JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH. (ADVANCED MANUFACTURING SYSTEMS)

EFFECTIVE FROM ACADEMIC YEAR 2022- 23 ADMITTED BATCH

R22 COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Core-I	Precision Engineering	3	0	0	3
Professional Core-II	Theory of Metal Cutting and Tool Design	3	0	0	3
Professional Elective - I	1. Design for Manufacturing & Assembly 2. Advanced Manufacturing Processes 3. Product Data Management	3	0	0	3
Professional Elective - II	1. Optimization Techniques & Applications 2. Automation in Manufacturing 3. Additive Manufacturing	3	0	0	3
	Research Methodology & IPR	2	0	0	2
Lab - I	Material Testing and Characterization Lab	0	0	4	2
Lab - II	Advanced Computer Aided Design and Analysis Lab	0	0	4	2
Audit - I	Audit Course- I	2	0	0	0
	Total	**16**	**0**	**8**	**18**

I Year II Semester

Course Code	Course Title	L	T	P	Credits
Professional Core - III	Computer Integrated Manufacturing	3	0	0	3
Professional Core - IV	Manufacturing Systems: Simulation Modelling & Analysis	3	0	0	3
Professional Elective - III	1. Materials Technology 2. Quality Engineering in Manufacturing 3. Advanced Tool Design	3	0	0	3
Professional Elective - IV	1. Artificial Intelligence in manufacturing 2. Concurrent Engineering 3. Industrial Robotics	3	0	0	3
	Mini Project with Seminar	0	0	4	2
Lab - III	Automation Lab	0	0	4	2
Lab - IV	Advanced Manufacturing Processes & Metal Cutting Lab	0	0	4	2
Audit - II	Audit Course - I	2	0	0	0
	Total	**14**	**0**	**12**	**18**

II Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Elective - V	1. Production and Operations Management 2. MEMS 3. Flexible Manufacturing Systems	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review – I & II	0	0	12	6
	Total	**6**	**0**	**12**	**12**

II YEAR II - SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review - III	0	0	12	6
Dissertation	Dissertation Viva-Voce	0	0	28	14
	Total	**0**	**0**	**40**	**20**

***For Dissertation Work Review, please refer R22 Academic Regulations.**

Audit Course I & II:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

Open Electives:

1. Business Analytics
2. Waste to Energy
3. Principles of Automation
4. Artificial Neural Networks

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

PRECISION ENGINEERING (Professional Core - I)

L	T	P	C
3	0	0	3

Pre-requisites: Machine Tools, Metrology

Course Objectives:

- To give the basic precision engineering methodology and state-of-the-art concepts for designing high-precision CNC machines and products.
- The course is specifically tailored to teach the novel design principles leading to improved machine performance and reliability.
- To apply the acquired knowledge to other design efforts and fields as well

Course Outcomes: At the end of the course, the student will be able to:

- Apply fits and tolerances for parts and assemblies according to ISO standards.
- Apply selective assembly concept for quality and economic production.
- Assign tolerances using principles of dimensional chains for individual features of a part or assembly.
- Evaluate the part and machine tool accuracies.
- Analyze the causes for dimensional and geometrical errors prior to and during machining and suggest remedies

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.

Geometric Dimensioning and Tolerance: Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum –Datum Feature of Representation – Form Controls, Orientation Controls – Logical Approach to Tolerance.

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, C_p, C_{pk}, Cost aspects, Feature Tolerances, Geometric Tolerances.

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

UNIT–IV:

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-V:

Measuring Systems Processing: In process 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.

TEXT BOOKS:

1. Precision Engineering in Manufacturing by Murthy R. L., New Age International (P) limited, 1996.
2. Geometric Dimensioning and Tolerancing by James D.Meadows, Marcel Dekker Inc.1995.

REFERENCE BOOK:

1. Engineering Design – A systematic Approach by Matousek, Blackie & Son Ltd, London.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

THEORY OF METAL CUTTING & Tool Design (Professional Core - II)

L	T	P	C
3	0	0	3

Pre- requisites: Engineering graphics, Mechanics of solids, Heat Transfer, Machine Tools, Strength of Materials, Material Science and Metallurgy.

Objectives:

- To impart the knowledge of basic methodology of metal cutting.
- To educate the student about the structure, working, forces involved in single point andmultipoint cutting tools.
- To understand the concepts of tool life, machinability, wear, influence of heat.
- To design the jigs and fixtures required for machine tools.

Course Outcomes: Students can analyze the machining processes in terms of input variables like Speed, feed, depth of cut and their influence on surface roughness and performance measures, Metal removal rate, tool wear rate, machining time, energy, work done, heat distribution.

UNIT-I:
Mechanics of Metal Cutting: Geometry of Metal Cutting Process, Chip formation, Chip Thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut - Types of Chips, Chip breakers. Orthogonal and Oblique cutting processes-definition, Forces and energy calculations (Merchant's Analysis) - Power consumed – MRR – Effect of Cutting variables on Forces, Force measurement using Dynamometers.

UNIT-II:
Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools, throwaway inserts.

UNIT-III:
Multi point Cutting Tools: Drill geometry, design of drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, Milling Cutters-cutting speed & feed – machining time – design - From Cutters.
Grinding: Specifications of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio. Depth of cut, speed, machining time, temperature, power.

UNIT-IV:
Tool Life and Tool Wear: Theories of tool wear-adhesion, abrasion and diffusion wear

mechanisms, forms of wear, Tool life criteria, machinability and machinability index. Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting. Effect of Tool angle, Economics, cost analysis, mean co-efficient of friction.
Cutting Temperature: Sources of heat in metal cutting, influence of metal conditions. Temperature variation, zones, experimental techniques, analytical approach. Use of tool-work thermocouple for determination of temperature. Heat distribution in Metal Cutting.

UNIT-V:
Tool Design: Determination of shank size for single point carbide tools, Determining the insert thickness for carbide tools.
Design of jigs and fixtures: Basic principles of location and clamping; Locating methods and devices. Jigs- Definition, Types. General consideration in the design of Drill jigs, Drill bushing, Methods of construction. Fixtures - Vice fixtures, Milling, Boring, Lathe, Grinding fixtures.

Text Books:

1. Metal Cutting Principles by M C Shaw, Oxford and IBH Publications, New Delhi.
2. Fundamentals of Machining by Boothryd, Edward Amold publishers Ltd.

Reference Books:

1. Fundamentals of Metal cutting and Machine tools by B.L.Juneja, G. S. Sekhom and Nitin Seth,New Age International publishers.
2. Machine Tool Engineering by G.R.Nagpal, Khanna Publishers.
3. Tooling Data by P.H. Joshi, Wheeler Publishing.
4. Metal Cutting and Tool Design by B.J Ranganath, Vikas Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

DESIGN FOR MANUFACTURING AND ASSEMBLY (Professional Elective - I)

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes, Engineering Materials

Course Objectives: The objective of course isidentify the manufacturing constraints that influence the design of parts and part systems. Students will be introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.

Course Outcomes: At the end of the course, the student will be able to:

- Understand the quality aspects of design for manufacture and assembly
- Apply Boothroyd method of DFM for product design and assembly
- Apply the concept of DFM for casting, welding, forming and assembly
- Identify the design factors and processes as per customer specifications
- Apply the DFM method for a given product

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 dies 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.

Plastics: Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic components – Design considerations for Injection Moulding.

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.

TEXT BOOKS:

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.

REFERENCES:

1. Computer Aided Assembly London/ A Delbainbre/.
1. Product Design for Manufacturing and Assembly/ Geoffrey Boothroyd, Peter Dewhurst & Winston Ansthony Knight/CRC Press/2010

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

ADVANCED MANUFACTURING PROCESSES (Professional Elective - I)

L	T	P	C
3	0	0	3

Prerequisites: Production Technology, Machine Tools, Metal Cutting, Material Science.

Course Objectives:

- To make acquainted the various unconventional manufacturing processes
- To know about the applications of advanced manufacturing processes (which are exceptional)
- To encourage the students for developing the models of Advanced Manufacturing Processes

Course Outcomes: At the end of the course, the student will be able to

- Explain the surface treatment processes
- Describe the Nontraditional Machining processes
- Estimate the performance characteristics of various machining processes
- Understand the ceramics and composites processing
- Apply e-manufacturing &nanotechnology in high speed machining processes

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 vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT-II:

Non-Traditional Machining: Introduction, need, AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment, process characteristics, performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM.

UNIT-III:

Laser Beam Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

UNIT-IV:

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-V:

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 microelectronics, surface mount technology, Integrated circuit economics.

E-Manufacturing, nanotechnology, micromachining and High-speed Machining, basic principles, working, applications, advantages.

TEXT BOOKS:

1. Manufacturing Engineering and Technology by Kalpakijian, Addison Wesley, 1995.
2. Foundation of MEMS by Chang Liu, Pearson, 2012.
3. Advanced Machining Processes by V.K.Jain, Allied Publications.

REFERENCE BOOKS:

1. Process and Materials of Manufacturing by R. A. Lindburg, 4th edition, PHI 1990.
2. Introduction to Manufacturing Processes by John A Schey, Mc Graw Hill.
3. Micro Machining of Engineering Materials by J.Mc Geough, CRC Press.
4. Non-Traditional Manufacturing Processes by Gary F Benedict, CRC Press.
5. Advanced Methods of Machining by J.A Mc Geough, Springer.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

PRODUCT DATA MANAGEMENT (Professional Elective - I)

L	T	P	C
3	0	0	3

Prerequisites: Management Science

Course Objectives:

- Competence with a set of tools and methods for product design and development.
- Confidence in own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
- Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.
- Enhanced team working skills.

Course Outcomes:

- After doing this course, the student will be able to
- Understand the need of Industrial Product & Development, customer needs & Design aspects of new products.
- Involve customer into the development of new products and managing requirements
- Understand the design of experiments and technical analysis
- Understand product architecture
- Investigate the customer needs and survey of problems
- Design for manufacture and do prototyping

UNIT- I:

Introduction -Need for IPPD – strategic importance of product development – integration of customer, designer, material supplier and process planner, Competitor and costumer – behavior analysis. Understanding customer – promoting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specification.

UNIT – II:

Concept Generation and Selection: Task – Structured approaches – Clarification – Search – Externally and internally – explore systematically – reflect on the solutions and process – concept selection – methodology – benefits.

PRODUCT ARCHITECTURE: Implications – Product change – variety – component standardization – product performance – manufacturability.

UNIT - III:

Product Development Management: Establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

Industrial Design: Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – simulating product performance and manufacturing processing electronically – Need for industrial design – impact – design process.

UNIT – IV:

Investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT – V:

Design for Manufacturing and Product Development: Definition – Estimation of manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity. Prototype basics – Principles of prototyping – planning for prototypes – Economics analysis – Understanding and representing tasks – baseline project planning – accelerating the project execution.

TEXT BOOKS:

1. Product Design and Development / Kari T. Ulrich and Steven D. Eppinger / McGraw Hill International Edns. 1999.
2. Concurrent Engg/integrated Product development / Kemnneth Crow / DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310)377-569, Workshop Book.

REFERENCES:

1. Effective Product Design and Development / Stephen Rosenthal / Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.
2. Tool Design–Integrated Methods for Successful Product Engineering / Staurt Pugh / Addsion Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41369-5.
3. Production and Operations Management/Chase/TMH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

OPTIMIZATION TECHNIQUES AND APPLICATIONS (Professional Elective - II)

L	T	P	C
3	0	0	3

Pre-requisites: Operations Research

Course Objectives: The main objectives of the course are: Learn

- Numerical optimization techniques for single variable and multi variable non- linear optimization problems.
- Sensitivity analysis on LPP queuing
- Simulation of annexing problem & inventory problem.
- Geometry cutting plane method & branch bound method for linear IPP.
- Meaning of stochastic programming problem simple problems for finding mean variance of random variables chance constrained algorithm.
- Formulation of GP model and solving it using arithmetic geometric inequality theorem.
- State of art nontraditional optimization technique, namely genetic algorithm simulated annealing & particle swarm optimization.

Course Outcomes: At the end of the course, the student will be able to

- apply appropriate optimization techniques and solve based on the type of optimization problem like single variable or multivariable
- Make sensitivity analysis to study effect of changes in parameters of LPP on the optimal solution without reworking.
- Simulate the system to estimate specified performance measures.
- Solve integer programming problem by either geometry cutting plane algorithm or branch band method.
- Apply chance constrained algorithm and solve stochastic linear programme.
- Formulate GP model and solve it.
- Solve given optimization problem by genetic algorithm or simulated annealing or PSO.

UNIT-I:

Single Variable Non-Linear Unconstrained Optimization: Elimination methods: Uni-Model function-its importance, Fibonacci method & Golden section method. Interpolation methods: Quadratic & Cubic interpolation methods.

UNIT-II:

Multi variable non-linear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hook -Jeeves, Rosenbrock search methods. Gradient methods: Gradient of function& its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT-III:

Linear Programming: Formulation, Simplex method & Artificial variable optimization techniques: Big M & Two-phase methods. Sensitivity analysis: Changes in the objective coefficients, constants&

coefficients of the constraints. Addition of variables, constraints. Simulation – Introduction – Types-steps – applications: inventory & queuing – Advantages and disadvantages.

UNIT-IV:

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

Stochastic Programming: Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

UNIT-V:

Geometric Programming: Posynomials – Arithmetic - Geometric inequality – unconstrained G.P-constrained G.P (≤ type only)

Non-Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing-Working Principle-Simple Problems. Introduction to Particle Swarm Optimization (PSO) (very brief)

TEXT BOOKS:

1. Optimization theory & Applications by S.S.Rao, New Age International.
2. Optimization Methods for Engineers, NVS Raju, PHI Publications

REFERENCE BOOKS:

1. Operations Research by S.D.Sharma.
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI
3. Operation Research by H.A.Taha, TMH
4. Optimization in operations research by R.LRardin
5. Optimization Techniques by Benugundu&Chandraputla, Pearson Asia.
6. Optimization Techniques theory and practice by M.C.Joshi, K.M.Moudgalya, Narosa Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

AUTOMATION IN MANUFACTURING (Professional Elective - II)

L	T	P	C
3	0	0	3

Prerequisites: Production Technology, Machine Tools, Operations Research

Course Objectives:

- Lower Cost and Improve Time-to-Market
- Automation investment life-cycle analysis
- Empowered teams of talented employees
- Partnering with automation suppliers
- On-line process analysis
- Procedural process control
- Information integration and data warehousing

Course Outcomes: Upon completion of this course the student will be able to:

- Illustrate the basic concepts of automation in machine tools.
- Analyze various automated flow lines, Explain assembly systems and line balancing methods.
- Describe the importance of automated material handling and storage systems.
- Interpret the importance of adaptive control systems, automated inspection systems.

UNIT-I:

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

UNIT-II:

Introduction to Material Handling: Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

UNIT -III:

Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

UNIT-IV:

Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

UNIT-V:

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

TEXT BOOKS:

1. Automation, Production systems and computer integrated manufacturing by Mikel P. Groover, Pearson Education.

REFERENCE BOOKS:

1. CAD CAM: Principles, Practice and Manufacturing Management by Chris Mc Mohan, Jimmie Browne, Pearson edu. (LPE)
2. Automation by Buckinghsm W, Haper& Row Publishers, New York, 1961
3. Automation for Productivity by Luke H.D, John Wiley & Sons, New York, 1972.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

ADDITIVE MANUFACTURING (Professional Elective - II)

L	T	P	C
3	0	0	3

Prerequisites: Basics of Manufacturing, Basic knowledge in Calculus, Physics, Thermodynamics, and Chemistry

Course Objectives: The objective of the Course is to study methods used in additive manufacturing, theories governing the additive manufacturing, give information on materials, explain relations between materials to be processed and methods of additive manufacturing with introduction to common machines used for the technology and show applications and business opportunities with future directions.

Course outcomes: At the end of the course, the student will be able to

- Understand the fundamentals for additive manufacturing and how it is different.
- understand about various types of liquid based and solid based AM technologies.
- understand about various types of powder-based, laser based and rapid tooling AM technologies.
- Understand the various types of Pre-processing, processing, post-processing errors in AM. Also to know the various types of data formats and software's used in AM.
- Know the various applications of AM in design analysis, aerospace, automotive, biomedical and other fields.

UNIT–I:
Introduction: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

UNIT–II:
Liquid-based AM Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, 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. Poly jet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Micro fabrication.
Solid-based AM 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. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT–III:
Powder Based AM 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.

Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Electron Beam Melting (EBM): 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: Arc Spray Metal Deposition, Investment 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:

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques.

AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab.

UNIT–V:

AM 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. Web Based Rapid Prototyping Systems

TEXT BOOK:

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

REFERENCE BOOKS:

1. Rapid Manufacturing by D.T. Pham and S.S. Dimov, Springer, 2001.
2. Wholers Report 2000 by Terry Wohlers, Wohlers Associates, 2000.
3. Rapid Prototyping & Engineering Applications by Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

Prerequisite: None

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes: At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT-III:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

REFERENCES:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

MATERIAL TESTING AND CHARACTERIZATION LAB (Lab-I)

L	T	P	C
0	0	4	2

1. Determination of tensile strength of PMC / MMC
2. Determination of flexural strength of PMC/MMC
3. Determination of wear characteristics of PMC / MMC
4. Determination of fracture toughness of MMC using fatigue test
5. Study of fracture surface of different materials tested under UTM, fatigue test
6. Determination of Hardness of PMC/MMC using micro hardness testing machine
7. Determination of thermal conductivity of PMC / MMC
8. Preparation of nano powders using ball mill
9. Determination of water absorption in PMC.
10. Synthesis of a polymer composite
11. Synthesis of a semiconductor nano-particles by chemical method
12. Preparation of metal oxide semiconductor thin film
13. Determination of optical absorption characteristics
14. Electrical transport properties of polymer composite
15. Electrical transport properties of thin film
16. Determination of thermal stability of polymer composite
17. Structural characterization of nano-materials by XRD technique.
18. Evaluation of the performance of material systems using the relationship between structure, properties and processing.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

ADVANCED COMPUTER AIDED DESIGN AND ANALYSIS LAB (Lab - II)

L	T	P	C
0	0	4	2

Note: Conduct any Ten exercises from the list given below:

1. Two- dimensional drawing using CAD software.
2. Three-dimensional drawing using CAD software.
3. Various Dimensioning and tolerancing techniques on typical products using CADsoftware.
4. Assembly and animation of simple assemblies like screw jack, bolt-nut mechanism, etc.
5. Truss analysis using FEA software.
6. Beam analysis using FEA software.
7. Frame analysis using FEA software.
8. Buckling analysis of columns using FEA software.
9. Harmonic analysis using FEA software.
10. Fracture analysis using FEA software.
11. Analysis of laminated composites using FEA software.
12. Couple-field analysis using FEA software.
13. Modal Analysis
14. Transient dynamic analysis.
15. Spectrum analysis.

Note: Conduct any Ten exercises from the list given above

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)

Computer Integrated Manufacturing (Professional Core - III)

L	T	P	C
3	0	0	3

Course Objectives: To make the students
1. To understand the role of computers in manufacturing.
2. To provide an in-depth understanding of manufacturing and data base systems.
3. To provide an understanding of needs of the market and design the product.
4. To design and develop material handling, storage and retrieval systems for specific cases of manufacturing.
5. To develop CIM systems for current manufacturing scenario by using computer and networking tools.

Course Outcomes: At the end of the course, student will be able to
1. Select the necessary computing tools for development of product.
2. Use appropriate database systems for manufacturing a product and store the same for future use.
3. Apply the latest technology of manufacturing systems and software for the development of a product.
4. Use modern manufacturing techniques and tools including principles of networking.
5. Apply the concepts of lean manufacturing and agile manufacturing.

UNIT-I

Basic Concepts of CIM: The meaning of Manufacturing, Types of Manufacturing; CIM Definition, Elements of CIM, CIM wheel, concept or technology, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Fundamentals of Communication: Communications Matrix. Product Development Cycle, Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Framework for integration of Life- cycle phases in CE, Concurrent Engineering Techniques, Integrated Product Development (IPD), Product Life-Cycle Management (PLM), Collaborative Product Development.

UNIT – II

Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete).
Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQLAccess, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

UNIT – III

Product Design: Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly. Computer-Aided Process **Planning:** Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II), Cellular Manufacturing: Design of Cellular **Manufacturing Systems, Cell Formation Approaches:** Machine– Component Group Analysis, Similarity Coefficients-Based Approaches, Evaluation of Cell Design.
Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout; Operational Problems of FMS. FMS benefits

UNIT – IV

Introduction to Networking: Principles of Networking, Network Terminology, types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance.
Frame work for Enterprise-wide Integration.
CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

UNIT – V

Lean Manufacturing: Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing.
Introduction to Agile and Web Based Manufacturing systems.

TEXT BOOKS:

1. Principles of Computer Integrated Manufacturing, S.Kant Vajpayee, Prentice Hall India, 1998.
2. Systems Approach to Computer Integrated Designand Manufacturing, Nanua Singh, John Wiley, 1st edition, 1995.

REFERENCEBOOKS:

1.P.Radhakrishnan, S.Subramanyam: “CAD/CAM/CIM”, New Age International
2. Alavudeen, Venkateshwaran: “Computer Integrated Manufacturing”, Prentice Hall India

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)

MANUFACTURING SYSTEMS: SIMULATION MODELLING AND ANALYSIS
(Professional Core - IV)

L	T	P	C
3	0	0	3

Prerequisites: Operations Research, Optimization Techniques and Applications and Probability Statistics

Course Objectives:

- Learn way of analyzing the systems.
- Classification of systems-based nature of dynamics and knowledge of elements.
- To develop simulation model for dynamic discrete – event stochastic system.
- To run the model and collect the data.
- To analyze the output data of simulation for specified for performance measures bases on type of simulation and method of output data analysis.

Course Outcomes:At the end of course, student should able to

- Define the state of system W.R.T specified performance measures.
- Develop simulation model for the said system
- Generate random variates and learn various simulation languages.
- Analyze through simulation the model and present the results to specified confidence level.
- Apply simulation for flow shop systems and job shop systems..

UNIT - I:

System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1& 2 errors – Framing – strong law of large numbers.

UNIT - II:

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

UNIT - III:

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poison. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.

UNIT - IV:

Output data analysis – Types of Simulation with respect to output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

UNIT –V:

Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – New boy paper problem.

TEXT BOOKS:

1. Simulation Modelling and Analysis by Law, A.M. & Kelton, McGraw Hill, 2nd Edition, New York, 1991.
2. Discrete Event System Simulation by Banks J. & Carson J.S., PH, Englewood Cliffs, NJ, 1984.

REFERENCE BOOKS:

1. Simulation of Manufacturing Systems by Carrie A., Wiley, NY, 1990.
2. A Course in Simulation by Ross, S.M., McMillan, NY, 1990.
3. Simulation Modelling and SIMNET by Taha H.A., PH, Englewood Cliffs, NJ, 1987.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)

MATERIALS TECHNOLOGY (Professional Elective - III)

L	T	P	C
3	0	0	3

Course Objectives:
The objective of this course is to help students in learning the properties of various metallic and non metallic materials and their behaviour. It also provides details of advanced materials.

Course Outcomes: At the end of the course, the student is able to

- understand on elastic, plastic and fractured behaviour of engineering materials.
- Understand toughening mechanisms in steels.
- Understand the concept of fatigue in non metallic materials.
- To do appropriate selection of metallic and non-metallic materials for the various engineering applications.
- Learn different modern metallic and non metallic materials.

UNIT - I:
Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material

UNIT - II:
Griffth's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller parameter, Deformation and Fracture mechanism maps.

UNIT - III:
Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

UNIT - IV:
Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep. Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing, Case studies in Materials Selection with relevance to Aero, Auto, Marine, Machinery and Nuclear Applications.

UNIT - V:
Modern Metallic Materials: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.
Nonmetallic Materials: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering

Polymers, Advanced Structural Ceramics WC, TiC, TaC, $A1_2\ O_3$, SiC, Si_3N_4, CBN and Diamond – properties, Processing and applications.

TEXT BOOKS:

1. Mechanical Behavior of Materials/Thomas H. Courtney/ McGraw Hill/2nd Edition/2000
2. Mechanical Metallurgy/George E. Dicter/McGraw Hill, 1998.

REFERENCES:

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.
2. Engineering Materials Technology/James A Jacob Thomas F Kilduff/Pearson
3. Material Science and Engineering/William D Callister/John Wiley and Sons.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)

QUALITY ENGINEERING IN MANUFACTURING (Professional Elective - III)

L	T	P	C
3	0	0	3

Course Objective:
The course aims at providing the students with the details of importance of quality engineering in terms of tolerance through various mathematical models in ANOVA and orthogonal arrays.

Course Outcomes: At the end of the course, the student is able

- understand the concept of quality engineering in design and production.
- analyze tolerances of different components in various designs.
- perform analysis of variance in different levels.
- perform calculations through orthogonal arrays.
- understand and implement concepts of brain storming, bench marking and fishbone diagram.

UNIT-I:
Quality Value and Engineering: An overall 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 tolerances. (N-type, S-type and L-type)

UNIT-II:
Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type. L-type and S-type 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 F-test, 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 contributor, estimating the mean.

UNIT-V:
ISO-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 *I* G. Taguchi, A. Elsayed et al / McGraw Hill Intl. Edition, 1989**.**
3. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi*I*Prentice Hall md. Pvt. Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)
ADVANCED TOOL DESIGN (Professional Elective - III)

L	T	P	C
3	0	0	3

Prerequisite: Production Technology

Course Objectives:

To teach the students in identifying different types of tools, design, nomenclature and their materials. Students shall also learn dies design for various sheet metal processes.

Course Outcomes: At the end of the course the students will be able to

- Identify standard tool materials and their properties.
- Design cutting tools for different processes.
- Design jigs and fixtures for different machining processes.
- Design dies for sheet metal processes like blanking and piercing.
- Design bending and forming dies for sheet metal working.

UNIT – I: Tool Materials:

Prosperities of materials: Tools steels, Cast Iron, Mild or low carbon steels, Nonmetallic and nonferrous materials, Heat treating

UNIT – II: Design of Cutting Tools:

Single Point cutting tools: Milling cutters, Drills, Selection of carbide steels – Determination of shank size for single point carbide tools, Determining the insert thickness for carbide tools

UNIT – III: Design of Jigs and Fixtures:

Basic principles of location and clamping: Locating methods and devices, Jigs-Definition Types, General considerations in the design of Drill jigs, Drill bushing, Methods of Construction. Fixtures-Vice fixtures, Milling, Boring Lathe Grinding fixtures.

UNIT – IV: Design of Sheet Metal Blanking and Piercing Dies:

Fundamentals of Die cutting operation, Power press types, General press information, Materials Handling equipment. Cutting action in Punch and die operations. Die clearance, Types of Die construction. Die design Fundamentals-Banking and piercing die construction, pilots, stripper and pressure pads presswork material, Strip layout, Short run tooling for piercing.

UNIT – V: Design of Sheet Metal Bending, Forming and Drawing Dies:

Bending dies, drawing dies, forming dies, drawing operations, Variables that effect metal flow during drawing. Determination of blank size, Drawing force, Single, and double action draw dies.

TEXT BOOKS:

1. Donaldson “Tool Design”/ Tata McGraw Hill
2. Production Technology/HMT/Tata McGraw Hill/

REFERENCES:

1. Production Technology by R.K. Jain and S.C. Gupta.
2. Mechanical Metallurgy/ George F Dieter/ Tata McGraw Hill
3. Machine Tools/C Elanchezhian& M. Vijayan/Anuradha Publications
4. Principles of Machine Tools, Bhattacharya A and Sen. G. C. New Central Book Agency.
5. Hand Book of Metal forming/ Kurt Lange/ Mc Graw-Hill,1987.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)

ARTIFICIAL INTELLIGENCE IN MANUFACTURING (Professional Elective - IV)

L	T	P	C
3	0	0	3

Course Objectives: The main objective of this course is to introduce the concepts of Artificial intelligence to students and enable them to apply the concepts in various applications of manufacturing engineering**.**

Course Outcomes: After completion of this course the student will be able to

- Understand concepts of AI and use various problem solving methods
- Understand and describe ANN architecture and apply BPNN.
- Demonstrate image processing using ANN
- Understand and apply various supervised and un supervised learning methods.
- Understand and apply reinforcement learning and ensemble learning techniques

Unit 1: Introduction to Artificial Intelligence and Problem Solving
Definition, History, Present state of Artificial Intelligence (AI), Phases of AI, Approaches to AI - Hard or Strong AI, Soft or Weak AI, Applied AI, Cognitive AI, and Applications domains focused on manufacturing-role of AI in Industrial Revolution 4.0, components, advantages, challenges.
Problem solving methods-1. Uninformed search includes Depth First Search (DFS), Breadth First Search (BFS), Uniform Cost Search (UCS), Depth Limited Search, Iterative Deepening Depth First Search (IDDFS) and bidirectional search. 2. Informed Search (heuristic search) includes greedy best first search, A* search, memory bounded heuristic search, learning to search better, Simple problems

Unit 2: Neural Networks
Introduction to Perceptron and Neural Networks, Activation and Loss functions, Single Neuron of Human and Human Brain Modelling, ANN architecture-Input layer, Hidden layer and output layer, Types of Neural Networks- Single layer feed-forward network, Multilayer feed-forward network, Multi-Layer Perceptron (MLP), Recurrent networks or feedback ANN, Characteristics of Neural Networks, Simple problems on Back Propagation Algorithms to minimize the error

Unit 3: Computer Vision
Introduction to Convolutional Neural Networks (CNNs), What is CNN, Common uses for CNN, CNN's Basic Architecture- LeNet, AlexNet, VGGNet, GoogLeNet, ResNet, Introduction to Images, representation, image extraction, segmentation, analysis, Simple demonstration on Image processing using ANN - Face detection, Finger print recognition etc

Unit 4: Supervised and Unsupervised Learning
Unsupervised learning- Definition, basic concepts, applications, K-means Clustering, hierarchical Clustering, Dimension Reduction-PCA, Simple Examples
Supervised Learning - Definition, basic concepts, applications, Linear Regression, Multiple Variable Linear Regression, Logistic Regression, Naive Bayes Classifiers, k-NN Classification, Support Vector Machine, Simple Examples

Unit 5: Reinforcement Learning and Ensemble Learning Techniques
Reinforcement Learning
Reinforcement Learning (RL) Framework, Component of RL Framework, Types of RL Systems. Q-learning, Simple Examples

Ensemble Learning Techniques
Introduction on ensemble methods, Decision Trees, Bagging, Random Forests, Boostin, Simple Examples

TEXT BOOKS

1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Prentice-Hall, Third Edition (2009)

REFERENCES

1. Artificial Intelligence, Ela Kumar, Wiley , 2021
2. Artificial Intelligence: Concepts and Applications, LavikaGoel, Kindle Edition, Wiley , 2021
3. Nature-Inspired Optimization in Advanced Manufacturing Processes and Systems, Edited by Ganesh M. Kakandikar and Dinesh G. Thakur, CRC press, First edition, 2021.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)
CONCURRENT ENGINEERING (Professional Elective - IV)

L	T	P	C
3	0	0	3

Prerequisites: Computer-Aided Design
Course objective: To provide a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support.

Course Outcomes: At the end of the course, the student will be able to

- Understand the need of concurrent engineering and strategic approaches for product design.
- Apply concurrent design principles to product design.
- Analyze the manufacturing concepts in qualitative and physical approach.
- Design assembly workstation using concepts of simultaneous engineering.
- Understand the concurrent mechanical design and new product development.

UNIT-I:
Introduction: Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development
Use Of Information Technology: IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

UNIT-II:
Design Stage: Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design.
Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

UNIT-III:
Manufacturing Concepts and Analysis: Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative, physical approach - An intelligent design for manufacturing system.

UNIT-IV:
JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.
Project Management: Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost.

UNIT-V:
Concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

TEXT BOOK:
1. Concurrent Engineering: Automation Tools and Technology by Andrew Kusaik, Wiley John and Sons Inc., 1992.

REFERENCE BOOKS:

1. Integrated Product Development by Anderson MM and Hein, L. Berlin, Springer Verlog, 1987.
2. Design for Concurrent Engineering by Cleetus, J.Concurrent Engineering Research Centre, Morgantown W V, 1992.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (AMS)

INDUSTRIAL ROBOTICS (Professional Elective - IV)

L	T	P	C
3	0	0	3

Prerequisites: Kinematics of machinery

Course Objectives:

- To demonstrate knowledge of different types of actuators used in robotic systems.
- To analyze the position and velocity kinematics of a robot arm, implement in 2D.
- To analyze the dynamics of a robot arm, implement in 2D.
- To analyze sensor signals to implement real-time control algorithms.
- To demonstrate knowledge of error propagation in electrical, mechanical and computational systems.
- To construct, program, and test the operation of a robotic system to perform a specified task.

Course Outcomes: After doing this course, the student will be able to,

- Understand the evolution, classification, structures and drives for robots.
- Perform motion analysis through kinematic approach of manipulators.
- Understand robot dynamics and machine vision for robotics.
- Learn and write robot programming languages.
- Expose the students to build a robot for any type of application.

UNIT-I:

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

Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Power Transmission Systems.

UNIT-II:

Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

UNIT-III:

Robot Dynamics: Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators, configuration of robot controller.

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

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, SINGNAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT-V:

Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.

Robot Applications: Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

TEXT BOOKS:

1. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
2. Industrial robotics by Mikell P.Groover, McGraw Hill.

REFERENCE BOOKS:

1. Industrial robotics by Mikell P.Groover, McGraw Hill
2. Robotics by K.S.Fu, McGraw Hill.
3. Introduction to Robotics Mechanics & Control by John J.Craig, Pearson
4. Robot Analysis by Lung Wen Tsai, John Wiley & Sons
5. Robot Analysis and Control by Asada H. and J. E. Slotin, Wiley, New York

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

AUTOMATION LAB (Lab-III)

L	T	P	C
0	0	4	2

Note: Conduct any Ten exercises from the list given below:

1. Draw the circuit diagram to operate single acting pneumatic cylinder using 3/2 push button direction control valve.
2. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 direction control valve using push button momentary switch/push button latch.
3. Draw the circuit diagram to operate single acting pneumatic cylinder using 5/2 air spring valve & PLC.
4. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 air spring valve & PLC.
5. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using push button switch/latch switch.
6. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction.
7. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using PLC.
8. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/3 direction control valve (solenoid control) using PLC.
9. Direct Kinematic Analysis of a Robot.
10. Inverse Kinematic Analysis of a Robot.
11. Trajectory planning of a Robot joint in Space scheme.
12. Palletizing Operation using Robot Programming.
13. Robotic programming using SCARA.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (AMS)

ADVANCED MANUFACTURING PROCESSES & METAL CUTTING LAB (Lab - IV)

L	T	P	C
0	0	4	2

List of Experiments:

1 Study of the morphology of chips produced from different materials sand machining processes.
2 Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
3 Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.
4 Evaluations of tool face temperature with thermocouple method.
5 Roughness of machined surface. Influence of tool geometry and feed rate.
6 Extrusion of cylindrical billets through dies of different included angles and exit diameters and their effect on extrusion pressure.
7. Practice and study of blanking and punching process and their characteristic features on mechanical press with existing dies.
8 Study of operation of tool and cutter grinder, twist drill grinder, Centreless grinder
9 Determination of cutting forces in turning
10 Inspection of parts using tool makers microscope, roughness and form tester
11 Experimental Study of MRR on EDM
12 Experimental Study of TWR on EDM
13 Experimental Study of Surface Roughness on EDM
14 Experimental Study on ECM
15 Experimental Study on 3D Printing

Note: Conduct any Ten exercises from the list given above

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. II Year I Sem. (AMS)

PRODUCTION AND OPERATIONS MANAGEMENT (Professional Elective - V)

L	T	P	C
3	0	0	3

Prerequisites: Operations Research, Production Planning and Control

Course Objectives:

This course explores a wide variety of concepts such as product design, process design, aggregate planning, MRP and PERT which are important for production and operations management to make better decisions in terms of manufacturing management, supply chain management and inventory control.

Course Outcomes: At the end of the course, the student is able to

- Understand the importance of production and operations management, for getting the Competitive edge.
- Do value analysis for a given product and design the plant layout for the specified production system.
- Implement aggregate planning and MRP.
- Understand the importance of Work study and scheduling.
- apply the project management techniques.

UNIT- I:

Overview of Production & Operations Management (POM): Introduction-Definition-Importance-Historical Development of POM-POM scenario today

Product & Process design: Role of product development- Product development process-Tools for efficient product development (briefly) - Determination of process characteristics- Types of processes and operations systems- Continuous –Intermittent-Technology issues in process design- Flexible Manufacturing Systems- Automated Material Handling Systems

UNIT –II:

Value Analysis: Definition-Objectives-Types of Values-Phases- Tools -FAST diagram-Steps-Advantages-Matrix method-Steps.

Plant Location& Plant layout: Factors affecting locations decisions-Location planning methods-Location factor rating -Centre of Gravity method-Load distance method. Plant layout- Definition-Objectives-Types of layouts-Design of product layout-Line balance-Terminology-RPW method.

UNIT- III:

Aggregate Planning: Definition- Objectives-Basic strategies for aggregate production planning-Aggregate production planning method-Transportation model- Master Production Scheduling.

Material Requirement Planning: Terminology-Logic-Lot sizing methods-Advantages & Limitations

UNIT – IV:

Work Study: Work study: method study –definition-objectives-steps-Charts used- Work measurement-Time study- Definition-steps- Determination of standard time- Performance rating-Allowances. Work sampling- steps- comparison with time study.

Quality Management: Economics of quality assurance-Control charts for variables and for attributes –Acceptance sampling plans-Total Quality Management-ISO 9000 series standards-Six sigma

UNIT – V:

Scheduling: Need-basis for scheduling- Scheduling rules- Flow shop & Job shop scheduling. Line of Balance. **Project management:** PERT- Critical path determination- Probability of completing project in a given time- CPM- Types of floats- Critical path determination- Crashing of simple networks- Optimum project schedule.

TEXT BOOKS:

1. Operations Management for Competitive Advantages- Chase Aquinano-TMH, 2009
2. Operations Management: Theory and Practice: B.Mahadevan Pearson.
3. Industrial Engineering and Mangement: Dr.Ravi Shankar- Galgotia.

REFERENCES:

1. Modern Production and Operations Managemet: Buffa, Wiley
2. Theory and Problems in Production and Operations Managemet: SN Chary TMH.
3. Operations Management 8e Process and Value Chains: Lee Krajewskiet. all Pearson

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. II Year I Sem. (AMS)

Micro Electro Mechanical Systems (MEMS)
(Professional Elective - V)

L	T	P	C
3	0	0	3

Prerequisites: Electronic Circuits, Basic knowledge in material science

Course Objectives:

- To make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- To design, analysis, fabrication and testing the MEMS based components.
- To introduce the students various opportunities in the emerging field of MEMS.
-

Course Outcomes: At the end of the course, the student will be able to

- Design and analyze methods and tools for micro and nano manufacturing.
- Understand the importance of engineering science for design and fabrication of Microsystems.
- Improve the quality of MEMS by analyzing the variables of the underlying micro and nano manufacturing method
- Apply the concepts of thermo fluid engineering in MEMS.
- Select appropriate industrially-viable process, equipment and tools for a specific product.

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 fluidics

UNIT-II:

Engineering Science for Microsystems Design and Fabrication: Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, 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, Thermomechanics, 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 Micro 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 Piezo resistors, 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.

TEXT BOOKS:

1. Tia-Ran Hsu, MEMS & Microsystems. Design & Manufacturing, TMH 2002
2. Foundation of MEMS/ Chang Liu/Pearson, 2012

REFERENCE BOOKS:

1. An Introduction to Microelectromechanical Systems Engineering by Maluf M., Artech House, Boston 2000
2. Micro robots and Micromechanical Systems by Trimmer, W.S.N., Sensors & Actuators, Vol. 19, 1989.
3. Applied Partial Differential Equations by Trim, D.W., PWS-Kent Publishing, Boston, 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. II Year I Sem. (AMS)

FLEXIBLE MANUFACTURING SYSTEMS (Professional Elective - V)

L	T	P	C
3	0	0	3

Prerequisites: Machine Tools, Basics of Industrial Engineering

Course Objectives:

- To Understand the role of Flexible Manufacturing Systems (FMS) in manufacturing
- To Understand the concept of Group Technology
- To Understand the concept of Cellular Mfg Systems
- To Understand logic control and associated technologies

Course Outcomes: At the end of the course, the student will be able to

- Develop FMS using the most appropriate technique.
- Classify FMS layout
- Implement FMS concept in a manufacturing environment
- Identify the difference between Group Technology and Cellular Manufacturing
- Design and simulate FMS models.

UNIT-I:

Understanding of FMS: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type

UNIT-II:

Classification of FMS Layout: Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc.

UNIT-III:

Processing stations: Salient features Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/Deburring station

UNIT-IV:

Material Handling System: An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS) Management technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS

UNIT-V:

Design of FMS: Performance Evaluation of FMS, Analytical model and Simulation model of FMS Case studies: Typical FMS problems from research papers

TEXT BOOKS:

1. Flexible Manufacturing Cells and System by William W Luggen, Prentice Hall of Inc New Jersey, 1991
2. Flexible Manufacturing system by Reza A Maleki, Prentice Hall of Inc New Jersey, 1991
3. Flexible Manufacturing by John E Lenz, marcel Dekker Inc New York, 1989.

REFERENCE BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing byGroover, M.P, Prentice Hall.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. II Year I Sem. (AMS)

Business Analytics
OPEN ELECTIVE

L	T	P	C
3	0	0	3

Prerequisite: None

Course objectives:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes: At the end of the course, students willbe able to

- demonstrate knowledge of data analytics.
- demonstrate the ability of think critically in making decisions based on data and deep analytics.
- demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- demonstrate the ability to translate data into clear, actionable insights.

UNIT- I:
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT- II:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT- III:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining

Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT- IV:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting.

Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT- V:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making. Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH. II Year I Sem. (AMS)

Open Elective

Waste to Energy

L	T	P	C
3	0	0	3

Prerequisites: An introductory knowledge of solid and hazardous waste along with some basic understanding of solid waste management at industries

Course Objectives: To prepare the students for successful career in the energy industry, energy service companies, energy utility and consultancy agencies and in the academic and R&D institutions.
To produce graduates strong in understanding on energy resources, technologies and systems, energy management fundamentals, and capable in innovative technological intervention towards the present and potential future energy issues.
To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns, and who can apply their specialized knowledge for the sustainable development.

Course Outcomes: Understood and acquired fundamental knowledge on the science and engineering of energy technologies and systems. Acquired the expertise and skills required for energy auditing and management, economical calculation of energy cost, development, implementation, maintenance of energy systems. Become capable of analysis and design of energy conversion systems. Acquired skills in the scientific and technological communications and project preparation, planning and implementation of energy project

UNIT-I:
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste – MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal- Methods – Yields and application- Manufacture of pyrolytic oils and gases, yields and applications. Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and updraft gasifiers- Fluidized bed gasifiers- Design, construction and operation- Gasifiers burner arrangement for thermal heating Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-III:
Biomass Combustion: Biomass stoves- Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, Inclined grate combustors, Fluidized bed combustors, Design, construction and operation- Operation of all the above biomass combustors.

UNIT-IV:
Biogas: Properties of biogas (Calorific value and composition)- Biogas plant technology and status- Bio energy system – Design and constructional features- Biomass resources and their classification- Biomass Conversion Process

UNIT-V:

Thermo chemical conversion – Direct combustion – biomass gasification- pyroloysis and liquefaction- biochemical conversion- anerobic digestion- Types of biogas Plants- Applications Alcohol production from biomass- Bio diesel production- Urban waste to energy conversion Biomass energy programme in India

Text Books:

1. Non Conversional Energy by Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology – A Practical Hand Book by Khandelwal, K.C and Mahdi, S.S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd, 1983.

Reference Books:

1. Food, Feed and Fuel from Biomass by Challal, D.S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology by C.Y. WereKo- Brobby and E.B. Hagan, John Wiley & Sons, 1996.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH. II Year I Sem. (AMS)

Open Elective

PRINCIPLES OF AUTOMATION (OpenElective)

L	T	P	C
3	0	0	3

UNIT- I:

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

UNIT- II:

Introduction to Material Handling, Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

UNIT – III:

Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

UNIT- IV:

Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

UNIT- V:

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

REFERENCE BOOKS:

1. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
2. Automation, Buckinghsm W, / Haper & Row Publishers, New York, 1961
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH. II Year I Sem. (AMS)

Open Elective

ARTIFICIAL NEURAL NETWORKS (Open Elective)

L	T	P	C
3	0	0	3

Course Objectives: Objectives of this course are

- To introduce the basics of Neural Networks and its architectures.
- To introduce the Fuzzy sets and Fuzzy Logic system components
- To deal with the applications of Neural Networks and Fuzzy systems

Course Outcomes: After this course, the student

- To understand artificial neural network models and their training algorithms
- To understand the concept of fuzzy logic system components, fuzzification and defuzzification
- Applies the above concepts to real-world problems and applications.

UNIT – I:

Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT – II:

Feed Forward Neural Networks: Single Layer Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

Multilayer Feed forward Neural Networks: Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT – III:

Associative Memories: Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory).

Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem.

Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

UNIT – IV:

Classical and Fuzzy Sets: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT – V:

Fuzzy Logic System: Fuzzification, Membership value assignment, development of rule base and decision-making system, Defuzzification to crisp sets, Defuzzification methods.

TEXT BOOKS:

1. Rajasekharan and Pai, Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications– PHI Publication.
2. Satish Kumar, Neural Networks, TMH, 2004.

REFERENCE BOOKS:

1. James A Freeman and Davis Skapura, Neural Networks, Pearson Education, 2002.
2. Simon Hakins, Neural Networks, Pearson Education.
3. C. Eliasmith and Ch. Anderson, Neural Engineering, PHI.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:
Clarifying Who Did What, Highlighting Your Findings, Hedging and criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, the final check.

UNIT-IV:
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-VI:
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

DISASTER MANAGEMENT (Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:

Introduction:

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II:

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, L and slides **a**nd Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-IV:

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V:

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT-VI:

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends inMitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXT BOOKS/ REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)", Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L, Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

VALUE EDUCATION (Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-V:

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS/ REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

CONSTITUTION OF INDIA (Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

UNIT-II:
Philosophy of the Indian Constitution: Preamble**,** Salient Features

UNIT-III:
Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

UNIT-IV:
Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V:
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayatiraj:

Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-VI:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

PEDAGOGY STUDIES (Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:
Definitions of Eight parts of yog. (Ashtanga)

UNIT-II:
Yam and Niyam.

UNIT-III:
Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

UNIT-V:
i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (AMS)

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - I & II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.