**SYLLABUS**

**(APPENDIX-III, Open Elective Courses)**

**FOR**

**TWO-YEAR M. TECH./M.PLAN. PROGRAMMES**

**(All Specializations)**



|  |
| --- |
| **NAAC – A Grade** |

**COLLEGE OF ENGINEERING & TECHNOLOGY**

**(An Autonomous and Constituent College of BPUT, Odisha)**

**Techno Campus, Mahalaxmi Vihar, Ghatikia,**

**Bhubaneswar-751029, Odisha, INDIA**

[**www.cet.edu.in**](http://www.cet.edu.in)

**Ph. No.: 0674-2386075 (Off.), Fax: 0674-2386182**

**Open Elective Courses**

**Offered by**

**Department of Biotechnology**

**Food Process Engineering (POEBT301)**

**Module-I**

Different Food processing methods: Blanching, pasteurization, sterilization, extrusion cooking, micro wave processing, Concepts and equipment used.

Processing principles: thermal processing, chilling, freezing, dehydration, addition of preservatives and food additives, irradiation, fermentation, hurdle technology, intermediate moisture foods. Cereal processing and products: rice, wheat, and maize, extruded products and ready to eat breakfast cereals, Oil processing, Fruits and vegetables processing, Plantation crops processing and products: tea, coffee, cocoa, essential oils and oleoresins from spices. Milk and milk products processing, Processing of animal products: drying and freezing of fish and meat, production of egg powder.

Technology for improved process: Enzymes in bakery, fat/oil industries, beverage production, sugar syrup, Protease in cheese making, fermented cereal products, Genetically modified food. Food pack aging and storage: packaging materials, aseptic packaging, controlled and modified atmosphere storage.

**Module-II**

Fermented foods, beverages and safety: Pickles, soya-sauce, sauerkraut, alcoholic beverages and sausage, vinegar, Treatment and disposal of food processing wastes for value added products as pectin from fruit wastes, uses of by-products from rice milling. Oriental Foods and Scandinavian foods, Anti-nutrients and nutraceuticals, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination, Food preservations by physical and chemical methods , Food additives, Food standards and quality maintenance: FPO, PFA, Agmark, ISI, Hazard Analysis and Critical Control Point (HACCP), FSSAI, food plant sanitation and cleaning in place (CIP).

**Module-III**

Food spoilage: spoilage microorganisms in different food products including milk, fish, meat, egg, cereals and their products. Toxins from microbes: pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera.

**Recommended Books**

1. Modern Food Microbiology. J. M. Jay, M.J. Loessner, D.A. Golden, CBS Publishers
2. Desrosier, Technology of food preservation, CBS publishers,
3. Introduction to food engineering, R.P. Singh and D.R. Headman, Academic Press
4. Food Microbiology. William C. Frazier , Dennis C. Westhoff , N.M. Vanitha. McGraw Hill Education
5. Prescott and Dunn’s Microbiology, G. Reed, CBS publishers, 1987

**Bioanalytical Techniques (POEBT302)**

**Module-I**

Principles, experimental use and applications of Advanced Imaging Techniques in Microscopy: Electron microscopy (Scanning electron microscope, Transmission electron microscope), Atomic force microscopy, Confocal microscopy.

Radioisotope Techniques: Safety aspects of handling radioactive material, film, TLD, Ionization, Scintillation.

**Module-II**

Molecular absorption and applications, Infra red absorption, functional group analysis, FT-IR. Nuclear Magnetic Resonance: 1H and 13C-NMR spectroscopy, Principle, Basic instrumentation, terminology, Interpretation of data, Quantitative applications.

Mass Spectroscopic Techniques: Principles, Instrumentation, Ionization techniques, Characterization and applications.

Dynamic Light Scattering (DLS): Principle, Basic instrumentation, Quantitative applications ofX-ray Diffraction: Principle, Instrumentation, quantitative analysis

**Module-III**

Chromatography techniques: Principle, Basic instrumentation and applications of Ion exchange chromatography, Immobilized metal affinity chromatography (IMAC), High-performace liquid chromatography and Gas chromatography.

Thermogravimetry, Differential thermal analysis, differential scanning calorimetry, Principle, Block diagram, Applications,

**Recommended Books**

1. Bioinstrumentation by L. Veerakumari, MJP Publishers.
2. Analytical techniques in biochemistry and molecular biology. By R. Katoch, (Springer, New York, 2011).
3. Instrumental Methods of Analysis by Willard Merrit, Dean settle (7th edition).
4. Spectrometric Identification of Organic Compounds. By Robert M. Silverstein, Francis X. Webster, David Kiemle. John Wiley & Sons

**Open Elective Courses**

**Offered by**

**Department of Civil Engineering**

**Disaster Management and Mitigation (POECE301)**

**Course Objectives: -**

1. Distinguish between disaster management and risk management.
2. Explain selected models of disaster management.
3. Describe the strategies for risk mitigation.
4. List activities needed for post-disaster management.

**Module –I**

Introduction: Concepts and definitions: Disaster, hazard, vulnerability, resilience, risks, frequency and details, capacity, impact, prevention, mitigation.

Disasters: Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility. Disaster Impacts: Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability, etc. Dos and Don’ts during various types of Disasters.

**Module –II**

Disaster Risk Reduction (DRR): Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment. Emerging approaches in Disaster Management - Three stages: Pre-disaster stage (preparedness), Emergency stage and Post Disaster stage – Rehabilitation. Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

**Module –III**

Disasters, Environment and Development: Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods. Disaster management: Applications and case studies - Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**Text/Reference Books:**

1. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012.
2. Pradeep Sahni, “Disaster Mitigation: Experiences and Reflections”, Prentice Hall,2004.
3. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.
4. Donald Hyndman & David Hyndman, “Natural Hazards &amp; Disasters”, Cengage Learning, 2010.
5. Singh B.K., Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication, 2008.
6. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.

**Course Outcomes: -**

1. Affirm the usefulness of integrating management principles in disaster mitigation work.
2. Distinguish between the different approaches needed to manage pre- during and post- disaster periods.
3. Explain the process of risk management.
4. Relate to risk transfer.

**Geotechnics for Waste Materials (POECE302)**

**Module I**

Surface & subsurface contamination, biological & chemical contamination sources & effect of subsurface contamination, Fate & transport of underground contamination, advection, dispersion, diffusion, sorption, vertilization, chemical reaction, biodegradation radioactive decay. Geo-environmental soils characterization & remediation methods.

**Module II**

Contaminants of solid waste in landfills, characteristics of solid wastes, types of landfills, site selection, shape of size of landfills, liners, covers characteristics of solid wastes, types of landfills, site selection, shape & size of land fill, liners, covers and Leachete collection, waste containment principles, Types of barrier materials, planning & design aspects related to waste disposal. Land fill in ash ponds, infilling ponds & in rocks. Stability of landfills, sustainable waste management. Monitoring surface contamination, stabilization & modification of waste. Case studies in waste handling, soil-waste interaction.

**Module III**

Contaminable of slurry waste; Slurry transported wastes, slurry ponds, operation embankment construction & planning, design aspects, environmental impact & control. Vertical barriers system &cutoff walls, slurry trench cutoff, backfill design & potential defects, use of bentonite & cement in slurry. Constructional features, use of geosynsthetics in landfills, barriers &cutoff, installation of soil mixed wall barrier by deep soil mixing.

Environmental monitoring around landfills, detection, control & remediation of subsurface contamination; engineering properties & geotechnical reuse of waste materials. Demolition waste dumps, regulations. Soil erosion and land conservation; causes of soil erosion, factors contributory to erosion, erosion control measures.

**Text/Reference Book:**

1. Geoenvironmental Engineering- Principles and Applications: L.N. Reddy & H.F. Inyang, Marcel Dekkar (2004)
2. Geotechnical Practice for Waste Disposal: D.E. Daniel Chapman and Hall, London (1993)
3. Construction and Monitoring of Landfills: A. Bagchi, John Wiley and Pone N.Y., (1994)
4. Geotechnical Engineering (Chapter 09): D.P. Coduto, Pearson Education Asia, (2002)
5. Foundation Engineering Handbook (Chapter 20): H.Y. Fang, CBS Publishers (2004)

**Project Planning and Management (POECE303)**

**Course Objectives:**

1. Prepare work break down plan and estimate resources requirements.
2. Solve problems of resource allocation and levelling using network diagrams
3. Plan and develop management solutions to construction projects.
4. Understand the principles of project management, resource management and inventory.

**Module-I**

Introduction: Definition, Objective, functions and scope of construction management; Resources for Construction, Types of Construction, stages in construction, scientific methods of management; construction team. Construction Contracts and Specifications: Types of construction contracts; contract documents; specifications; general and special conditions of contract; contract management; arbitration and settlement. Construction Planning: Construction Planning methodology, Stages of planning: -Pre-tender planning; contract planning; planning and scheduling construction jobs by bar charts; Limitations of Bar Charts. Preparation of Man, Machine, Material and Money schedule.

**Module-II**

Network Techniques in Construction Management: Necessity of Network Technique in Construction planning and Management. Types of Network technique. Difference between PERT &amp; CPM. Elements of Network: -Event, Activity, Dummy. Network Rules, Methods of Numbering the Events. Work Breakdown Structure. PERT- Time Computations: - earliest Expected Time (T E), Latest Allowable Occurrence Time (T L). Combined Tabular computations for T E and T L. PERT-Network Analysis: -Slak, Critical path. CPM- Network Analysis: Activity Expected Time (T E), Latest Allowable Occurrence Time (T L). Combined Tabular computations for T E and T L. Float, Critical activity and critical path. Allocation of resources. Computer software for network analysis. Time Cost Optimization: Direct cost, indirect cost, total cost; purpose, stages and methods of cost control techniques of time cost optimization; examples and case studies.

**Module-III**

Site Lay-Out: Principles governing site lay out; factors affecting site lay out; preparation of site lay out. Supervision, Inspection and Quality Control: Supervisor’s responsibilities; keeping records; control of field activities handling disputes and work stoppages; storage and protection of construction materials and equipment; testing and quality control. Purpose of inspection: Inspection of various components of construction; reports and records; statistical quality control. Safety in Construction: Safety: importance of safety, accident-prone situations at construction site i.e, safety measures for excavation, drilling/blasting, scaffolding/formwork, hoisting &amp; erection demolition and hot bituminous work. Fire Safety: Safety record of construction industry, safety campaign.

Labour Laws and Acts: Wages of construction Labours, Trade unions connected with the Construction Industries, Trade union Act-1926. Labour Welfare Fund Act-1965, Payment of Wages Act, Minimum Wage Act-1948, Contract Labour act. Project Management: Feasibility study; project reports; progress reports; monitoring and controlling project activities.

**Text/Reference Books:**

1. Challahan, M.T., Construction Project Scheduling.
2. Srinath, L.S. PERT and CPM-Concepts and Applications.
3. Austen: Managing Construction Projects, A guide to Processes & Procedures International Labour office, Geneva
4. Douglas and Manager: Construction Management, Prentice Hall

**Course Outcomes:**

**CO1:** Able to prepare work break down plan and estimate resources requirements.

**CO2:** Able to solve problems of resource allocation and leveling using network diagrams

**CO3:** Able to plan and develop management solutions to construction projects.

**CO4:** Able to understand the principles of project management, resource management and inventory.

**Water Resource Management (POECE304)**

**INTENT:** To make students understand the ways in which water availability and use are matched, and seek to develop alternative land use and water allocation policies, including legal and institutional arrangements from the local watershed to the basin scale and beyond.

**Module1:**

Water as a finite resource, need of water, water security, water as an economic good; Need for management of water resources. International Hydrological Programme by UNESCO as a basis of water resource management

**Module2:**

Health and Environmental concerns related to availability and quality of water resources. Organized harnessing of water- dams, hydroelectric projects- their merits and demerits and short and long term impact on resource availability.

**Module3:**

Policy failures and institutional weaknesses; Water sharing across State and National boundaries; Exchange of information, joint monitoring and assessment. Case studies of sustainable water resource management in India and other developing countries; Environmental Planning.

**Text / Reference Books:**

1. Sahay R.N., Integrated Water Resource Management, 2014, ABD Publishers.
2. Mishra H.N, Managing Natural Resources: Focus on land and water, 2014, Prentice Hall India learning Pvt. Ltd.
3. Soncini- Sessa, Rodolfo & Cellina, Integrated and Participatory Water Resources management, 2007, Elsevier Science & Technology Publications.
4. Ganoulis J., Duckstein L., Literathy P. & Bogardi I., Trans boundary Water Resources Management: Institutional and Engineering Approaches, 2011, Springer Publications.

**Open Elective Courses**

**Offered by**

**Department of Computer Science & Engineering**

**Deep Learning (POECS301)**

**Course Objectives**

* Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

**Course Outcomes**

* Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
* Implement deep learning algorithms and solve real-world problems.

**SYLLABUS**

**Module-1:**

**Introduction:** Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques. **Feedforward neural network:** Artificial Neural Network, activation function, multi-layer neural network. **Training Neural Network:** Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.

**Module-2:**

**Conditional Random Fields:** Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy. **Deep Learning:** Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.

**Module-3:**

**Probabilistic Neural Network:** Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Auto encoders. **Deep Learning research:** Object recognition, sparse coding, computer vision, natural language processing. **Deep Learning Tools:** Caffe, Theano, Torch.

**Text Books**

* 1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
  2. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006.

**Reference Books**

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G. H., and Van Loan, C.F., Matrix Computations, JHU Press, 2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

**Natural Language Processing (POECS302)**

**Module1:**

Introduction- Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes. Linguistics resources- Introduction to corpus, elements in balanced corpus, Tree Bank, Prop Bank, WordNet, Verb Net etc.

**Module-2:**

Resource management with XML, Management of linguistic data with the help of GATE, NLTK. Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF. Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions.

**Module-3:**

A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax. Parsing- Unification, probabilistic parsing, Tree Bank. Semantics- Meaning representation, semantic analysis, lexical semantics, WordNetWord Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary based approaches. Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure. Applications of NLP- Spell-checking, Summarization Information Retrieval-Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview.

**Textbook:**

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009

**Reference Books:**

1. James A. Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V. Natural language processing: A Paninian perspective, PHI, 2000
3. Siddiqui T., Tiwary U. S. Natural language processing and Information retrieval, OUP,2008

**Open Elective Courses**

**Offered by**

**Department of Electrical Engineering**

**Waste to Energy (POEEE301)**

**Course Objectives:**

1. To understand the principles associated with effective energy management and to apply these principles in the day-to-day life.
2. Covers fundamentals of waste combustion-characteristics and handling of MSW fuel, furnace designs, waste combustion, and plant operations.

**Syllabus:**

**MODULE-I:**

**Solid Waste Sources:** Solid Waste Sources, types, composition, Properties, Municipal Solid Waste: Physical, chemical and biological properties, Waste Collection and Transfer stations, Waste minimization and recycling of municipal waste, Segregation of waste, Size Reduction, Managing Waste, Status of technologies for generation of Energy from Waste.

**Waste Treatment and Disposal:** Aerobic composting, incineration, Furnace type and design, Medical waste/Pharmaceutical waste treatment Technologies, incineration, Environmental impacts, Measures to mitigate environmental effects due to incineration.

**MODULE-II:**

**Land Fill method of Solid waste disposal:** Land fill classification, Types, methods and Sitting consideration.

Layout and preliminary design of landfills: Composition, characteristics, generation, Movement and control of landfill leachate and gases, Environmental monitoring system for land fill gases.

**MODULE-III:**

**Energy Generation from Waste:**

Bio-chemical Conversion: Sources of energy generation, Anaerobic digestion of sewage and municipal wastes, Direct combustion of MSW-refuse derived solid fuel, Industrial waste, agro residues. Anaerobic Digestion: Biogas production, Land fill gas generation and utilization,

Thermo-chemical conversion: Sources of energy generation, Gasification of waste using Gasifiers Briquetting, Utilization and advantages of briquetting, Environmental benefits of Bio-chemical and Thermochemical conversion.

**Text Books/References:**

* + - 1. Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003).
      2. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, Hillary Vigil, Samuel, “Integrated Solid Waste management: Engineering Principles and Management issues”, New York, McGraw Hill, 1993.
      3. M. Dutta, B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi (1999).
      4. Amalendu Bagchi. Design, construction and Monitoring of Landfills. John Wiley and Sons. New York. (1994)
      5. M. L. Davis and D. A. Cornwell. Introduction to environmental engineering. Mc Graw Hill International Edition, Singapore (2008)
      6. C. S. Rao. Environmental Pollution Control Engineering. Wiley Eastern Ltd. New Delhi (1995)
      7. S. K. Agarwal. Industrial Environment Assessment and Strategy. APH Publishing Corporation. New Delhi (1996)
      8. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), “Biomass Conversion Processes for Energy and Fuels”, New York, Plenum Press, 1981
      9. Hagerty, D. Joseph; Pavoni, Joseph L; Heer, John E., “Solid Waste Management”, New York, Van Nostrand, 1973
      10. P. Aarne Vesilind, William A. Worrell and Debra R. Reinhart. Solid Waste Engineering. Thomson Asia Pte Ltd. Singapore (2002).
      11. C Parker and T Roberts (Ed), Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
      12. KL Shah, Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, 2000
      13. M Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
      14. G Rich et.al, Hazardous Waste Management Technology, Podvan Publishers, 1987
      15. AD Bhide, BB Sundaresan, Solid Waste Management in Developing Countries, INSDOC, New Delhi,1983

**Course Outcomes:**

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

**CO 1**: To understand different conversion technologies to convert waste to energy.

**CO 2**: Adapt good practice for disposal of waste which helps in environmental monitoring.

**CO 3**: Understand cogeneration in industry and waste heat recovery techniques and devices.

**MAPPING OF CO’S WITH PO’S**

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO-1** | **PO-2** | **PO-3** | **PO-4** | **PO-5** | **PO-6** | **PO-7** |
| **CO-1** | High | Medium | High | Medium | High | High | High |
| **CO-2** | High | Low | Medium | Low | Medium | High | High |
| **CO-3** | High | High | Medium | Medium | Medium | High | Medium |

**Signal Transforms and Analysis (POEEE302)**

**Module-1**

Introduction to time frequency analysis; Fourier series, Orthogonality, Orthonormality and the method of finding the Fourier coefficients Complex Fourier series, Orthogonality of complex exponential bases, Mathematical preliminaries for continuous and discrete Fourier transform, limitations of Fourier domain signal processing

Signal representation with continuous and discrete STFT, concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's Uncertainty principle and time frequency tiling, The origins of wavelets, Wavelets and other wavelet like transforms, History of wavelet from Morlet to Daubechies via Mallat, Different communities and family of wavelets, Different families of wavelets within wavelet communities, Propertiesand mathematical conditions of wavelet functions. Some popularwavelet functions

**Module -2**

Wavelet transform-A first level introduction, Continuous time-frequency representation of signals, Properties of wavelets used in continuous wavelet transform, Continuous versus discrete wavelet transform, Discrete wavelet transform, tiling of the time-frequency plane and wave-packet analysis

**Module-3**

Signal decomposition (Analysis), Relation with filter banks, Frequency response, Signal reconstruction: Synthesis from coarse scale to fine scale, Up-sampling and filtering, Perfect reconstruction filters, QMF conditions, Computing initial *sj*+1 coefficients, Concepts of Multi-Resolution Analysis (MRA) and Multi-rate signal processing, Filter bank theory

Application of wavelet theory in to signal denoising, Power Signal Processing, image compression, digital communication, transient and fault detection in power system. Commercial applications in which wavelet approach is established.

**Text Books:**

1. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.

2 K. P. Soman, K. I. Rmachandran, N. G. Resmi, “Insight into Wavelets: From Theory to Practice, (Third Edition)”, PHI Learning Pvt. Ltd., 2010

3. M. Vetterli and J. Kovacevic, "Wavelets and Sub-band Coding," Prentice Hall, 1995.

**References:**

1. I.Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics,Philadelphia, PA, 1992.

2. Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.

3. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.

4. S. Mallat, "A Wavelet Tour of Signal Processing," Academic Press, Second Edition, 1999.

5. G. Strang and T. Q. Nguyen, "Wavelets and Filter Banks," Wellesley-Cambridge Press, RevisedEdition, 1998.

6. B.Boashash, Time-Frequency signal analysis, In S.Haykin, (editor), Advanced Spectral Analysis,Prentice Hall, New Jersey, 1991.

**Wavelet links:**

1. http://users.rowan.edu/~polikar/WAVELETS/WTtutorial.html

2. http://www.wavelet.org/

3. http://www.math.hawaii.edu/~dave/Web/Amara's%20Wavelet%20Page.htm

**Objectives:**

Wavelets have established themselves as an important tool in modern signal processing as well as in applied mathematics. The objective of this course is to establish the theory necessary to understand and use wavelets and related constructions. We thus study applications in signal and image processing where time-frequency transforms like wavelets play an important role.

**Course Outcomes**: Upon completion of this course, students should be able to:

* + - 1. Understand the terminology that are used in the wavelets literature.
      2. Explain the concepts, theory, and algorithms behind wavelets from an interdisciplinary perspective that unifies harmonic analysis (mathematics), filter banks (signal processing), and multiresolution analysis (computer vision).
      3. Understand how to use the modern signal processing tools using signal spaces, bases, operators and series expansions.
      4. Apply wavelets, filter banks, and multi-resolution techniques to a problem at hand, and justify why wavelets provide the right tool.
      5. Think critically, ask questions, and apply problem-solving techniques.

**Non-Conventional Energy (POEEE303)**

**MODULE-I**

**Energy Scenario**: Consumption & Standard of living, Energy potential in global and Indian context, Classification of Energy Sources, Energy resources (Conventional and Non-conventional), Energy needs of India, and energy consumption patterns. Energy efficiency and Energy security. Impacts of Conventional and Non-conventional energy sources.

**Solar Energy**: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length.

* **Solar thermal Systems**: Types of collectors, Collection systems, efficiency calculations, applications.
* **Photovoltaic (PV) technology**: fundamentals of solar cells, solar cell technologies, equivalent circuit of single solar cell, module and array, Standalone and grid interactive systems. applications

**MODULE-II**

**Wind Energy:** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

**Wind energy conversion systems**: Stand-alone and grid connected operation. Introduction to Wind energy farms.

**Small Hydro Systems**: Power Equation of small hydro system, classification, civil works, choice of electric generators (induction or synchronous)

**MODULE-III**

**BIOMASS ENERGY**: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, Power generation from landfill gas and liquid waste, biomass cogeneration. Fuel properties of bio gas, utilization of biogas.

**Fuel cell**: Principle of working of various types of fuel cells and their working, performance and limitations.**GEOTHERMAL ENERGY:** geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy,

**OCEAN ENERGY:** Tidal Energy-Principle of working, performance and limitations.

**Wave Energy**-Principle of working, performance and limitations.

**Ocean Thermal Energy**-Availability, theory and working principle, performance and limitations.

**Energy storage system**:

* **Battery** – types, equivalent circuit, performance characteristics, charge regulators. Battery management.
* **Flywhee**l-energy relations, components, benefits over battery.
* Fuel Cell energy storage systems. Ultra Capacitors.

Concept of smart grid, micro grid, diesel generators, Electric vehicles and hybrid energy systems.

**Texts/References**

1. G. D. Rai, “Non-Conventional Energy Sources”,4th Edition, Khanna Publishers, 2000
2. S.P.Sukhatme, “Solar Energy”,3rd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2008
3. B H Khan, “Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
4. S.Hasan Saeed and D.K.Sharma, “Non-Conventional Energy Resources”, 3rd Edition, S.K.Kataria & Sons, 2012.
5. 5. G.N.Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles and Applications”, Narosa Publishing House, 2004.
6. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, second edition, John Wiley, New York, 1991
7. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000
8. D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.
9. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.

**Reliability Analysis (POEEE304)**

**Module I**

Reliability Mathematics: Classical set theory, Boolean algebra, Sample space, Definitions of probability,

Basic properties of probability, Independent events, Conditional probability, Bayes’ theorem, Random

variables.

Probability distributions: Cumulative distributions, Mathematical expectation, Variance, Covariance and

correlation, Probability distributions, Markov processes, Random number generation.

**Module II**

Reliability Data Analysis: The reliability function, Mean time to failure, Variance, The bathtub curve,

Linear hazard models, Other hazard models, Analysis of failure data, Probability graph papers, Hazard

function plots, Selection of a distribution, Statistical estimation of failure data, Interval estimates.

System Reliability Modelling: System modelling, Assumptions for modelling, Two state modelling,

Three-state models.

**Module III**

Reliability Evaluation Techniques: Non path sets or cut sets approaches, Tie set and cut set approaches,

Reliability evaluation of flow networks, Path sets/cut sets enumeration.

Maintainability Analysis: Measures of system performance, State space approach, Network approach,

Conditional probability approach, Three state systems, Preventive maintenance, Condition-based

maintenance.

**Text Books**

* + - 1. K.B. Mishra, ‘Reliability Analysis and Prediction’, Volume 15, 1st Edition, 1992, Elsevier Science.
      2. Shelemyahu Zacks, ‘Introduction to Reliability Analysis’, 1 st Edition, 1992, Springer-Verlag New York.
      3. Gardoni Paolo (Ed.), ‘Risk and Reliability Analysis: Theory and Applications’, 1st Edition, 2017, Springer Series in Reliability.
      4. Birolini Alessandro, ‘Reliability Engineering Theory and Practice’, 1st Edition, 2004, Springer.

**Open Elective Courses**

**Offered by**

**Department of Instrumentation and Electronics Engineering**

**Artificial Intelligence (POEIE301)**

**Prerequisites:**

Introductory courses on probability theory and linear algebra, Fundamentals of Calculus, transformation geometry.

**Course Outcomes:**

At the end of the course, students will be able to,

1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
2. Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
3. Develop strategies for agents in games of perfect and imperfect information
4. Formulate and solve problems with uncertain information using Bayesian approaches.
5. Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.

**Module I**

What is AI (Artificial Intelligence)? The AI Problems, The Underlying Assumption, What are AI? Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System, Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

**Module II**

Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Symbolic Reasoning Under Uncertainty: Introduction to No Monotonic Reasoning, Logics for Non-Monotonic Reasoning. Statistical Reasoning: Probability and Baye’s Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory

**Module III**

Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC.

Game Playing: Overview, And Example Domain: Overview, Min-Max, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction.

Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse and Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, learning in Neural Network, Application of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI and Symbolic AI.

**Text Books:**

1. Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill, 2005.
2. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2009

**Reference Books:**

1. J.S.R. Jng, C.T. Sun and E. Mizutani, “Neuro-fuzzy and Soft Computing”, PHI.
2. S. Rajasekaran, G.A. Vijaylakshmi Pai: Neural Networks, Fuzzy Logic, and Genetic Algorithms,” PHI.

**Parallel Processing (POEIE302)**

**Prerequisites:** Computer Network

**Course Outcomes:**

At the end of the course, the student will be able to,

1. Design and analyse the parallel algorithms for real world problems and implement them on available parallel computer systems.
2. Optimize the performance of a parallel program to suit a particular hardware and software environment.
3. Design algorithms suited for Multicore processor systems using Open CL, OpenMP, Threading techniques.
4. Analyse the communication overhead of interconnection networks and modify the algorithms to meet the requirements.

**Module I**

Introduction to Parallel Architectures: Why Parallel Architectures, Diversity and Convergence of Parallel Architectures, Fundamental Design Issues

Parallel Programming and Workload-Driven Evaluation: The Parallelization Process, Workload-Driven Evaluation

**Module II**

Cache Coherent Bus-Based Multiprocessors: Cache Coherence and Bus Snooping, Design Space for Snooping Protocols, Single-Level Caches with an Atomic Bus Multilevel Cache Hierarchies, Split-Transaction Bus Design, Sequential Consistency, Relaxed memory consistency models Synchronization: Mutual Exclusion, Event, and Barrier Synchronization, Algorithms for locks and barriers

**Module III**

Directory-Based Cache Coherent Multiprocessors: Directory-Based Approaches, Memory-Based Directory Protocols, Cache-Based Directory Protocols, Hierarchical Coherence

Vector Processors: Vector Programming Model, Vector Instruction Set and its advantages, Vector Arithmetic Execution, Vector Memory System Interconnection Networks: Organizational Structure, Topologies, Routing, Switch Design, Flow Control, Communication Performance

**Text Books:**

1. Parallel Computer Architecture: A Hardware/Software Approach by David E. Culler and Jaswinder Pal Singh with Anoop Gupta. Morgan-Kaufmann Publishers, Inc. ISBN 1-55860-343-3
2. John Hennessy and David Patterson, Computer Architecture: A Quantitative Approach, Fourth Edition, Morgan Kaufmann Publishers, 2006, ISBN: 0-12-370490-1

**Reference Books:**

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education 2007
2. Michael J. Quinn (2004), Parallel Programming in C with MPI and OpenMP McGraw Hill International Editions, Computer Science Series,

**Machine Learning (POEIE303)**

**Prerequisite:**

Theory of Probability and Statistic, Basics of image processing and signal processing.

**Course outcome:**

At the end of this course student will be able to:

1. Evaluate and compare solutions by various learning approaches for a given problem.

2. Apply deep learning to combinatorial optimization problems.

3. Provide you with the knowledge and expertise to become a proficient data scientist.

4. Without the knowledge of IOT design system for pattern analysis.

**Module I**

Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes; Linear models: Linear Regression, Polynomial Regression, Logistic Regression, Generalized Linear Models; Support Vector Machines, Random Forests, Nonlinearity and Kernel Methods

**Module II**

Unsupervised Learning: Clustering: K-means/Kernel K-means; Dimensionality Reduction: PCA and kernel PCA; Matrix Factorization and Matrix Completion; Generative Models (mixture models and latent factor models)

**Module III**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging); Sparse Modeling and Estimation, Deep Learning and Feature Representation Learning

**Text Books:**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)

**Reference Book:**

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

**Open Elective Courses**

**Offered by**

**Department of Information Technology**

**Machine Learning and Data Science (POEIT301)**

**Prerequisites**

Programming Basics, Linear Algebra, Artificial intelligence

**Course Outcomes**

1. Select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
2. Understand classification and regression problems
3. Analyze statistical techniques for machine learning
4. Explain different clustering techniques and their importance

**Module I:**

Introduction: well-posed learning problems, designing a learning system, perspectives and issues in machine learning, concept learning and the general-to-specific ordering: Introduction, Concept learning task, concept learning as search Decision tree learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

**Module II:**

Artificial Neural Networks: Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, multilayer networks and the back propagation algorithm, Linear Models for Regression, Support Vector Machine, Kernel function and Kernel SVM.

Probability and Bayesian learning: Introduction, Bayes Theorem, Bayes theorem and concept Learning, maximum likelihood and least-squared error hypotheses, Bayes optimal classifier, Naïve Bayes Classifier, example to illustrate Naïve Bayes classifier.

**Module-III:**

Instance-Based Learning: Introduction, K-Nearest Neighbor Learning, Radial Basis Functions. Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model, Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

**Text Book**

1. Machine Learning by Tom Mitchell, First Edition, McGraw- Hill, 1997
2. An Introduction to Machine Learning by Miroslav Kubat, Second Edition, Springer

**Reference Books**

1. Introduction to Machine Learning by Ethem Alpaydin, 3rd edition, MIT Press
2. Machine Learning: A Probabilistic Perspective by Kevin P. MurphyMIT Press, 2012.

**Parallel and Distributed System (POEIT302)**

**Prerequisites**

Systems Programming, Operating Systems

**Course Outcomes**

1. Understand the requirements for programming parallel systems and how they can be used to facilitate the programming of concurrent systems.
2. Learn and apply knowledge of parallel and distributed computing techniques and methodologies
3. Understand the memory hierarchy and cost-performance tradeoffs.
4. Gain experience in the design, development, and performance analysis of parallel and distributed applications

**Module – I:**

Introduction to parallel computing, Parallel programming platforms: Trends in microprocessor Architectures, Limitations of memory system performance, Dichotomy of parallel computing platforms, physical organization of parallel platforms, communication costs in parallel machines, Routing mechanisms for interconnection network, Impact of process processors mapping and mapping techniques.

**Module – II:**

Principles of parallel algorithm design: Preliminaries, Decomposition techniques, Characteristics of tasks and interactions, Mapping techniques for load balancing, Methods for containing. Interactions overheads, Parallel algorithm models. Basic communication operations: One-to-All Broadcast and All-to-One Reduction, All-to-All broadcast and reduction All-Reduce and prefix sum operations, scatter and gather, All-to-All personalized communication, circular shift, Improving the speed of some communication operation.

**Module – III:**

Analytical modeling of parallel programs: Performance metrics for parallel systems, Effect of granularity of performance, scalability of parallel system, Minimum execution time and minimum cost-optimal execution time, Asymptotic analysis of parallel programs, other scalability metrics. Programming using the message passing paradigm:

Principle of message – Passing programming, Send and receive operations, the message passing interface, Topologies and embedding, Overlapping communication with computation, collective communication and computation operations, Groups and communicators.

Dense matrix algorithm: Matrix-vector multiplication, Matrix-matrix algorithm, Solving a system of linear equations.

**Text Book:**

* 1. Introduction to Parallel Computing, Second Edition, Ananth Gram, Anshul Gupta, George Karypis, Vipin Kumar Person Education.
  2. Parallel computing Theory and Practice, Second Edition, Michael J. Quinn, TMH.

**Open Elective Courses**

**Offered by**

**Department of Mechanical Engineering**

**Tribology (POEME301)**

**Module-I**

Introduction-Historical background, Bearing concepts and typical applications. Viscous flow concepts-Conservation of laws and its derivations: continuity, momentum (N-S equations) and energy, Solutions of Navier-Strokes equations. Order of magnitude analysis, General Reynolds equation-2D and 3D (Cartesian and Cylindrical), Various mechanisms of pressure development in an oil film, Performance parameters.;

**Module-II**

Boundary Layer Concepts-Laminar and turbulent flow in bearings, mathematical modeling of flow in high-speed bearings. Elastic Deformation of bearing surfaces-Contact of smooth and rough solid surfaces, elasticity equation, Stress distribution and local deformation in mating surfaces due to loadings, methods to avoid singularity effects,

**Module-III**

Estimation of elastic deformation by numerical Methods-Finite Difference; Method (FDM), Governing equation for evaluation of film thickness in Elasto Hydrodynamic Lubrication (EHL) and its solution, Boundary conditions. Development of computer.; Programs for mathematical modeling of flow in bearings, Numerical simulation of elastic deformation in bearing surfaces by FDM.

**Text Books:**

1. B. C. Majumdar, *Introduction to Tribology of Bearings.*
2. Dr S. P. Srivastava, *Lubricants Additives & Tribology*, 2008, Tech book international, New Delhi

**Composite Materials (POEME302)**

**Module I**

Review on definition, classification & fabrication technologies of composites. Principles of composites, micromechanics of composites. Various types of reinforcements and their properties. Role of interfaces.

**Module II**

Fabrication of metal matrix composites: insitu, dispersion hardened, particle, whisker and fibre reinforced; composite coatings by electro deposition and spray forming. ; Fabrication of polymeric and ceramic matrix composites.

**Module III**

Mechanical physical properties of composites. Mechanisms of fracture in composites. Property evaluation and NDT of composites. Wear and environmental effects in composites.

**Text Books:**

1. Mechanics of composite materials, R. M. Jones, Mc Graw Hill Book Co.
2. Mechanics of composite materials & structures, M Mukhopadhay, Universities Press.
3. Fiber-Reinforced composite materials, Manufacturing & Design, P. K. Mallick, Marcel Dekken, Inc. New York & Basel.

**Reference Books:**

1. Composites, Engineered Materials Handbook, Vol.1, ASM International, Ohio, 1988.
2. F.L. Matthews and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, London, 1994.
3. Weinheim, Structure and Properties of Composites, Materials Science &Technology, Vol. 13, VCH, Germany, 1993.
4. J. Prasad /CGK Nair, NDT and Evaluation of Materials, Mc Graw Hill

**Project Management (POEME303)**

**Module** ‐ **1**

Project Management Concepts and Needs Identification

Attributes of a Project, Project Life Cycle, The Project management Process, Benefits of Project Management, Needs Identification, Project Selection.

Project feasibility Analysis: Technical feasibility, commercial and financial visibility, Environment Analysis.

Project organization and staffing, Responsibilities of the Project Manager

**Module - 2**

**Project Planning and Scheduling:**

Design of project management system; work breakdown structure, project execution plan, work packaging plan, project procedure manual; project scheduling; bar charts, line of balance (LOB) and Network Techniques (PERT / CPM), Resource allocation, Crashing and Resource Sharing, capacity planning and expansion capacity decision.

**Module - 3**

**Project Monitoring and Control and Project Performance**

Planning, Monitoring and Control; Design of monitoring system; Computerized PMIS (Project Management Information System). Project Risk Management; Scope/Progress control, Performance control, Schedule control, Cost control, Performance Indicators; Project Audit; Project Audit Life Cycle, Responsibilities of Evaluator/ Auditor.

**Books:**

1. Project Planning, Analysis, Selection, Financing, Prasana Chandra, TMH

2. Project Management, Grey, TMH.

3. Project Management, Richman, PHI

4. Project Management, Vasant Desai, HPH

5. Project Management, Bhavesh M.Patel, Vikash

6. Project Engineering & Management- Prasanna Chandra, Prentice Hall.

7. Project management, S Choudhury, Tata McGraw Hill

**Computer Aided Design and Rapid Prototyping (POEME304)**

**Module I**

Raster graphics and volume graphics. Video basics. Display devices and interactive devices; 2-D and 3-D graphics primitives. Clipping in 2-D and 3-D; Generation and projection of 3-D wire frame solid models, polygonal models. Space curves and surface models. Intersection of surfaces and blending; hidden line and hidden surface elimination algorithms. Ray-surface intersection and inverse mapping algorithms. Ray tracing for photo realistic rendering. Illumination models. Shading, Transparency, Shadowing and Texture mapping; Representation of colours.

**Module II**

Visualization of experimental and simulated data. Surface construction from scattered data, 3-D data arrays and 2-D cross sections. Elevation maps, topological maps, contour maps and intensity maps; fractals for visualization of complex and large data sets. Algebraic stochastic and Geometrical fractals. Modeling of natural forms and textures using fractals; Visualization of multi variate relations. Flow visualization and hyper streamlines; visualization of Metrological, cosmological, seismic, biological data for scientific decision making.

**Module III**

Animation, Modeling issues in dynamic visualization. Behavioral animation; walk through coordinate transformation and view transformation; virtual reality interfaces. Interactive and immersive systems for prototyping and visualization; Visualization in concurrent engineering. Interactive multimedia technology and standards for Video-Graphics-Audio integration and tele-video conferencing.

**Text Books:**

1. CAD/CAM: Computer-Aided Design and Manufacturing - M. P. Groover and E.W. Zimmer, PHI, 1995

**Reference Books:**

1. AutoCAD 2002 - New Riders, Techmedia
2. Computer Aided Analysis and Design of Machine Elements - V. D. Rao, M. Ananda Rao and Rama Bhat. New Age International.

**Quality Engineering and Management (POEME305)**

**Module - 1**

Attributes of quality, Evolution of philosophy of Quality Management, Economics of quality and measurement of cost of quality, Data presentation techniques for quality analysis,

Statistical process control, Use of control charts and process engineering techniques for implementing quality plan, Machine and process capability analysis, statistical tolerance analysis, Acceptance sampling: Single, double and multiple sampling plans, Acceptance sampling for variables

**Module - 2**

Reliability analysis and predictions, Bath-Tub Curve, Exponential and Weibull distribution in modelling reliability, System reliability

Experimental designs and factorial experiments: 2k factorial experiments, Taguchi philosophy; Loss function; Signal to noise ratio, Orthogonal arrays for parameter and tolerance design.

**Module - 3**

Fundamentals of TQM: Customer orientation, Continuous improvement, Total participation; Some important philosophies and their impact on quality (Deming, Juran,Crossby), QC Tools, Components of Total Quality System (TQS), Quality audit,

Introduction to ISO 9000 and 14000 standards.

**Books:**

1. Fundamental of Quality Control and Improvement, Mitra A, PHI
2. Quality Planning and Analysis, Juran J M and Gryna F M, Tata McGraw Hill”

**Computational Fluid Dynamics (ME) (POEME306)**

**Module I**

Introduction: Basic tools of CFD, Numerical Vs experimental tools.; Mathematical Behavior of PDEs: Parabolic, Hyperbolic and Elliptic PDEs.; Methodology of CFDHT: Discrete representation of flow and heat transfer domain: Grid generation, Governing equations and boundary conditions based on FVM/FDM, Solution of resulting set of linear algebraic equations, Graphical representation and analysis of qualitative results,

**Module II**

Error analysis in discretization using FVM/FDM, Solution of 1-D/2-D steady/unsteady: Diffusion problems, Convection problems, Convection-diffusion problems, source term linearization; Explicit and Implicit Approach: Explicit and implicit formulation of unsteady problems, Von Numann Stability analysis.

**Module III**

Solution of Navier-Stokes Equations for Incompressible Flows: Staggered and collocated grid system, SIMPLE and SIMPLER algorithms.; Special Topics in CFDHT: Numerical Methodology for Complex Geometry, Multi-block structured grid system, Solution of phase change Problems. Particle dispersion technique and its tracking by ultrasonic dispersion method.

**Books**

1. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor and Francis, ISBN-10: 089116522

**Supplementary Reading:**

1. H. K. Versteeg and W. Malalasekra, Introduction to Computational Fluid Dynamics: The Finite Volume Method, Prentice Hall (2nd Edition), ISBN-10:0131274988.
2. Jr. D. A. Anderson, Computational Fluid Mechanics and Heat Transfer by McGraw-Hill Education
3. M. N. Ozisik, Finite Difference Method, CRC (1stEdition).

**Open Elective Courses**

**Offered by**

**Department of Textile Engineering**

**Polymer and Fiber Chemistry (POETE301)**

**MODULE I**

Introduction to natural and synthetic polymers; Terms and fundamental concepts; Step-growth polymerization, Carother’s equation, Functionality, Crosslinking; PET manufacturing; Chain growth polymerization, Free radical polymerization, Kinetics of free-radical initiation, termination, chain transfer, Mayo’s equation, cage effect, auto acceleration, inhibition and retardation; Polypropylene manufacturing; Acrylic manufacturing; Atom transfer radical polymerization, ionic polymerization, ring opening polymerization;

**MODULE II**

Nylon-6 manufacturing; Co-polymerization and its importance. Copolymer equation, reactivity ratio, tailor making of copolymer properties; Techniques of chain polymerization; Bulk, solution, emulsion, micro emulsion and suspension polymerization;

**MODULE III**

Chemical Modification of fibres; Polymer solution, Flory's theory; Interaction parameter; Molecular weight and its distribution by: End group analysis, osmometry, light scattering, ultra-centrifugation, gel permeation chromatography, intrinsic viscosity;

Spectroscopic methods of polymer characterization such as, FTIR. UV, NMR.

**Text Books:**

1. Instrumental Methods of Analysis, 7thEdition by H.H. Willard; L.L. Merritt, John A Dean, Frank A Settle, Jr. CBS Publishers & Distribution Delhi.
2. Instrumental Methods of Chemical Analysis, 5th Edition by Galen W. Ewing.
3. Basic Concepts of Analytical Chemistry, 2nd Edition by S.M. Khopkar
4. The Analytical Chemistry of Synthetic dyes Edited by K. Venkataraman. Wiley–Interscience Pub. John Wiley & Sons New York.
5. Hand Book of Textile Testing Part 1to4, Bureau of Indian Standards.
6. Instrumental Analysis of Cotton Cellulose & Modified Cotton Cellulose–Robert T. O’Connor.
7. Textile Laboratory Manual–W–Garner Vol. I &II.
8. Physical Methods of Investigating Textiles–EDR. Meredith & J.W.S. Hearle.
9. Seymour ’s Polymer Chemistry, Marcel Dekker, Inc.
10. Principles of Polymerization G. Odian: John Wiley.
11. Text Book of Polymer Science F.W. Billmeyer: John Wiley.
12. Polymer Science & Technology, P. Ghosh: Tata McGraw Hill
13. Journals

**Technology of solution spun fibers (POETE302)**

**Module I**

PAN properties; Solution rheology and its dependence on parameters. Effect of parameterson entanglement density, fibre spinning and subsequent drawing; Various solvent systems; Dope preparation; Wet and dry spinning processes; Effect of process parameters such as dope concentration, bath concentration, temperature and jet stretch ratio on coagulation rate, fibre breakage and fibre structure;

**Module II**

Modeling of coagulation process; properties and structure of dry and wet spun fibres; Dry jet wet spinning. Solution spinning of PAN. Bicomponent and bulk acrylic fibres. Acrylic fibre line, crimping and annealing, tow to top conversion systems; Viscose rayon process, Spinning with and without zinc sulfate; Polynosics and high performance cellulosic fibre; Non viscose processes, Lyocell spinning process, structure and properties; Gel spinning of PE, Gel spinning of PAN and PVA.

**Module III**

Introduction to high performance fibres and their spinning systems such as rigid rod polymer, liquid crystalline polymers, polylactic acid and spandex fibre manufacturing.

**Recommended Books:**

1. Billmeyer, Fred W., and Fred W. Billmeyer. Textbook of polymer science. Vol. 19842. New York: Wiley, 1984.
2. Cook, J. Gordon. Handbook of textile fibres: man-made fibres. Elsevier, 1984.
3. Lewin, Menachem. Handbook of fiber chemistry. Crc press, 2006.
4. Mishra, S. P. A text book of fibre science and technology. New Age International, 2000.
5. Gupta, V. B., and V. K. Kothari, eds. Manufactured fibre technology. Springer Science & Business Media, 2012.
6. Murthy, HV Sreenivasa. Introduction to textile fibres. WPI Publishing, 2018.
7. Moncrieff, Robert Wighton. Man Made Fibres. 1966.
8. Hearle, John WS, and William Ernest Morton. Physical properties of textile fibres. Elsevier, 2008.
9. Gowariker V R, Viswanathan N V and Sridhar J. Polymer Science, New Age International Ltd., New Delhi, 1996.
10. Vaidya, A. A. Production of synthetic fibres. Prentice-Hall of India Private Limited, 1988.
11. Meredith, Reginald. Mechanical Properties of Textile Fibres. (1956).
12. Ugbolue, S C O. Structure/property relationships in textile fibres. Textile progress 20, no. 4 (1990): 1-43.

**Open Elective Courses**

**Offered by**

**Department of Mathematics and Humanities**

**Optimization Techniques (POEMH301)**

**Module-I**

Integer Programming: Integer Programming Problem, Importance and application of Integer Programming Problem, Gromory cutting plane method and fractional cut method, Branch and Bound algorithm, Zero one programming problem, Travelling sales programming.

Dynamic Programming: Decision tree Bellman Principle of optimality, characteristics of DPP and Application of DPP to find maximum and minimum value.

**Module-II**

Non-Linear programming: Introduction to Non-Linear programming, Single variable optimization, Multivariate Optimization, Stochastic programming, Powell’s method of Conjugate Directions.

Unconstrained Optimization: Optimization without constraints, Conjugate Gradient method, Fibonacci Search Method, Golden Section Search Method, Steepest Descent Method, Newton’s, Quasi-Newton’s Method.

Constrained Optimization: Multivariate Optimization with equality constraints i.e Lagrange Multiplier and in-equality constraints i.e Kuhn-Tucker condition, Primal-Dual Method.

**Module-III**

Goal Programming Problem: Goal Programming model formulation, goal Programming algorithm. Constraint and Unconstraint Optimization with initial Point: Project Gradient method, Penalty function method, Interior Penalty function method, Exterior Penalty function method, Generalized Reduced Gradient Method, Geometric Programming.

**Text Books**

1. Ashok D Belegundu, A R Chandrupatla, Second Edition Cambridge University Press.
2. A.Ravindran, D.T.Phillip, .J.solberg, “Operations Research-Principle and Practice”, 2nd edition, Wiley India Pvt Ltd.

**Reference Books**

1. A. Ravindran, K.m.Rasdell, G.V. Reklaitis, “Engineering optimization” 2nd edition, Wiley India Pvt. Ltd.
2. Kalyamoy Ded, “Optimization for Engineering Design”, PHI Learning Pvt Ltd
3. 3. Stephen G. Nash, A. Sofer,” Linear and Non-Linear Programming”, McGraw Hill
4. H.A.Taha, A.M.natarajan, P. Balasubramanie, A.Tamilarasi, ‘Operations Research” 8th Edition Pearson Education.

**Modelling and Simulation Techniques (POEMH302)**

**Course Outcomes:**

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

1. Identify and model discrete systems (deterministic and random)

2. Identify and model discrete signals (deterministic and random)

3. Apply modelling and simulation techniques to characterize systems/processes.

**Module I**

Introduction Circuits as dynamic systems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.

Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.

**Module II**

Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, MonteCarlo Methods. Stochastic Processes and Markov Chains, Time Series Models.

**Module III**

Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.

Continuous simulation: Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics.

**Text Books:**

1. R. L. Woods and K. L. Lawrence, “Modeling and Simulation of Dynamic Systems”, Prentice-Hall, 1997.
2. Z. Navalih, “VHDL Analysis and Modelling of Digital Systems”, McGraw-Hill, 1993.
3. J. Banks, JS. Carson and B. Nelson, “Discrete-Event System Simulation”, 2nd Edition, Prentice-Hall of India, 1996.

**Numerical Analysis (POEMH304)**

**Module 1**

Errors, different type of errors. Representation of numbers in computer, computer arithmetic, zero in floating point number.

Operators –finite differences, average, differential, etc., their inter-relations. Difference of polynomials. Difference equation.

Interpolation. Lagrange’s methods, error terms. Uniqueness of interpolating polynomial. Newton’s fundamental interpolation. Forward, backward and central difference interpolations. Interpolation by iteration.

Spline interpolation, comparison with Newton’s interpolation. Hermite’s interpolation. Bivariate interpolation, Lagrange and Newton’s methods. Inverse interpolation.

**Module 2**

Approximation of function. Least square method. Use of orthogonal polynomials. Approximation by Chebyshev polynomials, Max-min principle. Economization of power series.

Solution of non-linear equation containing one variable. Newton’s methods. Modified Newton-Raphson method. Birge-Vieta method, Bairstow method. System of non-linear equations-iteration and Newton Raphson methods.

System of linear equations. Iteration methods, rate of convergence. Matrix factorization methods. Tridiagonal equations. Least square method for inconsistent system. Ill conditioned systems. Relaxation method.

Eigenvalues and eigenvectors of matrix. Leverrier-Faddeev method. Power method. Jacobi’s method, Givens method, Householder’s method. Comparisons.

Differentiation. Lagrange’s method.

**Module 3**

Gauss-quadrature. Degree of precision. Gauss-Legendre and Gauss-Chebyshev methods. Double integration. Monte-Carlo method.

Ordinary differential equation. Euler’s method. Runge-Kutta methods. Predictor-corrector method. Finite-difference method. IVP and BVP. Shooting method. Stability analysis.

Partial differential equation. Finite-difference approximation. Explicit methods. Crank-Nivolson method. Parabolic, hyperbolic and elliptic equation. Stability.

**Books**

1. Numerical Methods for Scientists and Engineers, R. W. Hamming
2. Analysis of Numerical Methods, Isaacson and Keller
3. Numerical Mathematics and Computing by E. Ward Cheney and David R. Kincaid
4. Introductory Methods of Numerical Analysis by Sastry SS
5. Theoretical Numerical Analysis: A Functional Analysis Framework, K. Atkinson, W. Han