3. Manufacturing and Automation Technology, R Thomas Wright and Michael Berkeihiser , Good Heart,Willcox Publishers.

## COMPUTER AIDED PROCESS PLANNING

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**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

**TEXTBOOKS:**


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", PrenticeHall1985
3. Groover , CADCAM and Automation ,Pearson edu


**REFERENCES:**


1. Chang,T.C., "An Expert Process Planning System", Prentice Hall,1985
2. Nanua Singh, "Systems Approach to Computer Intergrated Design and Manufacturing", John Wiley &Sons,1996
3. P N Rao ,Manufacturing technology ,vol2 ,TMH

## PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**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 – Representationalpower – properties – Manufacturing models.Stochastic Petri Nets – Exponential timed Petri Nets – Generalized Stochastic Petri Nets – modeling of KANBAN systems – Manufacturing models.

**TEXTBOOKS:**

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. Probability and Statistics, Murray R. Spiegel, Jhon Schiller, Schaum's series.

**REFERENCES:**

1. Fundamentals of Mathematical Statistics, Gupta S.C. & Kapoor V.K., 3rd Edition, Delhi, 1988
2. Operations Management, William J.Stevensan, McGhills.
3. Operations Research,Kanti Swarup, Dhanpat Rai publishers

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## OPTIMIZATION TECHNIQUES AND APPLICATIONS

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**UNIT- I:**

**Single Variable Non-Linear Unconstrained Optimization:** One dimensional Optimization methods:-Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods.

**UNIT-II:**

Multi variable non-linear unconstrained optimization: Direct search method – Univariant method - pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

**UNIT- III:**

**Linear Programming**: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints.

**Simulation** – Introduction – Types- steps – application – inventory – queuing systems

**UNIT –IV:**

**Integer Programming**: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

**Stochastic programming:**

Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, covariance, joint probability distribution- stochastic linear, dynamic programming.

**UNIT- V:**

**Geometric Programming:** Polynomials – arithmetic - geometric inequality – unconstrained G.P, constrained G.P.

**Non-traditional optimization Techniques:** Genetic Algorithms-Steps-Solving simple problems-Comparitions of similarities and dissimilarities between traditional and non-traditional techniques- Particle Swarm Optimization (PSO)- Steps(Just understanding)-Simulated Annealing-Steps-Simple problems.

**TEXTBOOKS:**


1. Optimization theory & Applications , S.S. Rao , New Age International.
2. Engineering Optimization-Kalyan Deb, PHI
3. Introductory to operation Research , Kasan& Kumar , Springer


**REFERENCES:**


1. Optimization Techniques theory and practice, M.C.Joshi, K.M. Moudgalya, NarosaPublications
2. Operation Research , H.A. Taha ,TMH
3. Optimization Techniques ,Benugundu&Chandraputla , Pearson Asia

## ADVANCED CAD, CAM LAB

| **M.Tech – I year I Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **0** | **0** | **4** | **2** |

**CAD Lab:**

1) Surface Modelling
2) Solid Modelling
3) Assembly
4) Drafting

**CAM Lab:**

Features and selection of CNC turning and milling centers. Practice in part programming and operation of CNC turning and milling machine subroutine techniques and use of cycles. Practice in part programming and operating a machining center, tool planning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming. Preparation of various reports and route sheets, Simulation of manufacturing system using CAM software.

## DESIGN FOR MANUFACTURING AND ASSEMBLY

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**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 die 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.

**TEXTBOOKS:**

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. Product Design and process planning, Niebel and Wrapper, McGrawhill

**REFERENCES:**

1. Hand Book of Product Design, Geoffrey Boothroyd, Marcel and Dekken, N.Y. 1990.
2. Product Design for Manufacturing and Assembly, Geoffrey Boothroyd, Peter Dewhurst & Winston Ansthony Knight,CRC Press,2010
3. Design for Manufacturing ,Chitale,standard publishers

## FLEXIBLE MANUFACTURING SYSTEMS

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**UNIT- I:**
Introduction to flexible manufacturing systems. Planning and scheduling and control o FMS. Knowledge based scheduling.

**UNIT - II:**
Hierarchy of computer control. Supervisory computer.

**UNIT - III:**
Software for simulation and database of FMS. Specification and selection, trends, application of simulation software.

**UNIT - IV:**
Manufacturing data systems data flow, CAD,CAM considerations. Planning FMS database, just in time characteristics, Pull method, quality small lot sizes, work station loads, close supplier ties, flexible workforce — line flow strategy.

**UNIT - V:**
Preventive maintenance. Karban system, implementation issues.

**TEXTBOOKS:**


1. Hand Book of Flexible Manufacturing Systems, Jha N K, Academic Press.
2. CAD CAM,Automation ,Groover, Pearson Education
3. Production Systems, Riggs,McGrawhill


**REFERENCES:**


1. Production System leyond Large Scale Production, TalichiOhno, Toyota Productivity Press India Pvt. Lid.
2. Flexible Manufacturing Systems, H K Shivanand,New Age International,2006
3. Operations Management, Buffa, standard publishers

## INDUSTRIAL ROBOTICS

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **0** | **0** | **4** |

**UNIT – I**

**Introduction**: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

**Control System And Components:** basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

**UNIT – II**

**Motion Analysis And Control:** Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

**UNIT - III**

**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.

**Machine Vision:** Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

**UNIT - IV**

**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.

**UNIT - V**

Robot Cell Desgin And Control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller.

**Robot Application**: Material transfer, Machine loading,unloading. Processing operation, Assembly and Inspection, Feature Application.

**TEXTBOOKS:**

1. Industrial Robotics , Groover M P ,Pearson Edu.
2. Introduction to Robotic Mechanics and Control, JJ Craig, Pearson, 3rd edition.
3. Robotics , Fu K S, McGraw Hill.

**REFERENCES:**

1. Robot Analysis and Intelligence , Asada and Slotine , Wiley Inter-Science.
2. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar , John Wiley & Sons (ASIA) Pte Ltd.
3. Robotics and Control , Mittal R K &Nagrath I J , TMH

## INTELLIGENT MANUFACTURING SYSTEMS

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**UNIT I:**

Computer Integrated Manufacturing Systems Structure and functional areas of CIM system, - CAD, CAPP, CAM**,** CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP,TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

**UNIT II:**

Components of Knowledge Based Systems - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

**UNIT III:**

Machine Learning - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

**UNIT IV:**

Automated Process Planning - Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

**UNIT V:**

Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

**TEXTBOOKS:**


1. Intelligent Manufacturing Systems, Andrew Kusiak,Prentice Hall.
2. Automation, Production Systems and CIM , Groover M.P.,PHI,2007
3. Neural networks: A comprehensive foundation, Simon Hhaykin, PHI.


**REFERENCES:**


1. Artificial neural networks, B.Vegnanarayana,PHI
2. Neural networks in Computer intelligence, Li Min Fu, TMH,2003
3. Neural networks, James A Freeman David M S kapura, Pearson education,2004

## SPECIAL MANUFACTURING PROCESS

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**UNIT- I**

**Surface Treatment:** Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

**UNIT- II**

**Processing Of Ceramics:** Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

**UNIT- III**

**Fabrication Of Microelectronic Devices:** Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

**UNIT - IV**

**E-Manufacturing:** Nano manufacturing techniques and micromachining, High Speed Machining and hot machining

**UNIT -V**

**Rapid Prototyping:** Working Principles, Methods, Stereo Lithography, Laser Sintering, Fused Deposition Method, Applications and Limitations, Rapid tooling, Techniques of rapid manufacturing

**TEXTBOOKS:**


1. Manufacturing Engineering and Technology I Kalpakijian , Adisson Wesley, 1995.
2. Process and Materials of Manufacturing , R. A. Lindburg , 1th edition, PHI 1990.
3. Microelectronic packaging handbook , Rao. R. Thummala and Eugene, J. Rymaszewski , Van NostrandRenihold.


**REFERENCES:**


1. MEMS & Micro Systems Design and manufacture , Tai, Run Hsu , TMGH
2. Advanced Machining Processes , V.K.Jain , Allied Publications.
3. Introduction to Manufacturing Processes , John A Schey, McGraw Hill.

## OPTIMIZATION TECHNIQUES AND APPLICATIONS

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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**UNIT- I**:
General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints, classification of optimization problems. Single and multivariable optimization techniques

**UNIT- II:**
Technique of unconstrained minimization. Golden section, Random, Pattern and Gradient search methods, interpolation methods, equality and inequality constraints.

**UNIT-III:**
Direct methods and indirect methods using penalty function, Lagrange multipliers, Geometric programming, stochastic programming, Genetic algorithms

**UNIT-IV**:
Engineering applications, structural-design application axial and transverse loaded members for minimum cost, maximum weight. Design of shafts and torsion members, design optimization of springs.

**UNIT-V**:
Dynamics applications for two degree freedom system. vibration absorbers. Application in mechanisms.

**TEXTBOOKS:**


1. Engineering Optimization, Theory and Practice, Singerusu S. Rao, New Age.
2. Optimum Design of Mechanical elements, Johnson Ray C, Wiley, John & Sons
3. Design and analysis of experiments, D. Montgomery,Wiley edition.


**REFERENCES:**


1. Genetic Algorithms in search, Optimization and Machine, Goldberg D. E. Addison,Wesley , NewYork..
2. Operations research, Wagner, PHI Publications.
3. Introduction to Optimum Design,Jasbir S. Arora, Academic Press, Everest, 3rd Edition.

## ADVANCED MECHATRONICS

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**UNIT-I**

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

**UNIT-II**

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

**UNIT-III**

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.

**UNIT-IV**

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

**UNIT-V**

System and interfacing and data acquisition, DAQS, SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

**TEXTBOOKS:**


1. MECHATRONICS Integrated Mechanical Electronics Systems,KP Ramachandran & GK VijayaRaghavan,WILEY India Edition,2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.


**REFERENCES:**


1. Mechatronics System Design , Devdasshetty,Richard,Thomson.
2. Mechatronics,M.D.Singh,J.G.Joshi,PHI.
3. Mechatronics, Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton

## MEMS AND MICRO SYSTEMS: DESIGN AND MANUFACTURING

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**UNIT I:**

**Overview And Working Principles Of Mems And Microsystems MEMS**& Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & Miniaturization, Applications of MEMS in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidies.

**UNIT II:**

**Engineering Science For Microsystems Design And Fabrication:** Atomic structure of Matter, Ions and Ionization, Molecular Theory of Mater and Intermolecular Force, Doping of Semiconductors, The diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics

**UNIT III:**

**Engineering Mechanics For Microsystems Design:** Static Bending of thin Plates, Mechanical Vibration, Thermo mechanics Fracture Mechanics, Thin-Film Mechanics, Overview of Finite Element Stress Analysis

**UNIT IV:**

**Thermo Fluid Engineering & Microsystems Design:** Overview of Basics of Fluid Mechanics in Macro and Meso scales, Basic equations in Continuum Fluid dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid Flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a Micro pressure Sensor.

**UNIT V:**

**Materials For Mems & Microsystems And Their Fabrication:** Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, chemical and physical vapor deposition, Etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

**TEXTBOOKS:**


1. MEMs & Microsystems: Design & Manufacture, Tai-Ran Hsu,Tata Mc-Graw Hill., ed.,2002
2. An Introduction to Microelectromechanical Systems Engineering, Maluf, M., Artech House, Boston, 2000
3. Micro robots and Micromechanical Systems, Trimmer, W.S.N, Sensors & Actuators, vol19, no.1989.

**REFERENCES:**

1. Applied Partial Differential Equations, Trim, D.W, PWS-Kent Publishing, Boston 1990.
2. Fundamentals of Microfabrication. Madou, M, CRC Press, Boca Raton, 1997.
3. The Finite Element Method in Thermomechanics, Hsu, T.R, Alien & Unwin, London.

## FUZZY LOGIC AND NEURAL NETWORKS

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**UNIT-I**

Knowledge and Processing – Knowledge and Intelligence- logic frames- production systems. Fundamentals of Fuzzy logic-characteristics of fuzzy logic and systems-Fuzzy sets-Fuzzy number- Equality of fuzzy sets- Empty Fuzzy set –Fuzzy point-universal Fuzzy set. Operations on Fuzzy sets-Intersection-union – complement.

**UNIT-II**

Fuzzy Relations-classical N-Array Relation-Reflexivity-Anti reflexivity-symmetricity – Transitivity- Equivalence- Binary fuzzy relations, operation on Fuzzy relations-Intersection-union-projection-Cartesian product.

**UNIT-III**

Fuzzy Implications, Translation rules, Triangular norms, Triangular conorm, Fuzzy Rule base system, Fuzzy logic controller, Defuzzification Methods, Fuzzy logic applications-prevention of Road accidents-control room temperature-Robot control system-domestic applications-Industrial applications.

**UNIT-IV**

Basic concepts of Neural Network-Processing units-connection between units-output rules-Network topologies-paradigms of learning –perception, Back-propagation, classification Models-Association Models, optimization models.

**UNIT-V**

Rule Based Neural Networks-Network Training –Application of Neural Network in Mathematical Modeling-

Knowledge based approaches-applications in Mechanical Engineering –Fuzzy –Neural, example, Neuro – Fuzzy examples-Intelligence in Automation.

**TEXTBOOKS:**


1. Intelligent Control Fuzzy Logic Applications, Clarence W.de Silva, CRS Press,1995.
2. Fuzzy logic &Neural Networks, Chennakesava R. Alavala, New Age International,2008
3. Fuzzy Logic with engineering Applications, Timothy J. Ross, McGraw Hill Inc., 1995.


**REFERENCES:**


1. Neural Networks in Computer Intelligence, Limin Fu , Tata McGraw Hill Publishing Company Ltd.,2003
2. Neural Networks Algorithms, Applications, James A. Freeman and David M. Skapura& Programming Techniques, Pearson Education Asia,2001
3. Artificial Neural Networks, Yegnarayane.B, Prentice Hall- 2001.

***R19 Regulations***

## ENGINEERING RESEARCH AND METHODOLOGY

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **4** | **0** | **0** | **4** |

**Unit - I**

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Important of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

**Unit - II**

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

**Unit - III**

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

**Unit – IV**

Data Collection: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V,s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software. Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

**Unit - V**

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References,Bibliography,Webliography, Technical paper writing,Journal report writing, making presentation, Use of visual aids. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

**TEXTBOOKS:**

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. RatanKhananabis and SuvasisSaha, Research Methodology, Universities Press, Hyderabad, 2015.

**REFERNECES:**

1. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
2. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
3. Research Methodology, RatanKhasnabis and SuvasisSaha, University Press, 2015.

| **M.Tech – I year II Sem. (CAD, CAM)** | **L** | **T** | **P** | **C** |
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| | **0** | **0** | **4** | **2** |

## COMPUTER AIDED MODELING AND ANALYSIS LAB

1. 1-D analysis of bar with Constant Cross-section
2. 1-D analysis of stepped bar to find reactions and deformations
3. Analysis of plane truss
4. Analysis of cantilever Beam with point load at the free end
5. Analysis of simply supported beam with uniformly distributed load
6. 1-D Thermal analysis of a stepped bar
7. 2-D Stress analysis of a rectangular plate with a circular hole.
8. 2-D thermal analysis of a rectangular plate with a circular hole.
9. Modal Analysis of Cantilever beam for natural frequency determination
10. 3-D analysis of a plate with structural and thermal loads

# Vidya Jyothi Institute of Technology (Autonomous)

*(Accredited by NBA, Approved By A.I.C.T.E., New Delhi, Permanently Affiliated to JNTU, Hyderabad)*

(Aziz Nagar, C.B.Post, Hyderabad -500075)

***M.Tech R15 Regulations***

**M.Tech. (CAD/CAM)**
**COURSE STRUCTURE AND SYLLABUS**

**I Year – I Semester**

| Subject Code | Category | Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|---|---|
| 15D3CS1101 | Core Course I | Advanced CAD | 40 | 60 | 4 | -- | 4 |
| 15D3CS1102 | Core Course II | Computer Aided Manufacturing | 40 | 60 | 4 | -- | 4 |
| 15D3CS1103 | Core Course III | Advanced FEM | 40 | 60 | 4 | -- | 4 |
| 15D3E11101<br>15D3E11102<br>15D3E11103 | Core Elective I | Mechanical Behaviour of Materials<br>Stress Analysis and Vibration<br>Rapid Prototyping Technolgies | 40 | 60 | 4 | -- | 4 |
| 15D3E21101<br>15D3E21102<br>15D3E21103 | Core Elective II | Automation in Manufacturing<br>Computer Aided Process Planning<br>Performance Modeling and Analysis of Manufacturing Systems | 40 | 60 | 4 | -- | 4 |
| 15D3OE1101<br>15D3OE1102 | Open Elective I | Numerical Methods for Partial Differential Equations<br>Production and Operations Management | 40 | 60 | 4 | -- | 4 |
| 15D3LB1101 | Laboratory I | Advanced CAD/CAM LAB | 40 | 60 | -- | 4 | 2 |
| 15D3SM1101 | Seminar I | Seminar | 50 | -- | -- | 4 | 2 |
| | **Total Credits** | | | | **24** | **8** | **28** |

**I Year – II Semester**

| Subject Code | Category | Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|---|---|
| 15D3CS1204 | Core Course IV | Design for Manufacturing And Assembly | 40 | 60 | 4 | -- | 4 |
| 15D3CS1205 | Core Course V | Flexible Manufacturing Systems | 40 | 60 | 4 | -- | 4 |
| 15D3CS1206 | Core Course VI | Industrial Robotics | 40 | 60 | 4 | -- | 4 |
| 15D3E31201<br>15D3E31202<br>15D3E31203 | Core Elective III | Intelligent Manufacturing Systems<br>Special Manufacturing Process<br>Design Optimization | 40 | 60 | 4 | -- | 4 |
| 15D3E41201<br>15D3E41202<br>15D3E41203 | Core Elective IV | Advanced Mechatronics<br>Design and Manufacturing of MEMS and Micro Systems<br>Fuzzy Logic and Neural Networks | 40 | 60 | 4 | -- | 4 |
| 15D3OE1201<br>15D3OE1202 | Open Elective II | Engineering Research and Methodology<br>Quality Engineering in Manufacturing | 40 | 60 | 4 | -- | 4 |
| 15D3LB1201 | Laboratory II | Computer Aided Modeling and Analysis Lab | 40 | 60 | -- | 4 | 2 |
| 15D3SM1201 | Seminar II | Seminar | 50 | -- | -- | 4 | 2 |
| | **Total Credits** | | | | **24** | **8** | **28** |

**II Year - I Semester**

| Subject Code | Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|---|
| 15D3CV2101 | Comprehensive Viva-Voce | -- | 100 | -- | -- | 4 |
| 15D3PW2101 | Project work Review I | 50 | -- | -- | 24 | 12 |
| | **Total Credits** | | | -- | 24 | **16** |

**II Year - II Semester**

| Subject Code | Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|---|
| 15D3PW2202 | Project work Review II | 50 | -- | -- | 8 | 4 |
| 15D3PE2201 | Project Evaluation (Viva-Voce) | -- | 150 | -- | 16 | 12 |
| | **Total Credits** | | | -- | **24** | **16** |

**Controller of Examinations** **DIRECTOR**

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(Aziz Nagar, C.B.Post, Hyderabad -500075)

***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

## ADVANCED CAD

**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 modelling, Geometric models, Geometric construction methods, Modelling facilities desired.

**UNIT- II:**

**Geometric 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 curve wire , 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:** 2-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).

**TEXT BOOKS:**


**1.** CAD/CAM Concepts and Applications/ Alavala/ PHI.

2. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill International.


**REFERENCES :**


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

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***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

## COMPUTER AIDED MANUFACTURING

**UNIT - I**

**Compute-Aided Programming**: General information, APT programming, Examples Apt programming probkms (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 tools, 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, the 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.

**TEXT BOOKS:**


**1.** CAD/CAM Concepts and Applications/ Alavala/ PHI.
2. CAD/CAM Principles and Applications, P.N.Rao, TMH


**REFERENCES:**


1. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill. 1983.
2. Computer Aided Design Manufacturing – K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI, 2008.
3. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age
4. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson
5. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

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***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

## ADVANCED FINITE ELEMENT METHODS

**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.

**TEXT BOOKS:**


1. Finite Element Methods: Basic Concepts and applications, Alavala, PHI.
2. Finite Element Method – Zincowitz / Mc Graw Hill


**REFERENCES:**


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

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***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

**MECHANICAL BEHAVIOUR OF MATERIALS**
**(Core Elective – 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, RambergOsgood 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.

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***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

**STRESS ANALYSIS AND VIBRATION**

**(Core Elective – 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

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**M.Tech – I year I Sem. (CAD/CAM)**

**RAPID PROTOTYPING TECHNOLGIES**
**(Core Elective – I)**

**Unit – I**

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

**Unit – II**

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopo l ymers, photo po l ymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies
Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

**Unit-III**

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.
Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

**Unit – IV**

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magic's, Mimics, Solid View, View Expert, 3 D View, Velocity 2 , Rhino, STL View 3 Data Expert and 3 D doctor.

**Unit –V**

RP Applications: Application – Material Relationship, Application in Design , Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

**TEXT BOOKS:**

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications , Third Edition, 2010.

REFERANCE BOOKS:

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2001
2. Whalers Report 2000 – Terry Wohlers, Wohlers Associates, 2000 Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press, 1996.

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***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

**AUTOMATION IN MANUFACTURING**

**(Core Elective – 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 Vs non 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.

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***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

**COMPUTER AIDED PROCESS PLANNING**

**(Core Elective – 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", PrenticeHall1985
3. Chang,T.C., "An Expert Process Planning System", Prentice Hall,1985
4. Nanua Singh, "Systems Approach to Computer Intergrated Design and Manufacturing", John Wiley &Sons,1996
5. Rao P.N., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.

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**M.Tech – I year I Sem. (CAD/CAM)**

**PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS**
**(Core Elective – 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

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***M.Tech R15 Regulations***

**M.Tech – I year I Sem. (CAD/CAM)**

**NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS**

**(Open Elective – I)**

**UNIT-I**:

Introduction to finite difference formula- Parabolic Equation: Introduction – Explicit finite difference approximation to one dimensional equation Crank – Nicholson implicit method – derivation boundary conditions.

**UNIT-I:**

Alternate direction implicit (ADI) method finite difference in cylindrical and spherical polar co-ordinates.

**Convergence stability and consistency:** Definitions of local truncation error and consistency convergence analysis – stability analysis by matrix method eigen value von Newmann stability methods, global rounding error-local truncation error-lax's equation theorem.

**UNIT-III:**

**Hyperbolic Equations:** Analytical solution of $1^{st}$ order quasi linear equation – numerical integration along a characteristic lax wenderoff explicit method.

**CFI** condition wenderoff implicit approximation – propagation of discontinues – Numerical solution by the method of characteristics.

**UNIT-IV:**

**Elliptic Equations**: Introduction – Finite differences in polar co-ordinates – formulas for derivative near a curved boundary analysis of the discretization error of the five point approximation to polman's equation over a rectangle.

**UNIT-V:**

Systemactic iterative methods for large linerar systems – necessary and sufficient condition for convergence of iterative methods – stones implicit methods.

Finite Element Method: weighted residual method – variations methods – division of the region into elements linear element – Galerkin formuation.

**REFERENCES:**


1. Numerical Solution of partial differential equations, Finite Differences methods/ G.D. Smith/ Brunel University, Clarandon Press Oxford.
2. The Finite Differences Methods in Partial Differential equation/ A.R. Mitchel and D.F. Grnra/ John Wiley.
3. Numerical Methods for Engineers and scientists/Joe D. Hoffman/ Mc Graw Hill
4. Applied Finite Element Analysis/ Larry J. Segerlind/ John Wiley.

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**M.Tech – I year I Sem. (CAD/CAM)**

**PRODUCTION AND OPERATIONS MANAGEMENT**

**(Open Elective –I)**

**UNIT -I**

**Operation Management:** Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.

Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

**UNIT – II**

**Value Engineering:** objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method.

Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout – line balancing.

**UNIT - III**

**Aggregate Planning:** definition – Different Strategies – Various models of Aggregate Planning – Transportation and graphical models.

Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP –Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.

**UNIT - IV**

**Scheduling**: Policies – Types of scheduling – Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.

**UNIT – V**

**Project Management**: Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method – crashing of simple nature.

**REFERENCES:**


1. Operations Management/ E.S. Buffs/ John Wiley & Sons / 2007
2. Operations Management Theory and Problems/ Joseph G. Monks / Macmillan / McGraw Hill / 3rd Edition.
3. Production Systems Management/ James I. Riggs / John Wiley & Sons.
4. Production and Operations Management/ Chary/ Mc Graw Hill/2004
5. Operations Management/ Richard Chase/ Mc Graw Hill/2006
6. Production and Operation Management / Panner Selvam / PHI.
7. Production and Operation Analysis/ Nahima/ Mc Graw Hill/2004

**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. preparation of various reports and route sheets, Simulation of manufacturing system using CAM software, controller operating system commands.

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***M.Tech R15 Regulations***

## 15DOE1201 - ENGINEERING RESEARCH METHODOLOGY
## (OPEN ELECTIVE – I)

**Unit - I**

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Important of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

**Unit - II**

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

**Unit - III**

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

**Unit – IV**

Data Collection: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software. Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

**Unit - V**

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

**Suggested Reading:**


1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. Ratan Khananabis and Suvasis Saha, Research Methodology, Universities Press, Hyderabad, 2015.
4. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
6. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
7. Research Methodology, Ratan Khasnabis and Suvasis Saha, University Press, 2015.

## 15D3E41203 - FUZZY LOGIC AND NEURAL NETWORKS
## (CORE ELECTIVE – II)

**UNIT-I**

Knowledge and Processing – Knowledge and Intelligence- logic frames- production systems. Fundamentals of Fuzzy logic-characteristics of fuzzy logic and systems-Fuzzy sets-Fuzzy number- Equality of fuzzy sets- Empty Fuzzy set –Fuzzy point-universal Fuzzy set. Operations on Fuzzy sets-Intersection-union – complement.

**UNIT-II**

Fuzzy Relations-classical N-Array Relation-Reflexivity-Anti reflexivity-symmetricity –Transitivity- Equivalence-Binary fuzzy relations, operation on Fuzzy relations-Intersection-union-projection-Cartesian product.

**UNIT-III**

Fuzzy Implications, Translation rules, Triangular norms, Triangular conorm, Fuzzy Rule base system, Fuzzy logic controller, Defuzzification Methods, Fuzzy logic applications-prevention of Road accidents-control room temperature-Robot control system-domestic applications-Industrial applications.

**UNIT-IV**

Basic concepts of Neural Network-Processing units-connection between units-output rules- Network topologies-paradigms of learning –perception, Back-propagation, classification Models-Association Models, optimization models.

**UNIT-V**

Rule Based Neural Networks-Network Training –Application of Neural Network in Mathematical Modeling-Knowledge based approaches-applications in Mechanical Engineering –Fuzzy –Neural, example, Neuro – Fuzzy examples-Intelligence in Automation.

**REFERENCES:**


1. Intelligent Control Fuzzy Logic Applications/ Clarence W.de Silva/ CRS Press,1995.
2. Fuzzy logic &Neural Networks/ Chennakesava R. Alavala/ New Age International,2008
3. Fuzzy Logic with engineering Applications/ Timothy J. Ross/ Mc Graw Hill Inc., 1995.
4. Neural Networks in Computer Intelligence/ Limin Fu / Tata McGraw Hill Publishing Company Ltd.,2003
5. Stamations and Understanding Neural Networks and Fuzzy Logic/ V. Karthalopoulos Basic concepts Applications, IEE Neural Networks Council PHI 2001.
6. Neural Networks Algorithms, Applications/ James A. Freeman and David M. Skapura & Programming Techniques/ Pearson Education Asia,2001
7. Artificial Neural Networks/ Yegnarayane.B/ Prentice Hall- 2001.

## 15DE31203 - DESIGN OPTIMIZATION
## (CORE ELECTIVE – I)

**UNIT- I:**

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints, classification of optimization problems. Single and multivariable optimization techniques

**UNIT- II:**

Technique of unconstrained minimization. Golden section, Random, Pattern and Gradient search methods, interpolation methods, equality and inequality constraints.

**UNIT-III:**

Direct methods and indirect methods using penalty function, Lagrange multipliers, Geometric programming, stochastic programming, Genetic algorithms

**UNIT-IV:**

Engineering applications, structural-design application axial and transverse loaded members for minimum cost, maximum weight. Design of shafts and torsion members, design optimization of springs.

**UNIT-V:**

Dynamics applications for two degree freedom system. vibration absorbers. Application in mechanisms.

**REFERENCES:**


1. Engineering Optimization -Theory and Practice/ Singerusu S. Rao/ New Age.
2. Optimum Design of Mechanical elements/ Johnson Ray C/ Wiley, John & Sons
3. Genetic Algorithms in search, Optimization and Machine/ Goldberg D. E. Addison/Wesley / NewYork..
4. Optimization for Engineering Design Algorithms and Examples/ Kalyanamoy Deb/Prentice Flail of India.
5. Introduction to Optimum Design/Jasbir S. Arora/ Academic Press/ Everest/ 3rd Edition.

## 15D3CS1205 - FLEXIBLE MANUFACTURING SYSTEMS
## (CORE COURSE – II)

**UNIT- I:**

Introduction to flexible manufacturing systems. Planning and scheduling and control o FMS. Knowledge based scheduling.

**UNIT - II:**

Hierarchy of computer control. Supervisory computer.

**UNIT - III:**

Software for simulation and database of FMS. Specification and selection, trends, application of simulation software.

**UNIT - IV:**

Manufacturing data systems data flow, CAD/CAM considerations. Planning FMS database, just in time characteristics, Pull method, quality small lot sizes, work station loads, close supplier ties, flexible workforce — line flow strategy.

**UNIT - V:**

Preventive maintenance. Karban system, implementation issues.

**REFERENCES:**


1. Hand Book of Flexible Manufacturing Systems/ Jha N K/ Academic Press.
2. Production System l3eyond Large Scale Production/ Talichi Ohno/ Toyota Productivity Press India Pvt. Lid.
3. Flexible Manufacturing Systems/ H K Shivanand/New Age International/2006

# Vidya Jyothi Institute of Technology (Autonomous)

*(Accredited by NBA, Approved By A.I.C.T.E., New Delhi, Permanently Affiliated to JNTU, Hyderabad)*

(Aziz Nagar, C.B.Post, Hyderabad -500075)

***M.Tech R15 Regulations***

## 15D3CS1204 - DESIGN FOR MANUFACTURING AND ASSEMBLY
## (CORE COURSE – I)

**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/.
5. Product Design for Manufacturing and Assembly/ Geoffrey Boothroyd, Peter Dewhurst & Winston Ansthony Knight/CRC Press/2010

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***M.Tech R15 Regulations***

## 15D3CS1206 - INDUSTRIAL ROBOTICS
## (CORE COURSE – III)

**UNIT – I**

**INTRODUCTION**: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

**CONTROL SYSTEM AND COMPONENTS:** basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

**UNIT – II**

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

**UNIT - III**

**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.

**MACHINE VISION:** Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

**UNIT - IV**

**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.

**UNIT - V**

**ROBOT CELL** DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller.

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

**REFERENCES:**


1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall
5. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.
7. Robotics and Control / Mittal R K & Nagrath I J / TMH

## 15D3E31201 - INTELLIGENT MANUFACTURING SYSTEMS
## (CORE ELECTIVE – I)

**UNIT I:**

Computer Integrated Manufacturing Systems Structure and functional areas of CIM system, - CAD, CAPP, CAM**,** CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

**UNIT II:**

Components of Knowledge Based Systems - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

**UNIT III:**

Machine Learning - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

**UNIT IV:**

Automated Process Planning - Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

**UNIT V:**

Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

**REFERENCES:**


1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ Yagna Narayana/PHI/2006
3. Automation, Production Systems and CIM / Groover M.P./PHI/2007
4. Neural networks: A comprehensive foundation/ Simon Hhaykin/ PHI.
5. Artificial neural networks/ B.Vegnanarayana/PHI
6. Neural networks in Computer intelligence/ Li Min Fu/ TMH/2003
7. Neural networks/ James A Freeman David M S kapura/ Pearson education/2004
8. Introduction to Artificial Neural Systems/Jacek M. Zurada/JAICO Publishing House Ed. 2006.

## 15D3E31202 - SPECIAL MANUFACTURING PROCESS
## (CORE ELECTIVE – I)

**UNIT- I**

**SURFACE TREATMENT:** Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

**UNIT- II**

**PROCESSING OF CERAMICS:** Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

**UNIT- III**

**FABRICATION OF MICROELECTRONIC DEVICES:** Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

**UNIT - IV**

**E-MANUFACTURING:** Nano manufacturing techniques and micromachining, High Speed Machining and hot machining

**UNIT -V**

**RAPID PROTOTYPING:** Working Principles, Methods, Stereo Lithography, Laser Sintering, Fused Deposition Method, Applications and Limitations, Rapid tooling, Techniques of rapid manufacturing

**REFERENCES:**


1. Manufacturing Engineering and Technology I Kalpakijian / Adisson Wesley, 1995.
2. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.
3. Microelectronic packaging handbook / Rao. R. Thummala and Eugene, J. Rymaszewski / Van Nostrand Renihold,
4. MEMS & Micro Systems Design and manufacture / Tai — Run Hsu / TMGH
5. Advanced Machining Processes / V.K.Jain / Allied Publications. 6. Introduction to Manufacturing Processes / John A Schey I Mc Graw Hill.

## 15D3E31203 - DESIGN OPTIMIZATION
## (CORE ELECTIVE – I)

**UNIT- I**:

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints, classification of optimization problems. Single and multivariable optimization techniques

**UNIT- II:**

Technique of unconstrained minimization. Golden section, Random, Pattern and Gradient search methods, interpolation methods, equality and inequality constraints.

**UNIT-III:**

Direct methods and indirect methods using penalty function, Lagrange multipliers, Geometric programming, stochastic programming, Genetic algorithms

**UNIT-IV**:

Engineering applications, structural-design application axial and transverse loaded members for minimum cost, maximum weight. Design of shafts and torsion members, design optimization of springs.

**UNIT-V**:

Dynamics applications for two degree freedom system. vibration absorbers. Application in mechanisms.

**REFERENCES:**


1. Engineering Optimization -Theory and Practice/ Singerusu S. Rao/ New Age.
2. Optimum Design of Mechanical elements/ Johnson Ray C/ Wiley, John & Sons
3. Genetic Algorithms in search, Optimization and Machine/ Goldberg D. E. Addison/Wesley / NewYork..
4. Optimization for Engineering Design Algorithms and Examples/ Kalyanamoy Deb/Prentice Flail of India.
5. Introduction to Optimum Design/Jasbir S. Arora/ Academic Press/ Everest/ 3rd Edition.

## 15D3E41201 - ADVANCED MECHATRONICS
## (CORE ELECTIVE – II)

**UNIT-I**

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

**UNIT-II**

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

**UNIT-III**

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.

**UNIT-IV**

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

**UNIT-V**

System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

**REFERENCES:**


1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
4. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
5. Mechatronics System Design / Devdas shetty/Richard/Thomson.
6. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
7. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4$^{th}$ Edition, Pearson, 2012 W. Bolton
8. Mechatronics – Principles and Application Godfrey C. Onwubolu, Elsevier, 2006 Indian print.

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***M.Tech R15 Regulations***

## 15D3E41202 - DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS (CORE ELECTIVE – II)

**UNIT I:**

**OVERVIEW AND WORKING PRINCIPLES OF MEMS AND MICROSYSTEMS MEMS** & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & Miniaturization, Applications of MEMS in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidies.

**UNIT II:**

**ENGINEERING SCIENCE FOR MICROSYSTEMS DESIGN AND FABRICATION:** Atomic structure of Matter, Ions and Ionization, Molecular Theory of Mater and Intermolecular Force, Doping of Semiconductors, The diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics

**UNIT III:**

**ENGINEERING MECHANICS FOR MICROSYSTEMS DESIGN:** Static Bending of thin Plates, Mechanical Vibration, Thermo mechanics Fracture Mechanics, Thin-Film Mechanics, Overview of Finite Element Stress Analysis

**UNIT IV:**

**THERMO FLUID ENGINEERING & MICROSYSTEMS DESIGN:** Overview of Basics of Fluid Mechanics in Macro and Meso scales, Basic equations in Continuum Fluid dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid Flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a Micro pressure Sensor.

**UNIT V:**

**MATERIALS FOR MEMS & MICROSYSTEMS AND THEIR FABRICATION:** Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, chemical and physical vapor deposition, Etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

**REFERENCES:**

1. MEMs & Microsystems: Design & Manufacture/ Tai-Ran Hsu/Tata Mc-Graw Hill., ed./2002
2. An Introduction to Microelectromechanical Systems Engineering/ Maluf, M./ Artech House, Boston, 2000
3. Micro robots and Micromechanical Systems/ Trimmer, W.S.N/ Sensors & Actuators, vol19, no.1989.
4. Applied Partial Differential Equations/ Trim, D.W/ PWS-Kent Publishing/ Boston 1990.
5. Fundamentals of Microfabrication. Madou, M/ CRC Press, Boca Raton, 1997.
6. The Finite Element Method in Thermomechanics/ Hsu, T.R / Alien & Unwin, London.

## 15D3OE1202 - QUALITY ENGINEERING IN MANUFACTURING
## (OPEN ELECTIVE – I)

**UNIT I:**

**QUALITY VALUE AND ENGINEERING:** An overview of quality system, quality engineering in production design, quality engineering in design of production processes.

Loss Function and Quality Level: Derivation and use of Quadratile loss function, Economic consequences of tightening tolerances as a means to improve quality, Evaluations and types of tolerances.(N-type,S-type and L-type)

**UNIT II:**

**TOLERANCE DESIGN AND TOLERANCING**: Functional limits, tolerance design for N-type, L-type and Stype characteristics, tolerance allocation for multiple components. Parameter and Tolerance Design;

Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

**UNIT III:**

**ANALYSIS OF VARIANCE (ANOVA):** NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of Ftest, ANOVA for four level factors, multiple level factors.

**UNIT IV:**

**ORTHOGONAL ARRAYS:** Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contribution, estimating the mean.

**UNIT V:**

ISD-9000 Quality System, BDRE, 6-sigma, Bench -marking, Quality circles - Brain Storming –Fishbone diagram - Problem analysis.

**REFERENCES:**


1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill, Intl. II Edition, 1995.
2. Quality Engineering in Production systems / G. Taguchi, A. Elsayed et al / Mc.Graw Hill Intl. Edition, 1989.
3. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi / Prentice Hall Ind. Pvt. Ltd., New Delhi.

## 15D3LB1201 - COMPUTER AIDED MODELING AND ANALYSIS LABORATORY

**MODELING**

1. Surface modeling.
2. Solid modeling.
3. Drafting.
4. Assembling.

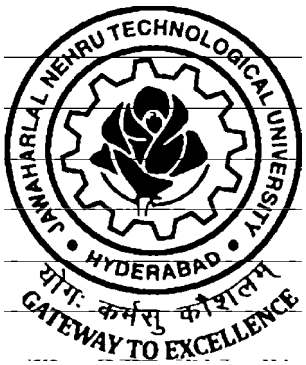
**ANALYSIS OF STRUCTURES USING FEA PACKAGES**

1. Static Analysis.
2. Modal Analysis.
3. Harmonic Analysis.
4. Spectrum Analysis.
5. Buckling Analysis.
6. Analysis of Composites.
7. Fracture mechanics.
8. Transient analysis

# ACADEMIC REGULATIONS
# COURSE STRUCTURE
# AND
# DETAILED SYLLABUS

## M.TECH
## CAD / CAM

**(Applicable for the batches admitted from 2013-14)**




**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**KUKATPALLY, HYDERABAD – 500 085.**

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

## M.TECH - CAD / CAM

## COURSE STRUCTURE AND SYLLABUS

**I Year I Semester**

| Code | Group | Subject | L | P | Credits |
|---|---|---|---|---|---|
| | | Advanced CAD | 3 | - | 3 |
| | | Advanced Finite Element Analysis | 3 | - | 3 |
| | | Precision Engineering | 3 | - | 3 |
| | | Design for Manufacturing and Assembly | 3 | - | 3 |
| | Elective-I | Numerical Methods for Partial Differential Equations<br>Advanced Mechanics of Solids<br>Advanced Mechatronics | 3 | - | 3 |
| | Elective-II | Advanced Mechanics of Composite Materials<br>Total Quality Management<br>Stress Analysis and Vibrations | 3 | - | 3 |
| | | Computer Aided Design Lab | - | 3 | 2 |
| | | Seminar | - | - | 2 |
| | | Total Credits | 18 | 3 | 22 |

**I Year II Semester**

| Code | Group | Subject | L | P | Credits |
|---|---|---|---|---|---|
| | | Design of Hydraulics and Pneumatics Systems | 3 | - | 3 |
| | | Flexible Manufacturing Systems | 3 | - | 3 |
| | | Computer Aided Manufacturing | 3 | - | 3 |
| | | Industrial Robotics | 3 | - | 3 |
| | Elective –III | Production and Operations Management<br>Computational Fluid Dynamics<br>Automation in Manufacturing | 3 | - | 3 |
| | Elective -IV | Design Optimization<br>Intelligent Manufacturing Systems<br>Computer Aided Process Planning | 3 | - | 3 |
| | Lab | Computer Aided Machining and Robotics Lab<br>Seminar | -<br>- | 3<br>- | 2<br>2 |
| | | Total Credits | 18 | 3 | 22 |

**II Year - I Semester**

| Code | Group | Subject | L | P | Credits |
|---|---|---|---|---|---|
| | | Comprehensive Viva | - | - | 2 |
| | | Project Seminar | - | 3 | 2 |
| | | Project work | - | - | 18 |
| | | Total Credits | - | 3 | 22 |

**II Year - II Semester**

| Code | Group | Subject | L | P | Credits |
|---|---|---|---|---|---|
| | | Project work and Seminar | - | - | 22 |
| | | Total Credits | - | - | 22 |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**ADVANCED CAD**

**UNIT I:**

**Principles of Computer Graphics :** Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of characters.

**UNIT II:**

**CAD Tools:** Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software. **Geometricmodelling:** Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves.

**UNIT III:**

**Surface Modeling** :Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

**UNIT IV:**

**Parametric Representation of Synthetic Surfaces:** Hermite Bicubic surface, **Bezier** surface, **B-** Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation — Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

**UNIT V:**

**Geometricmodelling-3D** : Solid modeling, Solid Representation, Boundary Representation (13-rep), Constructive So! id Geometry (CSG). CAD/CAM Exchange : Evaluation of data — exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. Design Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.

**Collaborative Engineering:** Collaborative Design, Principles, Approaches, Tools, Design Systems.

**REFERENCES :**

1. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill International.
2. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition.
3. CAD/CAM /Groover M.P./ Pearson education.
4. CAD/CAM Concepts and Applications/ Alavala/ PHI.
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)**

**ADVANCED FINITE ELEMENT ANALYSIS**

**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 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.
8. Finite Element Analysis – Bathe / PHI.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**PRECISION ENGINEERING**

**UNIT I:**

**Concepts of Accuracy:** Introduction – Concept of Accuracy of Machine Tools – Spindle and Displacement Accuracies – Accuracy of numerical Control Systems – Errors due to Numerical Interpolation Displacement Measurement System and Velocity lags.

**Geometic Deimensioning and Tolerancing**: Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datums – Datum Feature of Representation – Form controls, Orientation Controls – Logical Approach to Tolerancing.

**UNIT II:**

**Datum Systems:** Design of freedom, Grouped Datum Systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue – slot pair – Computation of Transnational and rotational accuracy, Geometric analysis and application.

**UNIT III:**

**Tolerance Analysis:** Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature Tolerances, Geometric Tolerances. Surface finish, Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerances sure fit law, normal law and truncated normal law.

**UNIT IV:**

**Tolerance Charting Techniques:** Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining; Datum Features – functional and manufacturing Components design – Machining Considerations, Redesign for manufactured, Examples.

**UNIT V:**

**Foundamentals of Nanotechnolgy**: Systems of nanometer accuracies – Mechanism of metal Processing – Nano physical processing of atomic bit units. Nanotechnology and Electrochemical atomic bit processing.

**Measuring Systems Processing**: In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

**REFERENCES:**

1. Precision Engineering in Manufacturing/Murthy R.L./New Age International (P) limited, 1996.
2. Geometric Dimensioning and Tolerancing / James D. Meadows / Marcel Dekker inc. 1995.
3. Nano Technology / Norio Taniguchi / Oxford University Press, 1996.
4. Engineering Design – A systematic Approach / Matousek / Blackie & Son Ltd., London.
5. Precision Engineering/VC Venkatesh & S Izman/TMH.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**DESIGN FOR MANUFACTURING AND ASSEMBLY**

**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/.
5. Product Design for Manufacturing and Assembly/ Geoffrey Boothroyd, Peter Dewhurst & Winston Anthony Knight/CRC Press/2010.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS**

**ELECTIVE – I**

**UNIT-I**:

Introduction to finite difference formula- Parabolic Equation: Introduction – Explicit finite difference approximation to one dimensional equation Crank – Nicholson implicit method – derivation boundary conditions.

**UNIT-II:**

Alternate direction implicit (ADI) method finite difference in cylindrical and spherical polar co-ordinates.

**Convergence Stability and Consistency:** Definitions of local truncation error and consistency convergence analysis – stability analysis by matrix method eigen value von Newmann stability methods, global rounding error-local truncation error-lax's equation theorem.

**UNIT-III:**

**Hyperbolic Equations:** Analytical solution of $1^{st}$ order quasi linear equation – numerical integration along a characteristic lax wenderoff explicit method.

**CFI** condition wenderoff implicit approximation – propagation of discontinues – Numerical solution by the method of characteristics.

**UNIT-IV:**

**Elliptic Equations**: Introduction – Finite differences in polar co-ordinates – formulas for derivative near a curved boundary analysis of the discretization error of the five point approximation to polman's equation over a rectangle.

**UNIT-V:**

Systemactic iterative methods for large linerar systems – necessary and sufficient condition for convergence of iterative methods – stones implicit methods.

**Finite Element Method:** weighted residual method – variations methods – division of the region into elements linear element – Galerkin formuation.

**REFERENCES:**

1. Numerical Solution of partial differential equations, Finite Differences methods/ G.D. Smith/ Brunel University, Clarandon Press Oxford.
2. The Finite Differences Methods in Partial Differential equation/ A.R. Mitchel and D.F. Grnra/ John Wiley.
3. Numerical Methods for Engineers and scientists/Joe D. Hoffman/ Mc Graw Hill.
4. Applied Finite Element Analysis/ Larry J. Segerlind/ John Wiley.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**ADVANCED MECHANICS OF SOLIDS**

**ELECTIVE - I**

**UNIT - I**

**Shear Centre:** Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.

**Unsymmetrical Bending:** Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

**UNIT - II**

**Curved Beam Theory:** Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform loads- stresses in chain links.

**UNIT - III**

**Torsion:** Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane ( Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends

**Axi-Symmetric Problems:** Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.

**UNIT - IV**

**Theory of Plates**: Introduction; Stress resultants in a flat plate; Kinematics: Strain- Displacement relations for plates; Equilibrium equations for small displacement theory of flat plates; Stress – Strain – Temperature relation for Isotropic plates: Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem; Solution of circular plate problem.

**Beams on Elastic Foundation:** General theory; Infinite Beam subjected to Concentrated load; boundary conditions; Infinite beam subjected to a distributed lad segment; Semi-infinite beam with concentrated load near its end; Short Beams.

**UNIT - V**

**Contact Stresses:** Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact. Normal and Tangent to contact area.

**REFERENCES:**

1. Advanced Mechanics of materials/Seely and Smith/ John Willey.
2. Advanced Mechanics of materials / Boresi & Sidebottom/wiely international.
3. Advanced strength of materials / Den Hortog J.P./Torrent.
4. Theory of Plates /Timoshenko/
5. Strength of materials / Sadhu singh/ Khanna Publishers.
6. Mechanics of Materials / Beer & Jhonson / McGraw Hill.
7. Theory of Plates & Shells / Timoshenko/ McGraw Hill/ 2nd Edition.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**ADVANCED MECHATRONICS**

**ELECTIVE – I**

**UNIT-I**

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

**UNIT-II**

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

**UNIT-III**

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.

**UNIT-IV**

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

**UNIT-V**

System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

**REFERENCES:**

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008.
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
4. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
5. Mechatronics System Design / Devdas shetty/Richard/Thomson.
6. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
7. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton.
8. Mechatronics – Principles and Application Godfrey C. Onwubolu, WIsevier, 2006 Indian print.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**ADVANCED MECHANICS OF COMPOSITE MATERIALS**

**ELECTIVE - II**

**UNIT – I**

**Basic Concepts and Characteristics:** Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

**Reinforcements:** Fibres – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

**UNIT – II**

**Micromechanics:** Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

**Manufacturing Methods:** Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

**Unit – III**

**Coordinate Transformation:** Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off – axis, stiffness modulus, off – axis compliance.

**Elastic Behavior of Unidirectional Composites:** Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

**Unit – IV**

**Strength of Unidirectional Lamina:** Micro mechanics of failure, Failure mechanisms, strength of an orthotropic lamina, strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micros mechanical predictions of elastic constants.

**Unit – V**

**Analysis of Laminated Composite Plates:** Introduction thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

**REFERENCES:**

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
3. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ Wiley- Interscience, New York, 1980.
4. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)/ Autar K. Kaw ,Publisher: CRC.
5. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, New York, 1969.
6. Advanced Mechanics of Composite Materials/ Vasiliev &Morozov/Elsevier/Second Edition.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**TOTAL QUALITY MANAGEMENT**

**ELECTIVE - II**

**UNIT – I:**

**Introduction:** The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

**UNIT – II:**

**Customer Focus and Satisfaction**: The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

**UNIT – III:**

**Organizing for TQM**: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

**UNIT – IV:**

**The cost of Quality:** Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

**UNIT – V:**

**ISO9000:** Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

**REFERENCES:**

1. Total Quality Management / Joel E.Ross/Taylor and Franscis Limited.
2. Total Quality Management/P.N.Mukherjee/PHI.
3. Beyond TQM / Robert L.Flood.
4. Statistical Quality Control / E.L. Grant.
5. Total Quality Management- A Practical Approach/H. Lal.
6. Quality Management/Kanishka Bedi/Oxford University Press/2011.
7. Total Engineering Quality Management/Sunil Sharma/Macmillan.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech – I year I Sem. (CAD/CAM)**

**STRESS ANALYSIS AND VIBRATION**

**ELECTIVE - II**

**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 beams. 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)**

**COMPUTER AIDED DESIGN LAB**

Creation of working drawing, creating geometry, constraining the profile, extracting a part using tools, creating pattern of holes, translating rotating, mirroring, managing the specification tree. Creating sheets and views, creating text and dimensions, creating an assembly, moving components, assembling existing components, creating bill of materials, creating wire frame and surface geometry using generative shape design and sweep tools. Generation of Ferguson's cubic surface patches, Bezier surface patches. Coons patches. Import and export of drawing from other software.

Linear static analysis, Automatic calculation of rigid body modes, uses specified eigen value shift, lumped and consistent mass matrices. Buckling analysis, Jacobi inverse iteration techniques. Steady state harmonic response, mode superposition method, overall structural and damping, linear dynamic analysis, non linear static analysis, non- linear dynamic analysis. Steady state heat transfer analysis problems. Transient heat transfer analysis. Familiarity with element library. Defining Boundary conditions, multipoint constraint familiarity with different types of loads. Solution techniques, direct and iterative solver. Results and analysis. Design optimization.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**DESIGN OF HYDRAULICS & PNEUMATIC SYSTEMS**

**UNIT – I:**

Oil hydraulic systems Hydraulic pumps, types and construction details, sizing and selection.

**Direction control valves, flow and pressure control valves.**

**UNIT – II:**

Linear actuators types Piston rod design sizing and selection, Rotary actuators, hydraulic reservoir accumulators.

**UNIT – III:**

Design of hydraulic circuits, seals and packings, hydraulic servo techniques, cylinders and air motors.

**UNIT – IV:**

Sequencing and synchronizing circuits, accumulator, low cost automation Hydro circuits, accumulators, Hydro pneumatic circuits principles of pneumatic circuit design.

**UNIT – V:**

Maintenance and trouble shooting of hydraulic and pneumatic circuits, components,

PLC Automation and uses of Microprocessors.

**REFERENCES:**

1 Oil Hydraulic Systems/ S.R. Majumdar/ Tata Mc. Graw Hill.

2 Pneumatic systems, principles and maintenance/ S.R. Majumdar/Tata Mc.GrawHill.

3 Hydraulic and pneumatics/ Andrew Darr/ Jaico Publishing Hoise.

4 Fluid power with applications/ Antony Esponssito/ Prentice Hall.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**FLEXIBLE MANUFACTURING SYSTEMS**

**UNIT- I:**

Introduction to flexible manufacturing systems. Planning and scheduling and control of FMS. Knowledge based scheduling.

**UNIT - II:**

Hierarchy of computer control. Supervisory computer.

**UNIT - III**:

Software for simulation and database of FMS. Specification and selection, trends, application of simulation software.

**UNIT - IV:**

Manufacturing data systems data flow, CAD/CAM considerations. Planning FMS database, just in time characteristics, Pull method, quality small lot sizes, work station loads, close supplier ties, flexible workforce — line flow strategy.

**UNIT - V:**

Preventive maintenance. Karban system, implementation issues.

**REFERENCES:**

1. Hand Book of Flexible Manufacturing Systems/ Jha N K/ Academic Press.
2. Production System I3eyond Large Scale Production/ Talichi Ohno/ Toyota Productivity Press India Pvt. Lid.
3. Flexible Manufacturing Systems/ H K Shivanand/New Age International/2006

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**COMPUTER AIDED MANUFACTURING**

**UNIT - I**

**Compute-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 tools, 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, the 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. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill. 1983.
2. Computer Aided Design Manufacturing – K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI, 2008.
3. CAD/CAM Principles and Applications, P.N.Rao, TMH.
4. CAD / CAM Theory and Practice,/ Ibrahim Zeid,TMH.
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/2008.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**INDUSTRIAL ROBOTICS**

**UNIT - I**

**Introduction**: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

**Control System and Components:** basic concept and medias controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

**UNIT - II**

**Motion Analysis and Control:** Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

**UNIT - III**

**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.

**Machine Vision:** Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

**UNIT - IV**

**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.

**UNIT - V**

**Robot Cell Desgin and Control:** Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller.

**Robot Application**: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

**REFERENCES:**

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall.
5. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.
7. Robotics and Control / Mittal R K & Nagrath I J / TMH.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**PRODUCTION AND OPERATIONS MANAGEMENT**
**ELECTIVE – III**

**UNIT -I**

**Operation Management:** Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.

**Product Design:** Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

**UNIT- II**

Value Engineering – objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method.

Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout – line balancing.

**UNIT III**

**Aggregate Planning :** Definition – Different Strategies – Various models of Aggregate Planning – Transportation and graphical models. Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP –Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.

**UNIT IV**

**Scheduling:** Policies – Types of scheduling – Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.

**UNIT V**

**Project Management:** Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method – crashing of simple nature.

**REFERENCES:**

1. Operations Management by E.S. Buffs.
2. Operations Management Theory and Problems: by Joseph G. Monks.
3. Production Systems Management by James I. Riggs.
4. Production and Operations Management by Chary.
5. Operations Management " by Chase.
6. Production and Operation Management by Panner Selvam.
7. Production and Operation Analysis by Nahima.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**COMPUTATIONAL FLUID DYNAMICS**

**ELECTIVE – III**

**UNIT - I**

**Introduction:** Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

**Solution Methods:** Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

**UNIT – II**

**Hyperbolic Equations:** explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

**UNIT - III**

**Formulations of Incompressible Viscous Flows:** Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

**Treatment of Compressible Flows:** potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

**UNIT - IV**

**Finite Volume Method**: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

**UNIT - V**

**Standard Variational Methods:** Linear fluid flow problems, steady state problems, Transient problems.

**REFERENCES:**

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985.
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
4. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications.
5. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
6. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
7. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University Press/ 2nd Edition.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**AUTOMATION IN MANUFACTURING**

**ELECTIVE-III**

**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 Vs non 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/ MikeJ P. Grower/PHI.
3. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanyarn and Raju/New Age International Publishers/ 2003.
4. Svstem 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 II Sem. (CAD/CAM)**

**DESIGN OPTIMIZATION**

**ELECTIVE – IV**

**UNIT- I**:

General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints, classification of optimization problems. Single and multivariable optimization techniques.

**UNIT- II:**

Technique of unconstrained minimization. Golden section, Random, Pattern and Gradient search methods, interpolation methods, equality and inequality constraints.

**UNIT-III:**

Direct methods and indirect methods using penalty function, Lagrange multipliers, Geometric programming, stochastic programming, Genetic algorithms.

**UNIT-IV**:

Engineering applications, structural-design application axial and transverse loaded members for minimum cost, maximum weight. Design of shafts and torsion members, design optimization of springs.

**UNIT-V**:

Dynamics applications for two degree freedom system. vibration absorbers. Application in mechanisms.

**REFERENCES:**

1. Engineering Optimization -Theory and Practice/ Singerusu S. Rao/ New Age.
2. Optimum Design of Mechanical elements/ Johnson Ray C/ Wiley, John & Sons.
3. Genetic Algorithms in search, Optimization and Machine/ Goldberg D. E. Addison/Wesley / NewYork..
4. Optimization for Engineering Design Algorithms and Examples/ Kalyanamoy Deb/Prentice Flail of India.
5. Introduction to Optimum Design/Jasbir S. Arora/ Academic Press/ Everest/ 3rd Edition.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**INTELLIGENT MANUFACTURING SYSTEMS**

**ELECTIVE – IV**

**UNIT I:**

Computer Integrated Manufacturing Systems Structure and functional areas of CIM system - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

**UNIT II:**

Components of Knowledge Based Systems - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

**UNIT III:**

Machine Learning - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

**UNIT IV:**

Automated Process Planning - Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

**UNIT V:**

**Group Technology:** Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSGT) — Data Base, Knowledge Base, Clustering Algorithm.

**REFERENCES:**

1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ Yagna Narayana/PHI/2006.
3. Automation, Production Systems and CIM / Groover M.P./PHI/2007.
4. Neural networks: A comprehensive foundation/ Simon Hhaykin/ PHI.
5. Artificial neural networks/ B.Vegnanarayana/PHI.
6. Neural networks in Computer intelligence/ Li Min Fu/ TMH/2003.
7. Neural networks/ James A Freeman David M S kapura/ Pearson education/2004.
8. Introduction to Artificial Neural Systems/Jacek M. Zurada/JAICO Publishing House Ed. 2006.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**COMPUTER AIDED PROCESS PLANNING**
**ELECTIVE – IV**

**UNIT-I**

**Introduction to CAPP:** Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.

**Generative CAPP System:** Importance. principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

**UNIT-II**

**Retrieval CAPP** system: Significance, group technology, structure, relative advantages, implementation, and applications.

**Selection of Manufacturing Sequence:** Significance, alternative-manufacturing processes, reduction of total set-up cost for a particular sequence. quantitative methods for optimal selection, examples.

**UNIT-III**

**Determination of Machining Parameters:** reasons for optimal selection of machining parameters, effect of parameters on production i-ate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

**UNIT -IV**

**Determination of Manufacturing Tolerances**: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

**UNIT -V**

**Generation of Tool Path:** Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative methods.

**Implementation Techniques for CAPP:** MIPLAN system, Computer programming languages tbr CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

**REFERENCES:**

1. Automation, Production systems and Computer Integrated Manufacturing System/ Mikell P Groover.
2. Computer Design and Manufacturing/Sadhu Singh.
3. Computer Engineering /David Bedworth.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.Tech I year II Sem. (CAD/CAM)**

**COMPUTER AIDED MACHINING & ROBOTICS LABORATORY**

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 Joining 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. Robot path control, preparation of various reports and route sheets, Simulation of manufacturing system using CAM software, controller operating system commands.