## LIST OF OPEN ELECTIVES OFFERED FOR R19 M.TECH PROGRAMMES

<table>
<tr><th colspan="8">DEPARTMENT OF CIVIL ENGINEERING</th></tr>
<tr><th colspan="2">Structural Engineering/ Geotechnical Engineering</th><th colspan="2">Environmental Engineering</th><th colspan="2">Highway Engineering</th><th colspan="2">Transportation Engineering</th></tr>
<tr><td colspan="2">1. Numerical methods<br>2. Construction Management<br>3. Finite Element Methods<br>4. Artificial Intelligence: Techniques<br>5. Operation Research<br>6. Industrial Safety</td><td colspan="2">1. Environmental Legislation & Audit</td><td colspan="2">1. GIS & IoT For Planning & Policy Making for Smart Cities/Urban Areas<br>2. Disaster Management</td><td colspan="2">1. Disaster Analytics<br>2. GIS & IoT For Planning & Policy Making for Smart Cities/Urban Areas</td></tr>
<tr><th colspan="8">DEPARTMENT OF MECHANICAL ENGINEERING</th></tr>
<tr><th>Advanced Manufacturing Systems</th><th>CAD/CAM</th><th>Design for Manufacturing/Design & Manufacturing</th><th>Engineering Design</th><th>Machine Design</th><th>Mechatronics</th><th>Production Engineering</th><th>Thermal Engineering</th></tr>
<tr><td>1. Principles of Automation<br>2. Artificial Neural Networks<br>3. Fundamentals of Nano Technology</td><td>1. Concurrent Engineering<br>2. Industrial Safety<br>3. Principles of Automation</td><td>1. Principles of Manufacturing Engineering<br>2. Artificial Neural Networks<br>3. Fundamentals of Nano Technology</td><td>1. Mechanics of Composite Materials<br>2. Industrial Safety<br>3. Waste to Energy</td><td>1. Concurrent Engineering<br>2. Industrial Safety<br>3. Principles of Automation</td><td>1. Entrepreneurship<br>2. Optimization Techniques & Applications<br>3. Advanced Finite Element and Boundary Element Methods</td><td>1. Fundamentals of Production Engineering<br>2. Non-Destructive Testing & Evaluation<br>3. Particulate Materials Technology</td><td>1. Basics of Refrigeration Systems<br>2. Introduction to Thermal Storage Systems<br>3. Cogeneration & Waste Heat Recovery Systems</td></tr>
<tr><th colspan="8">DEPARTMENT OF CSE/EEE/ECE and Allied Branches</th></tr>
<tr><td colspan="8">1. Business Analytics<br>2. Industrial Safety<br>3. Operations Research<br>4. Cost Management of Engineering Projects<br>5. Composite Materials<br>6. Energy from Waste</td></tr>
</table>

***Important: *Open Elective subject must be chosen from the list of open electives offered by OTHER departments.**

**Ex: A M.Tech ECE student cannot take Open Elective – II offered by ECE Dept, but can select from open electives offered by OTHER departments.**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER STRUCTURAL ENGINEERING / GEOTECHNICAL ENGINEERING**

## NUMERICAL METHODS (Open Elective)

**Course Objectives:**

- To impart the basic concepts of mathematical modeling of problems in science and engineering
- To learn procedures for solving different kinds of problems.
- To understand the various numerical techniques which provide solutions to non-linear equations, partial differential equations etc that describe the mathematical models of problems.

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

- Know the approximations in any calculations and solutions to equations
- Solve simultaneous equations using matrix methods
- Calculate differentiation and integration problems using numerical methods
- Solve ordinary and partial differential equations

**UNIT- I**

**Approximations and Errors in Numerical Methods**; Solutions of Algebraic and Transcendental Equations, Bisection, False Position, Secant & Iterative Methods, Newton-Raphson, Horner's Methods; Comparison of Iterative Methods.

**UNIT- II**

**Simultaneous Linear Algebraic Equations** – methods of solution using inverse of the matrix, method of successive elimination, Iterative methods – Gauss-Siedel method, Relaxation method; Applications.

**UNIT- III**

**Matrix Inversion and Eigen value Problems** – Power, Jacobi Methods; Calculus of Finite Differences – Differences, Difference Formulae, Difference Table, Factorial Notation; Interpolation – Lagrange's, Newton's, Hermite's, Spline, Inverse Interpolation; Applications.

**UNIT- IV**

**Numerical Differentiation** – Derivatives, Maxima and Minima of a Tabulated Function; Numerical Integration – Quadrature, Romberg's, Euler-Maclaurin, Double Integration; Applications.

**UNIT- V**

**Numerical Solution of Ordinary Differential Equations** - Modified Euler's, Runge-Kutta's, Predictor-Corrector, Milne's Methods; Partial Differential Equations - Finite Difference Approximations, Elliptic, Laplace, Parabolic, Hyperbolic Equations; Applications.

**REFERENCE BOOKS:**

1. Grewal, B. S. - Numerical Methods in Engineering & Science, Khanna Publishers, 1999
2. Indian culture values and professional ethics by PSR Murthy, BS Publications
3. Chapra, S. C. & Canade, R. P. - Numerical Methods for Engineers, McGraw Hill publications, 2011
4. by Joe D Hoffman, Hoffman D Hoffman, Steven Frankel, Numerical Methods For Engineers and Scientists Second Edition, 2001
5. Ethics in Engineering, Mike W.Martin & Roland Schinzinger. TMH Publishers

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER STRUCTURAL ENGINEERING/ GEOTECHNICAL ENGINEERING**
**CONSTRUCTION MANAGEMENT (Open Elective)**

**Course Objectives:**

- To know about the various Construction Management Techniques available for execution of project.
- To understand Resource planning, different types of contract.
- To learn the occupational and safety Hazard Assessment.

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

- Plan, coordinate and control of project from beginning to completion.
- Distinguish different types of contracts that can be used for a project
- Adopt the most effect method for meeting the requirement in order to produce a functionally and financially viable project.

**UNIT -I**

**Management process**- Roles. Management theories. Social responsibilities. Planning and strategic management. Strategy implementation. Decision making: tools and techniques – Organizational structure. Human resource management- motivation performance- leadership.

**UNIT-II**

**Classification of Construction projects**, Construction stages, Resources- Functions of Construction Management and its Applications. Preliminary Planning-Collection of Data-Contract Planning – Scientific Methods of Management: Network Techniques in construction management - Bar chart, Gant chart, CPM, PERT- Cost & Time optimization.

**UNIT-III**

**Resource planning** - planning for manpower, materials, costs, equipment. Labour-Scheduling. Forms of scheduling - Resource allocation. Budget and budgetary control methods

**UNIT-IV**

**Contract** - types of contract, contract document, and specification, important conditions of contract – tender and tender document - Deposits by the contractor - Arbitration. Negotiation - M.Book - Muster roll -stores.

**UNIT-V**

**Management Information System** - Labour Regulations: Social Security - welfare Legislation - Laws relating to Wages, Bonus and Industrial disputes, Labour Administration - Insurance and Safety Regulations - Workmen's Compensation Act -other labour Laws - Safety in construction: legal and financial aspects of accidents in construction. occupational and safety hazard assessment. Human factors in safety. Legal and financial aspects of accidents in construction. Occupational and safety hazard assessment

**REFERENCE BOOKS:**

1. Ghalot, P.S., Dhir, D.M., Construction Planning and Management, Wiley Eastern Limited 1992.
2. Chitkara, K.K., Construction Project Management¸ Tata McGraw Hill Publishing Co, Ltd., New Delhi 998.
3. Punmia, B, C., Project Planning and Control with PERT and CPM, Laxmi Publications, New Delhi, 1987.
4. Sengupta, B. & Guha, H, Construction Management And Planning by: Tata McGraw-hill publications.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER STRUCTURAL ENGINEERING/ GEOTECHNICAL ENGINEERING**

## FINITE ELEMENT METHODS (Open Elective)

**Course Objectives:** This course will enable students to

- Understand in general how finite elements obtain approximate solutions to differential equations
- Appreciate the structure of a typical finite element program
- Gain experience of finite element analysis applied to classical geotechnical problems (e.g. settlement, seepage, consolidation, slope stability)
- Gain insight into the soil properties needed for finite element analysis

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

- To understand the fundamental theory of the Finite Element Method
- To apply the Finite Element theory to solve soil behavior under external loads.

**UNIT-I**

**Introduction:** Concepts of FEM, Steps involved in Finite Element Analysis Procedure, Merits and Demerits. Principles of Elasticity: Stress equations, Strain-Displacement relationships in matrix form, Plane stress, Plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

**UNIT-II**

**Element Properties**: Concept of an element, various element shapes, Displacement models, generalized coordinates, Shape functions, Convergent and Compatibility requirements, Geometric invariance, Natural coordinate system - area and volume coordinates.

**UNIT-III**

**Generation of Element Stiffness and Nodal Load Matrices, Isoparametric Formulation**: Concept, Different isoparametric elements for 2D analysis, formulation of 4-noded and 8-noded isoparametric quadrilateral elements, Lagrangian elements, Serendipity elements.

**UNIT-IV**

**Assemblage of Elements:** Discretization of a structure, numbering systems, Aspect ratio its effects, Assemblage, Direct Stiffness method.

**UNIT-V**

**Geotechnical Applications** Sequential construction, Excavations and embankments, Bearing capacity and Settlement analysis.

**REFERENCE BOOKS:**

1. Desai, C. S. and J.F, Abel, Introduction to the Finite Element Method, Van Nostrand Reinhold Company (1972).
2. Reddy, J. N. - Introduction to the Finite Element Method - McGraw-Hill Publishers, 1993.
3. Krishna Murthy, C. S. - Finite element analysis - Theory and programming, Tata McGraw-Hill,1994
4. Zienkiewicz, O. C. - Finite element Methods, McGraw-Hill Publishers, 1971.
5. Tirupati & Belgundu

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER STRUCTURAL ENGINEERING/ GEOTECHNICAL ENGINEERING**

## ARTIFICIAL INTELLIGENCE: TECHNIQUES (Open Elective)

**Course Objectives:**

- To study the Neural network characteristics, development of neural network principles.
- To Learn neural network models, types of learning, supervised, unsupervised, reinforced learning etc.
- To study Recurrent back propagation, introduction to counter propagation networks
- To study the concepts of Fuzzy logic, Applications in water resource engineering.

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

- Asses the applicability, strengths and weakness of problems and methods for particular engineering problem.
- Develop intelligent system for particular problem.
- Understand the concepts of Fuzzy logic, Applications in water resource engineering.

**UNIT-I**

**Introduction to Neural Networks:** ANN definition, components, input, output and hidden layers, threshold value, weights. Relationship of ANN with other technologies.

**UNIT-II**

**Neural Networks Models:** Perceptron model, Feedforward network-back propagation, Hopfeild network, Adaline and Madaline models.

**UNIT-III**

**Learning and Training:** Objective of learning, Supervised and Unsupervised learning, Hebb's rule, Delta Rule.

**UNIT-IV**

**Fuzzy Logic:** Crispness, Uncertainty, Vagueness, Fuzzyness, Fuzzy sets, Fuzzy Relations, Fuzzy association memory, Fuzzy events, Means, Variances.

**UNIT-V**

**Applications in Water Resources:** Applications of fuzzy logic in neural networks, Applications of fuzzy logic and neural networks in water resources engineering with case studies.

**REFERENCE BOOKS:**

1. Neural Networks and Fuzzy Systems by Bart. Kosko, prentice hall of India, 1994.
2. Artificial Neural Networks by Robert J. Schalokoff.
3. Fuzzy sets Uncertainty an information by George. J. Klir and Tina, Prentice Hall of India, New Delhi.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER STRUCTURAL ENGINEERING/ GEOTECHNICAL ENGINEERING**

## OPERATION RESEARCH (Open Elective)

**Course Objectives:**

- Aims to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.
- To introduce Decision and Game Theory concepts for scientific study of strategic decision making.

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

- Apply the dynamic programming to solve problems of discreet and continuous variables.
- Apply the concept of non-linear programming
- Carry out sensitivity analysis
- Model the real-world problem and simulate it.

**UNIT-I**

**Optimization Techniques**, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**UNIT-II**

**Formulation of a LPP** - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

**UNIT-III**

**Nonlinear programming problem** - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

**UNIT-IV**

**Scheduling and sequencing** - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**UNIT-V**

**Competitive Models**, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**REFERENCE BOOKS:**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008 4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER STRUCTURAL ENGINEERING/ GEOTECHNICAL ENGINEERING**

## INDUSTRIAL SAFETY (Open Elective)

**Course Objectives:**

- To provide information regarding different elements of industrial water pollution and Methods of treatment.
- To expose to the various industrial applications, maintenance, preventive measures taken against wear and tear.

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

- Know how to take safety measures in executing works
- Identify the need for maintenance (or) replacement of equipment
- Understand the need for periodic and preventive maintenance

**UNIT-I**

**Industrial safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

**UNIT-II**

**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**UNIT-III**

**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications,

i. Screw down grease cup,
ii. Pressure grease gun,
iii. Splash lubrication,
iv. Gravity lubrication,
v. Wick feed lubrication
vi. Side feed lubrication,
vii. Ring lubrication,

Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**UNIT-IV**

**Fault tracing: Fault tracing-concept and importance**, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like,

i. Any one machine tool,
ii. Pump
iii. Air compressor
iv. Internal combustion engine,
v. Boiler,
vi. Electrical motors, Types of faults in machine tools and their general causes.

**UNIT-V**

**Periodic and preventive maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:

i. Machine tools,
ii. Pumps,
iii. Air compressors,
iv. Diesel generating (DG) sets,

Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance

**REFERENCE BOOKS:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. Tech – II Year – I Sem. (Env. Engg.)**

## ENVIRONMENTAL LEGISLATION AND AUDIT (Open Elective)

**UNIT- I**

Common Environmental Laws - Role of Judiciary in Environmental Protection - Criminal Law, Common Law - Criminal Procedure Code - Indian Penal Code - Fundamental Rights and Fundamental Duties - International and National Efforts at Environmental Protection - Green Funding and Taxes - National Environmental Policies

**UNIT-II**

Framework for Environmental Impact Assessment - Pollution Control Acts for Water and Air Pollution - Water Prevention and Control of Pollution) Act, 1974- Water (Prevention and Control of Pollution) Cess Act, 1977 - Air (Prevention & Control of Pollution) Act, 1981 - Other Environmental Protection Acts

**UNIT-III**

Environmental (Protection) Act, 1986 - Forest Conservation Act, 1980 - National Forest Policy 1988 - Wild Life (Protection) Act, 1972 - Public Insurance & Liabilities Act, 1991- Biomedical Wastes (Management and Handling), Noise Pollution, Eco Labelling, EIA Coastal Zone Notification (1991)

**UNIT-IV**

International Laws - Stockholm Conference - The Rio Earth Summit, 1992 - Montreal Protocol - Kyoto Summit, 1997 - Nairobi Declaration - World Summit on Sustainable Development, 2002

**UNIT-V**

Role of UN Authorities in Protection of Global Environment - Global Environmental issues and international Laws: to Control Global Warming, Ozone Depletion, Acid Rains, Hazardous Waste - Sustainable Developments and Environmental Movements - Sustainable Development Principles - Indicators of Sustainability - Sustainable Development Models - National and International Sustainable Development Scenarios (POP)

**TEXT BOOKS/REFERENCE BOOKS:**

1. S. Divan and A. Roseneranz, Environmental law and policy in India, Oxford University Press, New Delhi, 2001.
2. R. K. Sapru, Environmental Management in India Vol. I & II): Ashish Publishing House, 2004.
3. Gupta, K.R., Environmental Legislation of India, Atlantic Publishers, 2006.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER (HIGHWAY ENGINEERING)**

**GIS & IOT FOR PLANNING & POLICY MAKING FOR SMART CITIES/URBAN AREAS**
**(Open Elective)**

**Prerequisites:** Nil
**Course Objectives:**

- Introduction and vision of IoT.
- Use of IoT for smart cities along with GIS.
- Various levels of IoT and its advantages.

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

- The importance of National and International policies for smart cities
- Applications of with GIS for urban cities.
- Applications of IoT for smart cities
- The concepts of GIS and IoT at analytics level.
- Applications of IoT and GIS to reduce congestion and pollution in urban cities.

**UNIT - I**
**Smart Cities:** Urban cities-development, Transportation polices, Smart City configurations with reference to land use and Infrastructure, international policies on Urban cities development, National policies, Problems in urban areas of developing countries and developed countries**.**

**UNIT - II**
**GIS for Urban Cities:** GIS- types of architectures-features for spatial planning and spectral planning, application of GIS for time and space-based planning, GIS for land use, GIS for infrastructure and supportive infrastructure in design and planning.

**UNIT - III**
**IOT for Smart Cities:** Introduction, communication systems, Local server design for data transfer, central sever design for data analytics, sensor and communication system to address various problems in urban cities.

**UNIT - IV**
**GIS and IOT at analytics level:** GIS for spatial analytics, IOT for spectral characteristics of urban problem in reference to pollution, security, congestion, accident risk and urban floods - different versions and features of open source GIS.

**UNIT - V**
**Applications of IOT & GIS:** Urban Congestion and Mapping, pollution of water and air and measuring, risk of travel and advanced alert systems, urban floods and technology interface, 3rd dimension mapping and IOT interface, supportive infrastructure and smart city conversions. Case studies on World class cities.

**REFERENCE BOOKS:**

1. Lo, C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2002.
2. Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
3. Vijay Madisetti and Ashdeep banga “Internet of Things (a handson approach) 1st edn, VPT, 2014
4. Jan holter, Vlasios Tsiatsis Catherine mulligan, david boyle “From machine to machine to the Internet of things. Introduction to new age. Intelligence, 1st edition, academic press, 2014

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER (HIGHWAY ENGINEERING)**
**DISASTER MANAGEMENT (Open Elective)**

**Prerequisites:** Nil
**Course Objectives:**

- 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.
**Disaster Prone Areas in India:** Study of Seismic Zones; Areas prone to Floods and Droughts, Landslides and Avalanches; Areas prone to Cyclonic and Coastal Hazards with special reference to Tsunami; Post-Disaster Diseases and Epidemics

**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 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 - IV**
**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 - V**
**Disaster Mitigation:** Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

**REFERENCE BOOKS:**

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.- II YEAR- I SEMESTER (TRANSPORTATION ENGINEERING)**

## DISASTER ANALYTICS (Open Elective)

**Prerequisites:** Nil

**Course Objectives:**

- The various disasters and the factors contributing to disaster
- Modeling and simulation technique to be applied

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

- Understand the various disasters and their impact
- Understand the urban policies related to disaster
- Find methods to monitor disasters
- Understand ways to quantify and plan infrastructure
- Understand the concepts of Mapping and measuring disasters

**UNIT - I**

**Disaster Introduction:** Disasters-types – Man made & Natural disasters- causes and factors contributing to disasters, Impacts of disasters.

**UNIT - II**

**Disaster – Polices:** Policy on infrastructure to counter disasters, policy on safety at common areas, policy on water floods and on urban areas policy with reference to environment emissions in industrial areas.

**UNIT - III**

**Disaster-Technology Interface:** Mapping of disasters, sensor technologies to monitor disasters, Power resilient system during disasters of natural, monitoring mechanism on disasters generating from air, water and traffic.

**UNIT - IV**

**Disasters –simulations and communication:** Problem defining on disasters, IOT based communication to monitor certain disaster, Modeling to quantify disaster, simulation of disaster for infrastructure plan.

**UNIT - V**

**Case examples on disasters:** Mapping and measuring of flood as disaster. Road accidents and its impact on society, pollution in urban cities, congestion pricing and its impact on economy.

**REFERENCE BOOKS:**

1. Coppola DP, 2007 Introduction to International Disaster Management, Elsevier Science (B/4) London.
2. Manual on Natural Disaster Management in India, MC Gupta NIDM, New Delhi.
3. Disaster Management act 2005, Published by Govt of India.
4. R.B. Singh (Ed) Disasters Management, Universities press, India 2003.
5. R.K. Bandari – An overview on Natural and Man-Made Disaster & their Reduction, CSIR, New Delhi

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH.- II YEAR- I SEMESTER (TRANSPORTATION ENGINEERING)**

## GIS & IOT FOR PLANNING AND POLICY MAKING FOR SMART CITIES/URBAN AREAS (Open Elective)

**Prerequisites:** Nil

**Course Objectives:**

- Introduction and vision of IOT.
- Use of IOT for smart cities along with GIS.
- Various levels of IOT and its advantages.

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

- The importance of National and International policies for smart cities
- Applications of with GIS for urban cities.
- Applications of Iot for smart cities
- The concepts of GIS and Iot at analytics level.
- Applications of Iot and GIS to reduce congestion and pollution in urban cities.

**UNIT - I**

**Smart Cities:** Urban cities-development, Transportation polices, Smart City configurations with reference to land use and Infrastructure, international policies on Urban cities development, National policies, Problems in urban areas of developing countries and developed countries.

**UNIT - II**

**GIS for Urban Cities:** GIS- types of architectures-features for spatial planning and spectral planning, application of GIS for time and space-based planning, GIS for land use, GIS for infrastructure and supportive infrastructure in design and planning.

**UNIT - III**

**IOT for Smart Cities:** Introduction, communication systems, Local server design for data transfer, central sever design for data analytics, sensor and communication system to address various problems in urban cities.

**UNIT - IV**

**GIS and IOT at analytics level:** GIS for spatial analytics, IOT for spectral characteristics of urban problem in reference to pollution, security, congestion, accident risk and urban floods - different versions and features of open source GIS.

**UNIT - V**

**Applications of IOT & GIS:** Urban Congestion and Mapping, pollution of water and air and measuring, risk of travel and advanced alert systems, urban floods and technology interface, 3rd dimension mapping and IOT interface, supportive infrastructure and smart city conversions. Case studies on World class cities.

**REFERENCE BOOKS:**

1. Lo, C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2002.
2. Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
3. Vijay Madisetti and Ashdeep banga “Internet of Things (a hands-on approach) 1st edn, VPT, 2014
4. Jan holter, Vlasios Tsiatsis Catherine mulligan, david boyle “From machine to machine to the Internet of things. Introduction to new age. Intelligence, 1st edition, academic press, 2014

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (ADVANCED MANUFACTURING SYSTEMS)**

**PRINCIPLES OF AUTOMATION (Open Elective)**

**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. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/ Pearson Education.
2. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
3. Automation, Buckinghsm W, / Haper & Row Publishers, New York, 1961
4. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (ADVANCED MANUFACTURING SYSTEMS)**

**ARTIFICIAL NEURAL NETWORKS (Open Elective)**

**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. II Year I Sem. (ADVANCED MANUFACTURING SYSTEMS)**

## FUNDAMENTALS OF NANO TECHNOLOGY (Open Elective)

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

- To understand the evolution of Nano systems, and various fabrication techniques.
- Learn about nano materials and various nano measurements techniques.

**UNIT- I:**

**Over View of Nanotechnology:** Definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

**UNIT –II:**

**Nanodefects, Nano Partiles and Nanolayers**: Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties

**UNIT- III:**

**Nanostructuring:** Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishign of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends

**UNIT- IV:**

**Science and Synthesis of Nano Materials:** Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source-based production techniques – Gaseous carbon source-based production techniques – Diamond like carbon coating. Top down and bottom up processes

**UNIT –V:**

**Characterization of Nano Materials:** Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

**TEXT BOOKS:**

1. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Fahrner W.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Mark Madou, Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003.

**REFERENCE BOOKS:**

1. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN: 8493-9138-5.

2. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc., 2013, ISBN: 978-93-82291-39-8 29.
3. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN: 470-85106-6.
4. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003.
5. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (CAD/CAM)**

## CONCURRENT ENGINEERING (Open Elective)

**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:**

- Understand the need of concurrent engineering and strategic approaches for product design.
- Apply concurrent design principles to product design.
- Design assembly workstation using concepts of simultaneous engineering.
- Design automated fabricated systems – Case studies.

**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 Verlag, 1987.
2. Design for Concurrent Engineering by Cleetus, J. Concurrent Engineering Research Centre, Morgantown W V, 1992.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (CAD/CAM)**

## INDUSTRIAL SAFETY (Open Elective)

**UNIT – I:**
Safety Philosophy and principles of Accident prevention Introduction, accident, injury, unsafe act, unsafe condition, reportable accidents, need for safety, breakdown of accidents, hazardous industries. Theories & Principle of accidents Casualty, cost of accident, computation of cost, utility of cost data. Accident reporting & Investigation Identification of the key facts, corrective actions, classification of facts. Regulation American (OSHA) and Indian Regulation.

**UNIT – II:**
Safety Management Division of responsibility, Location of Safety function, size of safety department, qualification for safety specialist, safety committee – structure and functions.

**UNIT – III:**
Safe Working Condition and Their Development SOP for various Mechanical equipment, Incidental safety devices and methods, statutory of provisions related to safeguarding of Machinery and working condition.

**UNIT – IV:**
Safety in Operation and Maintenance Operational activities and hazards, starting and shut down procedures, safe operation of pumps, compressor, heaters, reactors, work permit system, entry into continued spaces.

**UNIT – V:**
Safety in Storage and Emergency Planning Safety in storage, handling of chemicals and gases, storage layout, ventilation, safety in chemical laboratories, emergency preparedness on site plan, off site plan, toxic hazard control.

**TEXT BOOKS**

1. Safety and Accident Prevention in Chemical Operation – H.H. Faweett and Wood
2. Personal Protective Equipment – NSC Bombay

**REFERENCE BOOKS**

1. Ergonomics - P. Krishna Murthy
2. Fire Prevention Hand Book – Derek James

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (CAD/CAM)**

**PRINCIPLES OF AUTOMATION (Open Elective)**

**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. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/ Pearson Education.
2. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
3. Automation, Buckinghsm W, / Haper & Row Publishers, New York, 1961
4. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (DESIGN FOR MANUFACTURING/ DESIGN AND MANUFACTURING)**
**PRINCIPLES OF MANUFACTURING ENGINEERING (Open Elective)**

**UNIT - I**

Hot and cold working – forging, rolling, extrusion and wire drawing; sheet metal working processes – blanking, bending and deep drawing, metal working defects

**Special Welding Processes:** Basic principle, equipment, applications, advantages and disadvantages of Electron beam welding, laser beam welding, ultrasonic welding, explosion welding, electro slag and electro gas welding, cold pressure welding, Friction Stir welding, diffusion bonding and adhesive bonding. Welding defects.

**UNIT - II**

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.

**UNIT - III**

Tool nomenclatures. Mechanics of chip formation, types of chips, orthogonal and oblique cutting, shear angle, velocity relationship. Tool failure analysis, theories of tool wear, measurement of tool wear. Tool dynamometers, Thermal aspects of machining, Tool life and economics of machining. Condition monitoring of machine tools.

Unconventional machining processes: Introduction to Abrasive Jet Machining, Electrical Discharge Machining, Ultrasonic Machining, Electron Beam Machining and Electrochemical Machining and its process parameters, advantages, disadvantages and applications.

**UNIT - IV**

Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Throwaway inserts.

Multi point Cutting Tools: Drill geometry, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speed &feed – machining time - from cutters.

**UNIT – V**

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.

**TEXT BOOKS:**

1. Manufacturing Engineering & Technology / Serope Kalpak jain / Steven R. Schmid / Pearson
2. Ghosh & A.K. Mallik; Manufacturing Science, Affiliated East West Press.
3. Foundation of MEMS by Chang Liu, Pearson, 2012.
4. Advanced Machining Processes by V. K. Jain, Allied Publications.

**REFERENCE BOOKS:**

1. B.L. Juneja & G.S. Skekhon; Fundamentals of Metal Cutting and machine Tools, Wiley Eastern
2. Sen & Bhattacharya; Principles of Machine Tools, New Central Agency.
3. Bhattacharyya; Metal Cutting: Theory & Practice, Central book publishers.
4. M.C. Shaw; Metal Cutting Principles, CBS Publishers.
5. HMT; Production Technology - Tata Mc Graw Hill.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (DESIGN FOR MANUFACTURING/ DESIGN AND MANUFACTURING)**

## ARTIFICIAL NEURAL NETWORKS (Open Elective)

**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.

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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. II Year I Sem. (DESIGN FOR MANUFACTURING/ DESIGN AND MANUFACTURING)**

## FUNDAMENTALS OF NANO TECHNOLOGY (Open Elective)

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

- To understand the evolution of Nano systems, and various fabrication techniques.
- Learn about nano materials and various nano measurements techniques.

**UNIT- I**

**Over View of Nanotechnology**: Definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

**UNIT – II**

**Nanodefects, Nano Partiles and Nanolayers:** Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties

**UNIT- III**

**NANOSTRUCTURING**: Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishign of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends

**UNIT- IV**

**Science and Synthesis of Nano Materials:** Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source-based production techniques – Gaseous carbon source-based production techniques – Diamond like carbon coating. Top down and bottom up processes

**UNIT –V**

**Characterization of Nano Materials:** Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

**TEXT BOOKS:**

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Fahrner W.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Mark Madou, Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003.

**REFERENCE BOOKS:**

1. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN: 8493-9138-5.

2. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc., 2013, ISBN: 978-93-82291-39-8 29.
3. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN: 470-85106-6.
4. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003.
5. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (ENGINEERING DESIGN)**

## MECHANICS OF COMPOSITE MATERIALS (Open Elective)

**Prerequisite:** Structure and properties of composite materials and design procedures for composite structures

**Course objectives:** To identify the properties of fiber and matrix materials used in commercial composites as well as some common manufacturing teaching and to predict the elastic properties of both long and short fiber and understand the stress-strain relations and establish the failure criteria for laminated structures.

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

- Understanding of types, manufacturing processes, and applications of composite materials.
- Basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
- Ability to analyze problems on macro and micro mechanical behavior of lamina
- Ability to analyze problems on macro mechanical behavior of laminate
- An ability to predict the loads and moments that cause an individual composite layer and a composite laminate to fail and to compute hygro thermal loads in composites.
- An ability to compute the properties of a composite laminate with any stacking sequence.

**UNIT – I**

**Basic Concepts and Characteristics:** Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.
**Reinforcements:** Fibres – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

**UNIT – II**

**Micromechanics:** Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.
**Manufacturing methods:** Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

**UNIT – III**

**Coordinate Transformation:** Hooke's law for different types of materials, Hooke's law for two-dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off – axis, stiffness modulus, off – axis compliance.
**Elastic behavior of unidirectional composites:** Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

**UNIT – IV**

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

**UNIT – V**

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

**TEXT BOOKS:**

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
3. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ Wiley-Interscience, New York, 1980.

**REFERENCES BOOKS:**

1. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)/ Autar K. Kaw, Publisher: CRC
2. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, New York, 1969.
3. Advanced Mechanics of Composite Materials/ Vasiliev & Morozov /Elsevier/Second Edition

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (ENGINEERING DESIGN)**

## INDUSTRIAL SAFETY (Open Elective)

**UNIT – I**

Safety Philosophy and principles of Accident prevention Introduction, accident, injury, unsafe act, unsafe condition, reportable accidents, need for safety, breakdown of accidents, hazardous industries. Theories & Principle of accidents Casualty, cost of accident, computation of cost, utility of cost data. Accident reporting & Investigation Identification of the key facts, corrective actions, classification of facts. Regulation American (OSHA) and Indian Regulation.

**UNIT – II**

Safety Management Division of responsibility, Location of Safety function, size of safety department, qualification for safety specialist, safety committee – structure and functions.

**UNIT – III**

Safe Working Condition and Their Development SOP for various Mechanical equipment, Incidental safety devices and methods, statutory of provisions related to safeguarding of Machinery and working condition.

**UNIT – IV**

Safety in Operation and Maintenance Operational activities and hazards, starting and shut down procedures, safe operation of pumps, compressor, heaters, reactors, work permit system, entry into continued spaces.

**UNIT – V**

Safety in Storage and Emergency Planning Safety in storage, handling of chemicals and gases, storage layout, ventilation, safety in chemical laboratories, emergency preparedness on site plan, off site plan, toxic hazard control.

**TEXT BOOKS:**

1. Safety and Accident Prevention in Chemical Operation – H.H. Faweett and Wood
2. Personal Protective Equipment – NSC Bombay

**REFERENCE BOOKS:**

1. Ergonomics - P. Krishna Murthy
2. Fire Prevention Hand Book – Derek James

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (ENGINEERING DESIGN)**

## WASTE TO ENERGY (Open Elective)

**Prerequisite:** 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 projects

**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-Conventional 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. (MACHINE DESIGN)**
**CONCURRENT ENGINEERING (Open Elective)**

**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:**

- Understand the need of concurrent engineering and strategic approaches for product design.
- Apply concurrent design principles to product design.
- Design assembly workstation using concepts of simultaneous engineering.
- Design automated fabricated systems – Case studies.

**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 Verlag, 1987.
2. Design for Concurrent Engineering by Cleetus, J. Concurrent Engineering Research Centre, Morgantown W V, 1992.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (MACHINE DESIGN)**

## INDUSTRIAL SAFETY (Open Elective)

**UNIT – I**

Safety Philosophy and principles of Accident prevention Introduction, accident, injury, unsafe act, unsafe condition, reportable accidents, need for safety, breakdown of accidents, hazardous industries. Theories & Principle of accidents Casualty, cost of accident, computation of cost, utility of cost data. Accident reporting & Investigation Identification of the key facts, corrective actions, classification of facts. Regulation American (OSHA) and Indian Regulation.

**UNIT – II**

Safety Management Division of responsibility, Location of Safety function, size of safety department, qualification for safety specialist, safety committee – structure and functions.

**UNIT – III**

Safe Working Condition and Their Development SOP for various Mechanical equipment, Incidental safety devices and methods, statutory of provisions related to safeguarding of Machinery and working condition.

**UNIT – IV**

Safety in Operation and Maintenance Operational activities and hazards, starting and shut down procedures, safe operation of pumps, compressor, heaters, reactors, work permit system, entry into continued spaces.

**UNIT – V**

Safety in Storage and Emergency Planning Safety in storage, handling of chemicals and gases, storage layout, ventilation, safety in chemical laboratories, emergency preparedness on site plan, off site plan, toxic hazard control.

**TEXT BOOKS:**

1. Safety and Accident Prevention in Chemical Operation – H.H. Faweett and Wood
2. Personal Protective Equipment – NSC Bombay

**REFERENCE BOOKS:**

1. Ergonomics - P. Krishna Murthy
2. Fire Prevention Hand Book – Derek James

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (MACHINE DESIGN)**

**PRINCIPLES OF AUTOMATION (Open Elective)**

**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. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/ Pearson Education.
2. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
3. Automation, Buckinghsm W, / Haper & Row Publishers, New York, 1961
4. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

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

**ENTREPRENEURSHIP (Open Elective)**

**Prerequisites:** Nil

**Course Outcomes:** At the end course, one should be able

- To assess the commercial viability of a new technology-based idea. The candidate can use various methods and tools for this purpose.
- To transform research-based ideas into feasibility and business plans. The candidate can use (tacit and explicit) methods and tools for this purpose.
- To present new ideas to the market.
- To assess the need for innovation, initiate the process and run innovations in organizations.
- To seize opportunities, organize and finance viable initiatives through to fruition.

**UNIT- I**

Nature of Entrepreneurship: Essential features, attitude and leadership of entrepreneur characteristics, qualities and skills, functions of entrepreneur, entrepreneur scenario in Indian economy, types of ownership, sole trading, partnership, joint stock company, important features of various types of businesses, corporate entrepreneurship, entrepreneurship, role of government in the promotion of entrepreneur, state enterprises in India.

**UNIT- II**

Aspects of Promotion: Opportunity analysis, SWOT analysis, internal and external environment analysis, technological competitiveness, entrepreneurs and legal regulatory systems, patents and trademarks, intellectual property rights, project planning.

Feasibility studies: The concept of project, project life cycle, project planning, feasibility, SWOT analysis, product and process development, major steps in product development.

**UNIT- III**

Financial Aspect of the Entrepreneurship: Source of capital, debit equity financing commercial banks, bank loans, assessment of benefits and costs, informal agencies in financing entrepreneurs, government grants and subsidies, types of investors and private offerings.

**UNIT- IV**

Entrepreneurial Strategy: Generation of new entry opportunity, decisions under uncertainty, entry strategy, new entry exploitation, environmental instability and first mover disadvantages, risk reduction strategies, market scope strategy, imitation strategies and managing newness.

**UNIT- V**

Women Entrepreneurship: Introduction, the dynamic need, entrepreneurship in a developing economy, the scope of entrepreneurship among women, promotional efforts supporting women entrepreneurs in India, issues of employment generation, rural entrepreneurship and EDPs: Need, rural industrialization, NGOs and rural entrepreneurship, need for EDPs, objectives of EDPs course contents and curriculum of EDPs, Phases of EDPs & evaluation of EDPs.

**REFERENCE BOOKS:**

1. Madhurimal ali, Shikhasahai, entrepreneurship, Excel books, first edition, New Delhi, 2006.
2. Nandan H, fundamentals of entrepreneurship, PHI New Delhi, 2009.

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

**OPTIMIZATION TECHNIQUES & APPLICATIONS (Open Elective)**

**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 is able to:

- Apply appropriate optimization techniques and solve 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 for Engineering Design by Kalyanmoy Deb, PHI

**REFERENCE BOOKS:**

1. Operations Research by S. D. Sharma
2. Operation Research by H. A. Taha, TMH
3. Optimization in operations research by R. L. Rardin
4. Optimization Techniques by Benugundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice by M. C. Joshi, K. M. Moudgalya, Narosa Publications.

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

**ADVANCED FINITE ELEMENT AND BOUNDARY ELEMENT METHODS (Open Elective)**

**Prerequisite:** Strength of Materials, Mathematics, Heat Transfer and Vibrations.
**Course Objectives:**

- To Introduce the basic concepts of the finite element method, the boundary element method
- To discuss the advantages and limitations of each method
- To Demonstrate the capabilities of each method on a variety of problems

**Course outcomes:** After completing this course, the student should be able to

- Understand the background of mathematical equations used for development of modeling software modules to develop the various structural related applications
- Identify mathematical model for solution of common engineering problems.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.

**UNIT– I**

**One Dimensional Problems**: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic shape functions.

**Analysis of Trusses:** Derivation of Stiffness Matrix for Trusses, Stress and strain Calculations, Calculation of reaction forces and displacements.

**Analysis of Beams:** Derivation of Stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses, Shear force and Bending moment, Problems on uniform and stepped beams for different types of loads applied on beams.

**UNIT– II**

**Finite element – formulation of 2D Problems:** Derivation of Element stiffness matrix for two-dimensional CST Element, Derivation of shape functions for CST Element, Elasticity Equations, constitutive matrix formulation, Formulation of Gradient matrix. Two dimensional Isoparametric Elements and Numerical integration.

**Finite element – formulation of 3D problems:** Derivation of Element stiffness matrix for Tetrahedron Element, Properties of Shape functions for 3D Tetrahedral Element, Stress-Strain Analysis for 3D Element, Strain Displacement for Relationship Formulation.

**UNIT– III**

**Steady state heat transfer analysis**: One Dimensional Finite Element analysis of fin and composite slabs. **Two-dimensional steady state heat transfer problems:** Derivation of Thermal Stiffness matrix for 2D heat transfer problems-CST, Derivation of thermal force vector for 2D heat transfer problems.

**Dynamic Analysis**: Formulation of mass matrices for uniform bar and beam Elements using lumped and consistent mass methods, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam Problems.

**UNIT– IV**

**Plate Bending**: Introduction – Plate behavior – $C^1$ (Kirchoff) Plate elements – $C^0$ (Mindlin) Plate elements – Mindlin beam – More devices for $C^0$ Plate elements – Boundary conditions - Analytical problems.

**Nonlinear finite element of solids**: Material Nonlinearities, objective rates, nonlinear elasticity, Plasticity, viscoplasticity, viscoelasticity

**UNIT– V**

**Boundary Element Method: Potential Problems:** Introduction, boundary Element Approach- Fundamental solution. Numerical Implementation - Determination of Ci, Final Relation, Three-dimensional analysis, tackling kernel singularity.

**Boundary Element Formulation for Electrostatic Problems:** Introduction, Basic Relation- Boundary condition, other relations. Discretization and Matrix Formulation – Determination of term $C(p)_m$.

**TEXT BOOKS:**

1. Finite and Boundary Element Methods in Engineering by O.P. Gupta, Oxford & IBH Publishing Co. Pvt. Ltd
2. The finite element methods in Engineering by S.S. Rao, Elsevier, 4th edition

**REFERENCE BOOKS:**

1. Finite Element Methods by Alavala, PHI.
2. Introduction to Finite Elements in Engineering by Tirupathi K. Chandrupatla and Ashok D. Belagundu.
3. An Introduction to Finite Element Methods by J. N. Reddy, Mc Graw hill
4. The Finite element method in engineering science by O.C. Zienkowitz, Mc Graw hill.
5. Concepts and Applications of Finite Element Analysis by Robert Cook, Wiley

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (PRODUCTION ENGINEERING)**

**FUNDAMENTALS OF PRODUCTION ENGINEERING (Open Elective)**

**UNIT- I**

Principle of special casting processes: Shell – investment – Ceramic mould – Pressure die casting – $CO_2$ process; Defects in various casting processes. Solidification, Gating and Risering, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and Risering design calculations, Fluidity, and its measurement.

**UNIT - II**

Laser Beam Welding: Types of lasers, equipment, power calculation, applications.
Friction Stir Welding: Details of process and process parameters, specific applications.
Electron Beam Welding: The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment and case studies.
Ultrasonic Welding: Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment and case studies.

**UNIT- III**

Fundamentals of Metal Forming: Classification of forming processes, mechanisms of metal forming: slab method, Upper and lower bound analysis, Deformation energy method and finite element method temperature of metal working, hot working, cold working, friction and lubricants.
Rolling processes, forces and geometrical relationship in rolling, classification and analysis of forging and load calculations.

**UNIT- IV**

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- V**

Tool Life and Tool Wear: Theories of tool wear-adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria 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. Sources of heat in metal cutting, Temperature distribution in Metal cutting

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao Vol. 1 & 2 / McGraw Hill
2. Manufacturing Engineering & Technology / Serope Kalpak jain / Steven R. Schmid / Pearson

**REFERENCE BOOKS:**

1. Metal Casting / T.V Ramana Rao / New Age
2. Elements of Workshop Technology, Vol. I and II/ Hajra Choudhury/ Media Promotors Pvt Ltd., Mumbai, 2001
3. Manufacturing Technology 1/S. Gowri, P. Hariharan, and A. Suresh Babu/ Pearson Education, 2008.
4. Production Technology / G. Thirupathi Reddy / Scitech
5. Manufacturing Processes/ J.P. Kaushish / PHI Publications

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (PRODUCTION ENGINEERING)**

**NON-DESTRUCTIVE TESTING & EVALUATION (Open Elective)**

**Pre-Requisites:** Nil

**Course Objectives**:

- Provide an opportunity to learn visual methods, electrical methods and magnetic methods.
- To develop a fundamental understanding of ultrasonic testing of material and radiographic methods.
- To be able to select the suitable NDT methods for particular environments.

**Course Outcomes**: The end of the student gain will be:

- Complete knowledge on microscopic evaluation and dynamic inspection.
- Knowledge about application of NDT methods like visual observation, penetrant detection, electrical methods etc.
- Ability to use ultrasonic testing and radiographic methods for checking various types of defects.
- Selection of suitable NDT methods for various environments.
- Documentation of testing and evaluation of results for further analysis.

**UNIT- I**

Introduction, Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.

**UNIT- II**

Penetrant flaw detection: Principles, Process, and Penetrant systems. Liquid penetrant materials, Emulsifiers, cleaners, developers, sensitivity. Advantages, limitations and applications. Magnetic methods: Methods of generating fields, magnetic particles and suspending liquids. Magnetography, field sensitive probes, advantages, limitations and applications of magnetic methods.

**UNIT- III**

Electrical methods: Eddy current methods, potential-drop methods, applications. Electromagnetic testing: Magnetism, Magnetic domains, Magnetization curves, Magnetic Hysteresis. Hysteresis-loop tests, comparator - bridge tests Absolute single-coil system, applications.

**UNIT- IV**

Ultrasonic testing of materials: Advantages, disadvantages, Applications, Generation of Ultrasonic waves, general characteristics of ultrasonic waves; methods and instruments for ultrasonic materials testing; special techniques. Principles, test procedures of composites by Ultrasonic flaw inspection. Acoustic emission methods: Basic Principles and practice, computerized tomography, composite health monitoring.

**UNIT- V**

Radiographic methods: Limitations, Principles of radiography, sources of radiation, Ionizing radiation - X-rays sources, gamma-rays sources. Recording of radiation. Radiographic sensitivity, principles and practice as applied to composites. Fluoroscopic methods, Special techniques, Radiation safety.

**TEXT BOOKS:**

1. Non-Destructive Testing by R. Halmshaw, 2nd edition, by The British Institute of NDT.
2. Ultrasonic Testing of Metals; J Krantkramer and H. Krantkramer, Spinger Vekg, 1987.

**REFERENCE BOOKS:**

1. Testing of Materials by A. V. K. Suryanarayana, 2nd edition, BS publications, 2007.
2. Metals Handbook Vol. II, Nondestructive inspection and quality control.
3. R. C. Mc Master Ed., Non-destructive Testing Hand Book Vol. I & II, Ronald Press Company.
4. J. F. Himsley, Non-destructive Testing, Macdonald and Evans, London, 1959.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (PRODUCTION ENGINEERING)**

## PARTICULATE MATERIALS TECHNOLOGY (Open Elective)

**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, stren and strain rate of plastic behaviour, 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.
**Non-metallic 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, A12 O3, SiC, Si3 N4, 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 BOOKS:**

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. II Year I Sem. (THERMAL ENGINEERING)**

## BASICS OF REFRIGERATION SYSTEMS (Open Elective)

**Prerequisites:** Nil

**Course Objectives:**

- To understand the principles of refrigeration.
- To understand different vapor Absorption systems.
- To know Aircraft Air refrigeration systems.
- To gain knowledge about refrigerants.
- Ozone depletion potential and global warming potential.

**Course Outcomes:** On successful completion of the course, the student will be able to:

- Illustrate the basic concepts of refrigeration system.
- Analyze the vapour compression cycle and interpret the usage of refrigerants.
- Explain the components of vapour absorption system.
- Demonstrate the use of refrigerants.
- Discuss the theory Ozone depletion potential and global warming potential.

**UNIT- I**

**Vapor Compression Refrigeration**: Analysis of vapor compression refrigeration cycle - reversed Carnot cycle for vapour - effect of suction temperature and condensing temperature on cycle performance – Practical refrigeration cycle – sub-cooled liquid and super-heated vapor refrigeration cycles their effect on performance. Multi Pressure Systems- removal of flash gas- intercooling – compound compression (conversion)-multi vapor systems- cascade systems- dual compression-system practices.

**UNIT- II**

Simple vapor Absorption systems- actual vapor absorption cycle- representation of the cycle on H-C diagram- common refrigerant- (Absorbent)Adsorbent) systems. Practical single effect Water- Lithium Bromide Absorption system- double effect system Electrolux refrigerator- newer mixtures for absorption systems.

**UNIT- III**

Aircraft Air refrigeration – Functions – working conditions – types. Steam jet water vapor systems-thermoelectric refrigeration systems - vortex refrigeration system - pulse tube refrigeration.

**UNIT- IV**

**Refrigerants**: Desirable properties- thermo dynamic-chemical and transport properties - designation of refrigerants - inorganic, halo carbon refrigerants - secondary refrigerants - Properties of mixtures of refrigerants

**UNIT- V**

Ozone depletion potential and global warming potential – effect of refrigerants- alternative refrigerants-newer refrigerants.

**TEXT BOOKS:**

1. R & A/C by F. Stoecker & Jerold. W. Jones-MGH Intl., 1982.
2. R & A/C by C. P. Arora, TMGH -2000.

**REFERENCE BOOKS**:

1. R & A/C by Manohar Prasad.
2. Principles of Refrigeration by Roy. J. Dossat, 1997.
3. Refrigeration by Gosney- Oxford University Press-1980.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (THERMAL ENGINEERING)**

**INTRODUCTION TO THERMAL STORAGE SYSTEMS (Open Elective)**

**Prerequisites:** Nil

**Course objectives:**

- To Understand the Necessity of Thermal Storage – Types-Energy Storage Devices
- To Understand Sensible Heat Storage System.
- To Know Parallel Flow and Counter Flow Regenerators.
- To Gain Knowledge about specific areas of Application of Energy Storage.
- Latent Heat Storage Systems.

**Course Outcomes:**

- To be able to state the types-energy storage devices – comparison of energy storage technologies.
- To be able to identify and describe Basic concepts and modeling of heat storage units - modeling of simple water and rock bed storage system.
- To be able to explain at a level understandable by a non-technical person how various Parallel flow and counter flow regenerators.
- To be able to calculate Modeling of phase change problems.
- To be able to explain greenhouse heating – power plant applications – drying and heating for process industries.

**UNIT - I**
**Introduction:** Necessity of thermal storage – types-energy storage devices – comparison of energy storage technologies - seasonal thermal energy storage - storage materials.

**UNIT - II**
**Sensible Heat Storage System:** Basic concepts and modeling of heat storage units - modeling of simple water and rock bed storage system – use of TRNSYS – pressurized water storage system for power plant applications – packed beds.

**UNIT - III**
**Regenerators:** Parallel flow and counter flow regenerators – finite conductivity model – non – linear model – transient performance – step changes in inlet gas temperature – step changes in gas flow rate – parameterization of transient response – heat storage exchangers.

**UNIT - IV**
**Latent Heat Storage Systems**: Modeling of phase change problems – temperature-based model - enthalpy model - porous medium approach - conduction dominated phase change – convection dominated phase change.

**UNIT - V**
**Applications:** Specific areas of application of energy storage – food preservation – waste heat recovery – solar energy storage – green house heating – power plant applications – drying and heating for process industries.

**TEXT BOOK:**

1. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.

**REFERENCE BOOKS:**

1. Schmidt. F. W and Willmott. A. J, Thermal Storage and Regeneration, Hemisphere Publishing Corporation, 1981.
2. Lunardini. V. J, Heat Transfer in Cold Climates, John Wiley and sons 1981.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M. TECH. II Year I Sem. (THERMAL ENGINEERING)**

**COGENERATION & WASTE HEAT RECOVERY SYSTEMS (Open Elective)**

**Prerequisites:** Nil

**Course objectives:** To impart knowledge on

- The basic energy generation cycles
- The concept of cogeneration, its types and probable areas of applications
- Significance of waste heat recovery systems and carry out its economic analysis

**Course Outcomes:** Ability to

- Analyze the basic energy generation cycles
- Do the economic analysis of waste heat recovery systems

**UNIT - I**

Introduction – principles of thermodynamics – cycles – topping – bottoming – combined cycle – organic Rankine cycles – performance indices of cogeneration systems – waste heat recovery – sources and types – concept of tri generation.

**UNIT - II**

**Cogeneration Technologies:** Configuration and thermodynamic performance – steam turbine cogeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems – combined cycles cogeneration systems – advanced cogeneration systems: fuel cell, Stirling engines etc.

**UNIT - III**

**Issues and Applications of Cogeneration Technologies:** Cogeneration plants electrical interconnection issues – utility and cogeneration plant interconnection issues – applications of cogeneration in utility sector – industrial sector – building sector – rural sector – impacts of cogeneration plants – fuel, electricity and environment.

**UNIT - IV**

**Waste Heat Recovery Systems:** Selection criteria for waste heat recovery technologies – recuperators – Regenerators – economizers – plate heat exchangers – thermic fluid heaters – Waste heat boilers – classification, location, service conditions, design Considerations – fluidized bed heat exchangers – heat pipe exchangers – heat pumps – sorption systems.

**UNIT - V**

**Economic Analysis:** Investment cost – economic concepts – measures of economic performance – procedure for economic analysis – examples – procedure for optimized system selection and design – load curves – sensitivity analysis – regulatory and financial frame work for cogeneration and waste heat recovery systems.

**TEXT BOOKS:**

1. Charles H. Butler, Cogeneration, McGraw Hill Book Co., 1984.11
2. Educogen – The European Educational tool for cogeneration, Second Edition, 2001.

**REFERENCE BOOKS:**

1. Horlock JH, Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford, 1987.
2. Institute of Fuel, London, Waste Heat Recovery, Chapman & Hall Publishers, London, 1963.

3. Seagate Subrata, Lee SS EDS, Waste Heat Utilization and Management, Hemisphere, Washington, 1983.
4. De Nevers, Noel., Air Pollution Control Engineering, McGraw-Hill, New York, 1995

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**CSE/EEE/ECE M. Tech - II Year I Semester**

## BUSINESS ANALYTICS (Open Elective)

**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:**

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will 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.

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## INDUSTRIAL SAFETY (Open Elective)

**Course Objectives:**

- To provide information regarding different elements of industrial water pollution and Methods of treatment.
- To expose to the various industrial applications, maintenance, preventive measures taken against wear and tear.

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

- Know how to take safety measures in executing works
- Identify the need for maintenance (or) replacement of equipment
- Understand the need for periodic and preventive maintenance

**UNIT- I**

**Industrial safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

**UNIT- II**

**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**UNIT- III**

**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications,

i. Screw down grease cup,
ii. Pressure grease gun,
iii. Splash lubrication,
iv. Gravity lubrication,
v. Wick feed lubrication
vi. Side feed lubrication,
vii. Ring lubrication,

Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**UNIT- IV**

**Fault tracing:** Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like,

i. Any one machine tool,
ii. Pump
iii. Air compressor
iv. Internal combustion engine,
v. Boiler,
vi. Electrical motors, Types of faults in machine tools and their general causes.

**UNIT- V**

**Periodic and preventive maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:

i. Machine tools,
ii. Pumps,
iii. Air compressors,
iv. Diesel generating (DG) sets,

Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance

**REFERENCE BOOKS:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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**OPERATIONS RESEARCH (Open Elective)**

**Prerequisite:** None

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

- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- Student should able to model the real-world problem and simulate it.

**UNIT- I**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**UNIT- II**

Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming

**UNIT- III**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT

**UNIT- IV**

Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**UNIT- V**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**TEXT BOOKS/ REFERENCE BOOKS:**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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## COST MANAGEMENT OF ENGINEERING PROJECTS (Open Elective)

**Prerequisite:** None

**UNIT- I**

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

**UNIT- II**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre-project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

**UNIT- III**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

**UNIT- IV**

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

**UNIT- V**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

**TEXT BOOKS/ REFERENCE BOOKS:**

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

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## COMPOSITE MATERIALS (Open Elective)

**Prerequisite:** None

**UNIT– I**
INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

**UNIT – II**
REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

**UNIT – III**
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

**UNIT– IV**
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

**UNIT – V**
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

**TEXT BOOKS/ REFERENCE BOOKS:**

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K. K. Chawla.
5. Composite Materials Science and Applications – Deborah D. L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

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## ENERGY FROM WASTE (Open Elective)

**Prerequisite:** None

**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.

**UNIT- III**
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

**UNIT- IV**
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- V**
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 processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic 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/ REFERENCE BOOKS:**

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.