JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech in ENVIRONMENTAL ENGINEERING
Effective from Academic Year 2025 – 26 admitted batch
R25 COURSE STRUCTURE AND SYLLABUS

I YEAR I – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core - I	Wastewater Engineering	3	0	0	3
Professional Core - II	Environmental Chemistry and Microbiology	3	0	0	3
Professional Elective - I	1. Computational and Statistical Methods 2. Environmental System Engineering 3. Eco system-based Disaster Risk Reduction	3	0	0	3
Professional Elective - II	1. Remote Sensing and GIS 2. Environmental Impact Assessment 3. Water Supply Systems	3	0	0	3
Lab - I	Water and Wastewater Lab	0	0	4	2
Lab - II	Microbiology lab	0	0	4	2
	Research Methodology and IPR	2	0	0	2
Audit - I	Audit Course - I	2	0	0	0
	Total	**16**	**0**	**8**	**18**

I YEAR II – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Core - III	Air Pollution and Control	3	0	0	3
Professional Core - IV	Solid and Hazardous Waste Management	3	0	0	3
Professional Elective - III	1. Water Quality Modeling 2. Environmental Hydrology 3. Environmental Structures	3	0	0	3
Professional Elective - IV	1. Climate Change Modeling 2. Industrial Waste Management 3. Remediation Technologies	3	0	0	3
Lab - III	Air Quality Management Lab	0	0	4	2
Lab - IV	Computational Lab	0	0	4	2
	Mini Project with Seminar	0	0	4	2
Audit - II	Audit Course - II	2	0	0	0
	Total	**14**	**0**	**12**	**18**

II YEAR I – SEMESTER

Course Code	Course Title	L	T	P	Credits
Professional Elective - V	1. Environmental Biotechnology 2. Instrumental Methods of Analysis 3. Rural Water Supply and Environmental Sanitation	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review -II	0	0	18	6
	Total	**6**	**0**	**18**	**12**

II YEAR II - SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review -III	0	0	18	6
Dissertation	Dissertation Viva-Voce	0	0	42	14
	Total	**0**	**0**	**60**	**20**

***For Dissertation Work Review-I, Please R25 Academic Regulations.**

Audit Course I & II:

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

Open Electives

1. Energy from Waste
2. Environmental Pollution and Control

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
WASTE WATER ENGINEERING

Course Objectives:

- Understand wastewater quality parameters and biological treatment processes **so students can identify the key contaminants and evaluate appropriate biological solutions for treatment.**
- Explain the kinetics and modeling of microbial growth in suspended growth systems **for designing and optimizing conventional and advanced wastewater treatment units.**
- Describe the concepts and principles of carbon oxidation, nutrient transformation (nitrification, denitrification, methanogenesis), and biological nutrient removal **to analyze key reactions impacting treatment performance.**
- Evaluate technologies and design approaches for anaerobic treatment, attached growth reactors, decentralized systems, and constructed wetlands **to address a variety of treatment needs.**
- Assess and design the full spectrum of wastewater treatment infrastructure—including pretreatment, secondary/tertiary systems, and sludge management—while considering reliability and cost-effectiveness, including responses to emerging contaminants

Couse Outcomes:

- **Students will be able to analyze and interpret wastewater quality parameters and select suitable biological treatment processes** for various types of wastewater.
- **Students will develop models simulating microbial growth kinetics and suspended growth system performance** to guide process selection and optimization.
- **Students will demonstrate the ability to design and evaluate processes for carbon oxidation, nutrient removal (nitrogen, phosphorus), and advanced biological cycles like methanogenesis** in wastewater systems.
- **Students will formulate solutions using anaerobic and attached growth systems, including decentralized and wetland-based treatments, to meet context-specific requirements**.

UNIT - I
Wastewater quality parameters, Biological processes; Microbial growth kinetics; Modeling of suspended growth systems;

UNIT - II
concepts and principles of carbon oxidation, nitrification, denitrification, methanogenasis. Biological nutrient removal;

UNIT - III
Anaerobic treatment; Attached growth reactors; decentralized wastewater treatment systems; constructed wetlands;

UNIT - IV
Design of pretreatment, secondary treatment, and tertiary disposal systems. Sludge stabilization, treatment, sludge thickening, sludge drying, aerobic and anaerobic digestion of sludges

UNIT - V
reliability and cost effectiveness of wastewater systems; Emerging contaminants in wastewater-treatment issues

REFERENCES:

1. Tchobanoglous,G. and Burton, F.L. Wastewater Engineering: Treatment, Disposal and Reuse. McGraw-Hill Publishing Company. 2002.
2. Maier, R.M., Pepper, I.L., and Gerba, C.P. Environmental Microbiology, Academic Press. 2000.
3. Pelczar, M.J.Michael, Chan, E.C.S., and Krieg, N.R. Microbiology. The McGraw-Hill Companies, Inc.. 2001.
4. Ahluwalia, P. and Nema, A.K. Water and wastewater systems: Source, treatment, conveyance and disposal. S.K. Kataria & Sons. 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Course Objectives: The course is designed to:

- **Introduce fundamental concepts of environmental chemistry** including chemical reactions, equilibria, thermodynamics, and gas laws relevant to environmental systems.
- **Explain acid-base, solubility, and redox equilibria** with emphasis on their role in water and wastewater treatment processes.
- **Develop understanding of electrochemical processes** such as corrosion, water stabilization, and water softening techniques.
- **Provide foundational knowledge of environmental microbiology** including classification, morphology, and growth of microorganisms.
- **Familiarize students with microbial processes** in water, wastewater, and industrial environments, including disease-causing agents and their control.

Course Outcomes: On completion of this course, students will be able to:

- **Apply basic chemical principles** to analyze and solve problems related to environmental systems and pollution control.
- **Interpret acid-base, solubility, and redox equilibria** to design and optimize water and wastewater treatment processes.
- **Evaluate corrosion and stabilization problems** in water systems using electrochemical concepts and predictive indices.
- **Identify, classify, and explain microbial structures** and their role in environmental processes.
- **Analyze microbial interactions in domestic, industrial, and natural waters** and recommend appropriate control measures for public health protection.

UNIT-I
Environmental Chemistry Basic concepts from general chemistry: chemical equations, types of chemical reactions, calculations from chemical equations, solutions, activity and activity coefficients, chemical equilibria, chemical thermodynamics, factors affecting chemical equilibrium. Gas laws.

UNIT-II
Acid Base Equilibria: fundamentals, equilibrium diagrams, alkalinity and acidity, the carbonic acid system, buffering inwater systems, measuring alkalinity. Solubility Equilibria: Solubility equlilibria for slightly soluble salts, effect of other solutes on salt solubility, removal of heavy metals from complex water and wastewater systems

UNIT-III
Oxidation reduction Equlilibria: oxidation reduction processes galvanic cell and chemical thermodynamics, stability diagrams measuring redox potentials.
Water Stabilization: Electrochemical aspects of corrosion, water stabilization, Langelier saturation index, Caldwell Lawrence diagrams, Water softening and neutralization: chemical precipitation, ion exchange Application of Redox Chemistry:

UNIT-IV
Microbiology: The characterization, classification and identification of microorganisms, morphology and fine structure of bacteria, Reproduction and growth. Pure cultures and cultural characteristics, Enzymes and their regulations.

UNIT-V
Microbial metabolism, energy production, utilization of energy and biosynthesis. Fungi, molds and yeast, algae, protozoa, viruses. Control of microorganisms. Microbiology of domestic water and wastewater, industrial microbiology. Epidemiology of infectious diseases, microbial agents of diseases.

REFERENCES:

1. Sawyer, C. N. and Mc Carty, P. L.: Chemistry for Environmental Engineers, Mc Graw-Hill Book Co., New Delhi, 1990.
2. Standard Methods for the Examination of Water and Wastewater, American Public Health

Association Inc. New York, 1992.
3. Mc Kinney R.E.: Microbiology for sanitary engineers, Mc Graw Hill Book Company Inc., New York, 1962.
4. Liptrot, G. F., Thompson, J.J., and Walker, G. R., Modern Physical Chemistry, ELBS, London, 1984.
5. Brock, T.D.: Biology of Microorganisms, Prentice - Hall, Englewood Cliffs, N.J., 1979.
6. Benefield, L.D., Judkins, J.F. and Weand, B.L.: Process Chemistry of Water and Wastewater, Prentice Hall Inc., 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
COMPUTATIONAL AND STATISTICAL METHODS (PE - I)

Course Objectives: The course aims to:

- **Introduce numerical techniques** for solving ordinary and partial differential equations relevant to environmental engineering problems.
- **Develop proficiency in finite difference methods** and iterative techniques for solving steady and unsteady environmental models.
- **Provide knowledge of probability and statistical methods** for the classification, analysis, and interpretation of environmental data.
- **Apply regression analysis techniques** for environmental modeling, prediction, and decision-making.
- **Familiarize students with fuzzy logic and neural network concepts** for solving complex, uncertain, and nonlinear environmental problems.

Course Outcomes: On successful completion of this course, students will be able to:

- **Apply numerical methods** such as Taylor's series, Euler's method, and Runge–Kutta to solve ODEs and boundary value problems in environmental contexts.
- **Implement finite difference and iterative methods** to model and solve real-world problems like flood routing and groundwater flow.
- **Analyze and interpret environmental data** using probability distributions, statistical measures, and parameter estimation techniques.
- **Perform regression and correlation analyses** for developing predictive models in environmental studies.
- **Integrate fuzzy logic and neural network models** to address uncertainty and complexity in environmental systems.

UNIT - I
Numerical Solution of Ordinary Differential Equations - Solution by Taylor's Series - Euler's Method – Runge-Kutta Methods - Simultaneous and Higher Order Equations -Boundary Value Problems
- Applications in environmental problems.

UNIT - II
Finite Difference Method - Finite Difference Representation of Differential Equations - Stability - Consistency and Convergence of Partial Differential Equations - Time integration - Finite Difference Methods in Solution of Steady and Unsteady Problem -Jacobi's Method, Gauss Seidel Method, Successive Over Relaxation Method and Method of Characteristics - Application and examples from flood routing studies, groundwater etc.

UNIT - III
Classification and Presentation of Data - Basic Concepts of Probability - Probability Axioms - Analysis and Treatment of Data - Population and Samples - Measures of Central Tendency - Measures of Dispersion - Measures of Symmetry - Measures of Peakedness Probability Distributions - Discrete and Continuous Probability Distribution Functions - Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distributions, Extreme Value Distributions - Transformations to Normal Distributions, Selecting A Probability Distribution, Parameter Estimation - Method of Moments, Method of Maximum Likelihood, Probability Weighted Moments and Least Square Method, Joint Probability Distributions in Environmental Applications.

UNIT - IV
Regression Analysis - Simple Linear Regression, Evaluation of Regression - Confidence Intervals and Tests of Hypotheses - Multiple Linear Regression - Correlation and Regression Analysis, in Environmental Applications

UNIT - V
Fuzzy logic and Neural Networks – Introduction – Concepts of fuzzy logic – Basic Fuzzy Mathematical Operations – Mathematical Model of Neuron, Learning Algorithms – Architecture - Applications

REFERENCES:

1. Akai, T.J, (1994) “Applied Numerical Methods for Engineers”, John Wiley Inc., New York
2. Haan C.T., (1995), “Statistical Methods in Hydrology”, East West Press, New Delhi
3. Huyorkon, P.S. and Pinder, G.F.: "Computational Methods in Subsurface Flow", Academic Press, 1983.
4. Press, W.H., Flannery, B.P. and Tenklsky, S.A. and Vetterling, W.T.: "Numerical Recipes - The Art of Scientific Computing", Cambridge University Press, Cambridge, 1994.
5. Kosko, B (1997), “Neural Networks and Fuzzy Systems”, Prentice Hall of India, N Delhi
6. Abbot, M.A. and Vervey (1996), “Computational Hydraulics”, Elsevier Publications

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
ENVIRONMENTAL SYSTEM ENGINEERING (PE – I)

Course Objectives: The course is designed to:

- **Introduce the fundamental concepts of mole and mass concentration** and review mass balance principles relevant to environmental systems.
- **Explain diffusive transport mechanisms** using Fick's laws and determine molecular diffusion coefficients in air and water.
- **Develop understanding of constitutive transport equations** including continuity, Navier–Stokes, and analogies between mass, momentum, and heat transport.
- **Familiarize students with mass transport theories** (two-film, penetration, surface renewal, boundary layer) and transport in sheared and turbulent flows.
- **Introduce particle and fractal concepts** along with coagulation mechanisms, stability factors, and numerical solution techniques for transport equations.

Course Outcomes: On completion of the course, students will be able to:

- **Apply mass balance and diffusive transport principles** to environmental and engineering problems.
- **Derive and utilize general transport equations** and relate mass, momentum, and heat transport processes.
- **Analyze and apply mass transport theories** to model transport in laminar, turbulent, and sheared systems.
- **Characterize particle size distributions** and determine fractal dimensions for environmental particulate matter.
- **Model and solve coagulation and transport problems** using finite difference and finite volume numerical methods.

UNIT - I
Basic concepts of mole and mass concentration: notations and conventions, Review of mass balance concepts. Diffusive transport: Diffusion and Fick's first law, Calculation of molecular diffusion coefficients in air and water

UNIT - II
The constitutive transport equation: Derivation of general transport equation and special forms ie continuity and NS equations and similarity between equations of mass momentum and heat dispersion laws.

UNIT- III
Theories of mass transport: two film theory, penetration and surface renewal theory, Boundary layer theory. Mass transport correlations Transport in sheared reactors: Fluid shear and turbulence, transport in steady sheared fluids, turbulent sheared fluids, shear rates in mixed reactors

UNIT - IV
Particles and fractals: Introductions, particle size spectra, solid particles and fractal aggregate geometries, measuring and calculating fractal dimensions from particle size distributions.

UNIT - V
Coagulation in natural and engineered systems: Introduction, general coagulation equations, factors affecting the stability of aquasols, coagulation kinetics, fractal coagulation models. Finite difference and Finite volume procedures for solutions of partial differential equations of Mass, Momentum and Energy transport phenomenon

REFERENCES:

1. Bruce E. Logan, Environmental Transport Processes, 2nd Ed., Wiley, 2012.
2. E.L. Cussler, Diffusion: Mass transfer in fluid systems, 3rd Ed., Cambridge University Press, 2007.
3. John S. Gulliver, Introduction to chemical transport in the environment, Cambridge University Press, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
ECOSYSTEM BASED DISASTER RISK REDUCTION (PE – I)

Course Objectives: The course aims to:

- **Introduce fundamental concepts of disasters and risk reduction**, including types, causes, and institutional frameworks at national and state levels.
- **Explain structural and non-structural measures** for disaster risk reduction and highlight capacity development strategies.
- **Analyze case studies** to understand risk, enhance resilience, and improve inter-agency coordination in disaster situations.
- **Familiarize students with economic and policy approaches** for disaster mitigation, including funding mechanisms and the role of geo-informatics.
- **Highlight international cooperation and partnerships** in disaster management, including acceptance of foreign and multilateral assistance.

Course Outcomes: On successful completion of this course, students will be able to:

- **Differentiate between types and levels of disasters** and describe the institutional frameworks for disaster management in India.
- **Identify and evaluate structural and non-structural measures** for reducing disaster risk and enhancing preparedness.
- **Apply lessons from disaster-specific case studies** to propose effective risk reduction and resilience strategies.
- **Assess economic and technological tools** such as disaster funds, plan schemes, and geo-informatics for effective disaster risk mitigation.
- **Explain the role of international cooperation** and partnerships in strengthening disaster management capabilities.

UNIT- I
Disasters, Risk Reduction and Management - Definitions, Disasters, Disaster Management, Disaster Risk Reduction (Mitigation), Types of Disasters, Natural Hazards, Human-Induced Disasters, Levels of Disasters, Institutional Framework - National Level & State Level

UNIT- II
Investing in DRR – Structural Measures, Investing in DRR – Non-Structural Measures, Capacity Development, Hazard-wise Responsibility Matrices for Disaster Risk Mitigation

UNIT- III
Reducing Risk; Enhancing Resilience- Disaster wise case studies example in (a)Understanding Risk, (b)Inter-Agency Coordination, (c)Investing in DRR – Structural Measures & Non-Structural Measures, (d)Capacity Development

UNIT- IV
Economic approaches – National & State Disaster Response Fund, National Disaster Mitigation FundPlan Schemes, Flexi Funds as a part of Centrally Sponsored Schemes, Externally Aided Projects supportive tool –Use of Geo-informatics in DRR, Biodiversity Acts.

UNIT- V
International Cooperation, Participation in International Efforts, Accepting Foreign Assistance Accepting Multilateral Assistance, Fostering Partnerships

REFERENCES:

1. National Disaster Management Plan, 2016. A publication of the National Disaster Management Authority, Government of India. May 2016, New Delhi.
2. Eco System Based Disaster Risk Reduction and Adaptation in practice by Fabrice G. Renaudetal by springer publications.
3. Disaster Management A Disaster Manager's Handbook by W. Nick Carter (Asian Development Bank)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
REMOTE SENSING AND GIS (PE – II)

Course Objectives: The course is designed to:

- **Introduce the fundamentals of remote sensing** including electromagnetic radiation principles, spectral signatures, and energy interactions with the atmosphere and earth's surface.
- **Explain sensor systems and data acquisition techniques** for different spatial, spectral, and radiometric resolutions, including thermal and microwave sensing.
- **Develop skills in digital image processing** techniques such as preprocessing, enhancement, filtering, and pattern recognition for remote sensing data interpretation.
- **Provide knowledge of Geographic Information Systems (GIS)**, including data types, database creation, spatial analysis, and modeling tools.
- **Demonstrate applications of remote sensing and GIS** in water resources, land use mapping, environmental monitoring, and resource management.

Course Outcomes: On successful completion of this course, students will be able to:

- **Explain the principles of electromagnetic radiation and remote sensing** and interpret spectral signatures for various earth surface features.
- **Select appropriate platforms and sensors** for specific remote sensing applications and acquire relevant spatial, spectral, and radiometric data.
- **Apply digital image processing techniques** for enhancement, classification, and interpretation of remote sensing data.
- **Utilize GIS tools** for spatial data management, analysis, and modeling in environmental and engineering applications.
- **Integrate remote sensing and GIS techniques** to solve real-world problems in water resources, land use, environmental monitoring, and planning.

UNIT- I
Introduction: Energy-electromagnetic radiation, radiation principles, electromagnetic spectrum, ideal remote sensing system, energy interaction with atmosphere, atmospheric windows, Energy interaction with earth surface feature, spectral signature, Multi concept of remote sensing.

UNIT- II
Sensor System: Various types of platforms, different types of sensors, Indian remote sensing systems, data acquisition, spatial, spectral & radiometric resolution, thermal sensors, fundamentals of microwave remote sensing.

UNIT- III
Digital Image Processing: Operations involved in Digital Image Processing, source of image acquisition, data preprocessing – atmospheric, radiometric, geometric. Histograms, density slicing, grey level mapping, contrast stretching, filtering, principal component analysis, basic pattern recognition concepts, and discrimination functions. Data Products And Interpretation: Various data products, characteristics, principles of interpretation, ground control points, ground truth.

UNIT- IV
Geographic Information Systems: Definition, functions of GIS, types of data – spatial, non-spatial, point, line, polygon, vector and raster. Database, digitizer, scanner, spatial analysis, overlay, query. Sample analysis, modeling in GIS, DEM, DTM, path analysis. Introduction to GIS packages.

UNIT- V
Application of Remote Sensing and GIS to Water Resources Land Use Land Cover mapping, determination of crop characteristics, ground water, pollutant mapping, snow mapping, rainfall measurement, weather monitoring, soil erosion, soil classification, water shed prioritization, solid waste collection, water supply.

REFERENCES:

1. Meijerink M J, HAM de Brouwer, C M Mannaerts, C R Velenzuela, (1994), "Introduction to the Use of Geographical Information Systems for Practical Hydrology", ITC publication no. 23,

UNESCO, Paris
2. Lillesand T M and R W Keifer (1994), “Remote Sensing and Image Interpretation”, John Wiley & Sons, N York
3. Swain P H and S M Davis (1987), “Remote Sensing – The Quantitative Approach”, McGraw-Hill Pub. Co. N York
4. Agarwal C S and P K Garg (2000), “Textbook on Remote Sensing in Natural Resources Monitoring and Management”, Wheeler Publishing, Allahabad.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
ENVIRONMENTAL IMPACT ASSESSMENT (PE – II)

Course Objectives: The course is designed to:

- **Introduce the concept and importance of Environmental Impact Assessment (EIA)**, its objectives, scope, advantages, and limitations.
- **Familiarize students with environmental indicators** for climate, terrestrial, aquatic, socio-economic, and cultural systems.
- **Analyze environmental issues** related to water resource development, including land use changes, erosion, sedimentation, and water quality impacts.
- **Examine environmental issues in industrial, infrastructure, and energy projects**, including pollution, greenhouse effect, and ecological disturbances.
- **Develop skills in EIA methodologies** such as checklists, matrices, networks, overlays, and benefit–cost analysis for effective project evaluation.

Course Outcomes: On successful completion of this course, students will be able to:

- **Explain the principles and purpose of EIA** and assess its role in sustainable development planning.
- **Select and apply appropriate environmental indicators** for assessing impacts on natural, social, and economic systems.
- **Evaluate the environmental impacts of water resource development projects** and recommend mitigation measures.
- **Assess industrial and infrastructure projects** for potential environmental impacts and long-term ecological effects.
- **Apply suitable EIA methodologies** to analyze, predict, and interpret environmental consequences of proposed projects.

UNIT - I

Introduction: Environment and its interaction with human activities - Environmental imbalances - Attributes, Impacts, Indicators and Measurements -Concept of Environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA

UNIT - II

Environmental Indicators - Indicators for climate - Indicators for terrestrial subsystems - Indicators for aquatic subsystems - Selection of indicators - Socio-economic indicators - Basic information - Indicators for economy - Social indicators - Indicators for health and nutrition - Cultural indicators - Selection of indicators.

UNIT - III

Environmental issues in water resource development - Land use - Soil erosion and their short and long term effects - Disturbance and long term impacts - Changes in quantity and quality of flow - Sedimentation - Environmental impact assessment of water resource development structures - Case studies, Water Quality Impact Assessment - Attributes, Water Quality Impact Assessment of Water Resources Projects, Data Requirements of Water Quality Impact Assessment for Dams, Impacts of Dams on Environment, Case Studies.

UNIT - IV

Environmental Issues in Industrial Development: On-site and Off-site impacts during various stages of industrial development, Long term climatic changes, Green house effect, Industrial effluents and their impact on natural cycle, Environmental impact of Highways, Mining and Energy development.

UNIT - V

Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies Adhoc, Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing A Methodology, Review Criteria.

REFERENCES:

1. Jain, R.K., Urban, L.V., Stracy, G.S., (1991), "Environmental Impact Analysis", Van Nostrand Reinhold Co., New York

2. Rau, J.G. and Wooten, D.C., (1996), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York
3. UNESCO, (1987), "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", UNESCO/UNEP, Paris
4. Canter, L.W., (1997), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
WATER SUPPLY SYSTEMS (PE- II)

Course Objectives: The course is designed to:

- **Introduce water supply requirements and quality standards**, including sources, drinking water standards, and selection of treatment processes.
- **Explain conventional water treatment processes** such as sedimentation, filtration, coagulation, flocculation, and disinfection.
- **Describe advanced treatment techniques** for water softening, nitrate removal, iron and manganese removal, and water stabilization.
- **Discuss methods for taste, odour, algae control, and dissolved salts reduction** including aeration, adsorption, reverse osmosis, and electrodialysis.
- **Familiarize students with water transportation and distribution systems** including hydraulic considerations, design, and storage.

Course Outcomes: On successful completion of this course, students will be able to:

- **Assess water quality parameters** and select appropriate treatment processes to meet drinking water standards.
- **Design and evaluate conventional treatment units** including sedimentation tanks, filters, and disinfection systems.
- **Apply advanced treatment methods** for water softening, iron/manganese removal, and water stabilization.
- **Recommend control strategies** for taste, odour, algae, and dissolved salts in water supply systems.
- **Design water distribution networks** with appropriate hydraulic considerations, reservoir sizing, and system configuration.

UNIT - I
Introduction: Water Requirements, Sources of Water, Water Supply Considerations, Water Quality, Drinking Water Standards, Secondary Standards-Toxic Water Pollutants, Quality Criteria for Surface Water, Purpose of Water Treatment - Selection of Water Processes, Water-Processing Sludges.

UNIT - II
Conventional Treatment Processes: Sedimentation, Type of Sedimentation, Zone Settling, fitration, Gravity Gnadular-Media Fitration, Head Losses, Back Washing and Media Fluidization - Pressure Filters - Slow Sand Filters, Coagulation and Flocculation Coagulants, Coagulants, Coagulant Aids, Rapid Mixing Devices, Disinfection, Disinfection Methods, Cl2 Handling and Dosage, Control of Thms, Fluoridation, Defluoridation.

UNIT - III
Water Softening: Lime Soda Process Variations-Ion Exchange Softening and Nitrate Removal. Iron and Manganese Removal: Iron Corrosion, Water Stabilization-Cathodic Protection.

UNIT - IV
Taste and Odour: Methods for Control, Aeration, Adsorption, Control of Algae Growth. Reduction of Dissolved Salts: Distillation, Reverse Osmosis, Electrodialysis.

UNIT - V
Transportation and Distribution of Water: Aqueducts, Hydraulic Consideration, Design of Transportation System, Distribution System Configuration, Distribution System Design and Analysis, Distribution Reservoirs and Service Storage.

REFERENCES:

1. Viessman Jr., Mark J. Hammer: Water Supply and Pollution Control
2. Peavy H.S., Row D.R. and Tchobanaglous G.: "Environmental Engineering", Mc Graw Hill International Edition, 1988.
3. Fair, Gair, Okun: Water Supply Engineering, John Wiley, 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
WATER AND WASTEWATER LAB

Water & Waste Water samples

1. pH & Solids Analysis
2. Aciditiy& Sulfate Ions
3. Dissolved Oxygen, Chlorides & Hardness
4. Standard Curve, Synthetic Solution Preparation and Glassware Washing and Microbial Decontamination Procedure
5. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

REFERENCES:

1. AWWA, WEF, APHA, 1998, Standard Methods for the Examination of Water and Wastewater
2. Sawyer, C.N., McCarty, P.L., and Parkin, G.F. 2000. Chemistry for Environmental Engineering 4th Edition. Tata McGraw-Hill Publishing Company Limited.

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

MICROBIOLOGY LAB

List of Experiments:

1. Lab safety method and Regulations.
2. Principles and methods of sterilization.
3. Preparation of media: Nutrient broth, Nutrient agar, slants, soft agar
4. Pure culture technique – Pour plate, Spread plate & Streak plate.
5. Measurement of microbes – Micrometry.
6. Motility determination – Hanging drop method.
7. Enumeration of bacterial / yeast cells – Viable count, Total count.
8. Enumeration of bacteria / fungi from environmental samples – Direct and Indirect methods (Haemocytometer & Total viable counts).
9. Staining methods: Simple, Negative, Acid fast, Gram staining, Spore, Flagella, Capsule and Metachromatic granular staining. Staining of fungus – Lacto phenol cotton blue staining.
10. Measurement of growth – Direct count, Viable count – Growth curve, Determination of growth rate and generation time.

REFERENCES:

1. Cappuccino J.G, N.Sherman, (2002), **Microbiology: A Laboratory Manual,** Addison– Wesley.
2. Atlas R. M, A. E. Brown and L. C. Parks, (1995), **Laboratory Manual of Experimental Microbiology,** Mosby, St. Louis.
3. Kannan K., (2002), **Laboratory Manual in General Microbiology**, Panima Publishers.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – I Sem. (Env. Engg.)
RESEARCH METHODOLOGY AND IPR

Course Objectives:

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

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

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

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

UNIT-II:
Effective literature studies approaches, analysis, Plagiarism, Research ethics

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

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

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

TEXT BOOKS:

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

REFERENCES:

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

7. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
AIR POLLUTION AND CONTROL

Course Objectives: The course is designed to:

- **Introduce the fundamentals of air pollution**, including sources, types, effects, and air quality/emission standards.
- **Explain meteorological factors** affecting air pollution dispersion and predictive models for air quality.
- **Describe control methods for particulate pollutants**, including design and operation of dust removal equipment.
- **Discuss control techniques for gaseous pollutants** using chemical, thermal, and physical methods.
- **Familiarize students with automobile pollution control, zoning, legislation, and management strategies** for air pollution prevention.

Course Outcomes: On successful completion of this course, students will be able to:

- **Identify sources, types, and effects of air pollutants** and apply relevant air quality standards.
- **Analyze meteorological parameters** and apply dispersion models to predict pollutant transport and dilution.
- **Design and evaluate particulate control devices** such as cyclones, fabric filters, wet scrubbers, and electrostatic precipitators.
- **Select and design appropriate equipment** for the control of gaseous pollutants using absorption, adsorption, combustion, and condensation.
- **Assess automobile emissions and recommend control strategies**, considering legislation, zoning, and urban planning measures.

UNIT-I
Air Pollution: Definition of Air Pollution - Sources & Classification of Air Pollutants - Effects of air pollution - Global effects - Air Quality and Emission standards - Sampling of Pollutants in ambient air - Stack sampling.

UNIT-II
Meteorology and Air Pollution: Factors influencing air pollution, Wind rose, Mixing Depths, Lapse rates and dispersion - Atmospheric stability, Plume rise and dispersion, Prediction of air quality, Box model - Gaussian model - Dispersion coefficient - Application of tall chimney for Pollutant dispersion.

UNIT-III
Control of Particulate Pollutants: Properties of particulate pollution - Particle size distribution - Control mechanism - Dust removal equipment - Design and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters & ESP.

UNIT-IV
Control of Gaseous Pollutants: Process and equipment for the removal by chemical methods - Design and operation of absorption and adsorption equipment - Combustion and condensation equipment.

UNIT-V
Automobile Pollution and Control; Sources, Theoretical Considerations, Operating conditions Vs Emissions, Pollution control Measures, Emission Standards.Control of Air Pollution: Zoning and site selection – Other Management controls, AP Legislation.

REFERENCES:

1. Rao M.N. (1986), Air Pollution, McGraw Hill.
2. Wark K. & Warner C.F., Air Pollution its origin and Control.
3. Martin Craford (1980), Air Pollution theory, Tata McGraw Hill Publishers
4. Stern A.C. (1968) Air Pollution, Vol. 1 - 5, Academic Press, New York.
5. Perkins H.C. (1974) Air Pollution, Mc Graw Hill Kogakusha Ltd., Tokyo.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)

SOLID AND HAZARDOUS WASTE MANAGEMENT

Course Objectives: The course is designed to:

- **Introduce the composition, sources, and characteristics of solid waste** and their environmental impacts.
- **Explain different waste collection systems** and their suitability for various community setups.
- **Describe disposal methods for segregated and unsegregated waste**, including sanitary landfills, composting, and incineration.
- **Present recovery and recycling techniques** for valuable resources from solid waste.
- **Familiarize students with hazardous waste management** including identification, treatment, and safe disposal.

Course Outcomes: On successful completion of this course, students will be able to:

- **Classify solid waste types** and evaluate their physical composition using standard sampling and analysis procedures.
- **Compare and select appropriate collection systems** based on community needs and waste generation patterns.
- **Design and assess disposal methods** such as sanitary landfilling, composting, and incineration for different waste streams.
- **Apply recovery processes** such as pelletization, refuse-derived fuel production, and material separation techniques.
- **Identify, characterize, and propose management strategies** for hazardous waste in compliance with environmental regulations.

UNIT-I
Composition: Types, Sources and Effects of Solid Waste, Physical Composition, Sampling Procedures for Physical Analysis, Typical Values in Developing and Developed Countries.

UNIT-II
Collection Systems: Communal Collection System, Kerb Side, Alley Side, Block, Set-Out, Set-In Set-Out, Door to Door Collection Systems.

UNIT-III
Disposal Methods for Unsegregated Solid Waste: Open Dumping, Sanitary Landfilling (Trench, Area and Ramp Methods), Environmental Impact Assessment of Sanitary Landfills.Disposal Methods for Segregated Solid Waste: Types, Process Descriptions of Composting and Incineration.

UNIT-IV
Recovery Processes from Solid Waste: Pelletization, Refuse Derived Fuel, Fuel Product Classification, Heating Value, Ferrous Metals, Magnetic Separation, Nonferrous Metals, Mechanical Separation, Floatation Separation, Optical Separation.

UNIT-V
Hazardous Waste Management: Sources and Effects, Characterization, Treatment, Remedial Actions, Secure Landfill.

REFERENCES:

1. Robert A. Corbitt: Standard Handbook of Environmental Engineering, McGraw-Hill, Inc., New Delhi, 1990.
2. Bhide, A.D and Sundaresan, B.B.: Solid Waste Management in Developing Countries, Indian National Scientific Documentation Centre, New Delhi, 1985.
3. Mackenzie L. Davis and David A. Cornwell: Introduction to Environmental Engineering, McGraw-HillInternational Editions, Chemical Engineering Series, New Delhi, 1985.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
WATER QUALITY MODELLING (PE - III)

Course Objectives: The course is designed to:

- **Introduce the concepts of scale and fate processes** in natural environmental systems, along with principles of model formulation, calibration, and validation.
- **Develop the ability to derive generalized mass balance equations** for contaminant transport in incompressible fluids.
- **Explain one-dimensional advection–dispersion–reaction models** for river systems under various pollutant loading scenarios.
- **Describe modeling approaches for estuaries and lakes**, including box models, generalized models, and sediment–water interactions.
- **Familiarize students with wetland modeling** for flow, redox reactions, and transport of heavy metals using equilibrium and kinetic approaches.

Course Outcomes: On successful completion of this course, students will be able to:

- **Formulate and validate environmental models** using calibration, error estimation, and sensitivity analysis.
- **Derive and apply mass balance equations** to describe contaminant transport in water systems.
- **Simulate river water quality** using advection–dispersion–reaction models for different pollutant sources and sediment interactions.
- **Apply estuary and lake models** to predict hydrodynamic and water quality changes under various environmental conditions.
- **Model wetland systems** for flow, redox chemistry, and heavy metal transport in natural and engineered environments

UNIT - I
Introduction: concepts of scale in natural systems, brief review of the fate processes in the environment, examples of natural systems, principles of model formulation, calibration, validation, error estimation and sensitivity analysis;

UNIT - II
Derivation of generalized mass balance equation for contaminants in incompressible fluid (water) in the non-inertial frame of reference;

UNIT - III
River Modeling: one dimensional advection-dispersion-reaction model, river properties and estimation of parameters, different forcing situations (point, non-point, aerial sources and sinks), sediment water interaction;

UNIT - IV
Estuary Modeling: types and properties, flow characterization, advection-dispersion models, salt gradient box models; Lake Modeling: box models, generalized models, special considerations for large lakes, sediment mixing and interaction with water column;

UNIT- V
Wetlands: box models for flow, equilibrium and kinetic geochemical models for red-ox reactions, transport of heavy metals

TEXT BOOKS:

1. Surface water quality modeling –Steven C. Chapra
2. Water Quality Modelling for Rivers and Streams Authors: Benedini, Marcello, Tsakiris, George
3. Water Quality Modelling for Rivers, Streams and Estuaries by Dr. R. Manivanan.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
ENVIRONMENTAL HYDROLOGY (PE - III)

Course Objectives: The course is designed to:

- **Introduce fundamental principles of fluid dynamics** including continuity, momentum, energy equations, and friction in pipes.
- **Develop analytical skills for pipe network analysis** using Hardy–Cross, Tong, O'Connor, and other computational methods.
- **Explain open channel hydraulics** including uniform, critical, gradually varied, and unsteady flow with hydraulic jump analysis.
- **Describe design principles of drainage systems and groundwater hydraulics**, including aquifer parameter estimation and well hydraulics.
- **Familiarize students with pollutant transport in groundwater** and flow measurement devices in both pipes and channels.

Course Outcomes: On successful completion of this course, students will be able to:

- **Apply fundamental fluid mechanics principles** to solve problems involving friction, flow in pipes, and hydraulic systems.
- **Analyze complex pipe networks** using iterative and computational methods.
- **Model and compute open channel flow profiles** for different flow regimes and transitions.
- **Design drainage and groundwater extraction systems** by estimating aquifer parameters and applying steady/unsteady well flow concepts.
- **Evaluate pollutant transport in groundwater** and select appropriate flow measurement devices for pipes and channels.

UNIT - I
Introduction to the principles of fluid dynamics, continuity, momentum and energy equations, Basic concepts in friction and flow in pipes,

UNIT - II
Flow formulation, turbulent and viscous flow, Hardy-Cross, Tong O Conner and other methods of analysis of pipe networks,

UNIT - III
Basic concepts in open channel hydraulics, Energy and momentum equations, critical flow, channel control and transitions, uniform flow, gradually varied flow, flow profiles and their computation, unsteady flow, hydraulic jumps

UNIT - IV
Design of drainage systems, Ground water hydraulics, estimation of aquifer parameters, confined and unconfined aquifers, steady and unsteady flow into wells,

UNIT - V
Dupuit approximations, single and multi-well system, well losses, recharging, well developments etc., movement of pollutants in ground water and wastewater treatment plants hydraulics.
Different Flow measurement devices in channels and pipes

TEXT BOOKS:

1. Chow V T, Flow through open channel, McGraw-Hill, 1973.
2. Ranga Raju K. G., Flow through Open Channels, Second edition, TATA McGraw-Hill, 1997.
3. Garde R. J. and Ranga Raju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi, 2000.
4. Bhave P. R., Analysis of Flow in Water Distribution Network, Technomic Publishing Co., Lancaster, USA, 1996.
5. Todd D. K. Groundwater Hydrology, John Wiley publishers, 2004
6. Jacob and Bear, Hydraulics of Groundwater, McGraw Hill, 1997
7. Raghunath, Groundwater & Well Hydraulics, Wiley Eastern Ltd, New Delhi, 1992

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
ENVIRONMENTAL STRUCTURES (PE - III)

Course Objectives: The course aims to:

- **Introduce the structural design principles** for various types of pipes including concrete, prestressed concrete, steel, and cast iron.
- **Develop skills for analysis and design of water retaining structures** such as tanks, reservoirs, and folded plate roofing systems using IS Codes.
- **Explain design considerations for special purpose structures** like swimming pools, intake towers, clarifloculators, and aeration tanks.
- **Familiarize students with repair and rehabilitation techniques** for masonry, concrete, and steel structures.
- **Highlight environmental considerations** through design of industrial chimneys with focus on reducing carbon emissions.

Course Outcomes: On successful completion of this course, students will be able to:

- **Design and analyze different types of pipes** considering structural, hydraulic, and manufacturing aspects.
- **Apply membrane theory and IS Codes** to design concrete, prestressed concrete, and Intze-type tanks.
- **Design special water retaining structures** incorporating foundation design, earth pressure, and uplift considerations.
- **Diagnose structural issues and apply rehabilitation methods** for damaged masonry, concrete, and steel elements.
- **Design RCC and steel chimneys** with proper site selection criteria and emission control considerations.

UNIT - I
DESIGN OF PIPES
Structural design of a) Concrete b) Prestressed Concrete c) Steel andd) Castiron piping mains, sewerage tanks design - anchorage for pipes - massive outfalls - structural design and laying - hydrodynamic considerations. Advances in the manufacture of pipes.

UNIT - II
ANALYSIS AND DESIGN OF WATER TANKS
Design of concrete roofing systems a) Cylindrical b) Spherical and c) Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete. IS Codes for the design of water retaining structures.
Design of circular, rectangular, spherical and Intze type of tanks using concrete. Design of prestressed concrete cylindrical tanks - Economic analysis - introduction to computer aided design and packages.

UNIT - III
DESIGN OF SPECIAL PURPOSE STRUCTURES
Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. - effect of earth pressure and uplift considerations - selection of materials of construction.

UNIT - IV
REPAIR AND REHABILITATION OF STRUCTURES
Diagnosing the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures.

UNIT – V
CONTROL MEASURES FOR CARBON EMISSION
Criteria for selection of Site for Industrial chimneys. Design of RCC Chimneys and Steel Chimneys.

TEXT BOOKS:

1. Reinforced Concrete by P. Dayaratnam.
2. Prestressed Concrete by Krishna Raju, Tata McGraw Hill Publishing Co. 2nd Edition 1988.

3. Reinforced Concrete by N.C.Sinha & S.K.Roy - S.Chand and Co. 1985.

REFERENCES:

1. Hulse R., and Mosley, W.H., " Reinforced Concrete Design by Computer "Macmillan Education Ltd., 1986.
2. Ramaswamy, G.S., " Design and Construction of Concrete shell roofs "CBS Publishers, India, 1986.
3. Green, J.K. and Perkins, P.H., " Concrete liquid retaining structures "Applied Science Publishers, 1981.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
CLIMATE CHANGE MODELING (PE - IV)

Course Objectives: The course aims to:

- Provide foundational knowledge of climate variability, climate system components, and their interactions.
- Explain the fundamental physical processes governing atmospheric, oceanic, and land surface dynamics.
- Introduce climate models, their construction, numerical methods, and evaluation techniques.
- Develop understanding of the greenhouse effect, climate feedback mechanisms, and transient climate change responses.
- Analyze future climate scenarios, assess potential impacts, and explore mitigation/adaptation pathways.

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

- **Explain** the principles of climate dynamics and the role of various components in the Earth's climate system.
- **Apply** fundamental physical and thermodynamic equations to describe processes in the atmosphere and ocean.
- **Evaluate** the structure, parameterization, and simulation outputs of different climate models.
- **Analyze** the influence of greenhouse gases and feedback mechanisms on global and regional climate change.
- **Assess** climate change scenarios, interpret observed trends, and recommend strategies for sustainable climate management.

UNIT - I

Overview of Climate Variability and the Science of Climate Dynamics, Basics of Global Climate: Components and phenomena in the climate system, Basics of radiative forcing, Globally averaged energy budget—first glance, Gradients of radiative forcing and energy transports by atmosphere and ocean, Atmospheric circulation, Ocean circulation, Land surface processes, Carbon cycle

UNIT - II

Physical Processes in the Climate System: Conservation of momentum, Equation of state, Temperature equation, Continuity equation, Moisture equation and salinity equation, Moist processes, Wave processes in the atmosphere and ocean, El Niño and Year-to-Year Climate Prediction

UNIT - III

Climate Models: Constructing a Climate Model, Numerical representation of atmospheric and oceanic equations, Parameterization of small-scale processes, The hierarchy of climate models, Climate simulations and climate drift, Evaluation of climate model simulations for present day climate.

UNIT - IV

The Greenhouse Effect and Climate Feedbacks: The greenhouse effect in Earth's current climate**,** Global warming I: example in the global-average energy balance model, Climate feedbacks, The water vapor feedback, Snow/ice feedback, Cloud feedbacks, Other feedbacks in the physical climate system, Climate response time in transient climate change.

UNIT - V

Climate Model Scenarios for Global Warming: Greenhouse gases, aerosols and other climate forcings**,** Global-average response to greenhouse warming scenarios, Spatial patterns of warming for time-dependent scenarios, Climate response time in transient climate change, Ice, sea level, extreme events, Summary: the best-estimate prognosis, Climate change observed to date, Emissions paths and their impacts, The road ahead.

TEXT BOOKS/REFERENCES:

1. Lutgens, Frederick K. Tarbuck, Edward J. (2010), The Atmosphere: An Introduction to Meteorology, PHI Publications
2. C.Donald Athens,(2011), Essentials of Meteorology, Thompson Brooks/Cole, Cengage Learning
3. Andrew Gettelman, Richard B. Rood (2016), Demystifying Climate Models – A Users' Guide to Earth System Models, Springer Open

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – IISem. (Env. Engg.)
INDUSTRIAL WASTE MANAGEMENT (PE - IV)

Course Objectives: The course aims to:

- Provide an understanding of the characteristics and environmental impacts of industrial effluents.
- Familiarize students with national standards (ISI limits) for effluent discharge into various receiving environments.
- Introduce pretreatment techniques and resource recovery methods for industrial wastewater.
- Explain advanced treatment processes for removal of pollutants, including refractory organics and nutrients.
- Examine effluent characteristics and treatment methods for major industrial sectors.

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

- **Identify** the types, characteristics, and impacts of industrial effluents on ecosystems and public health.
- **Interpret** ISI tolerance limits and apply them in designing safe effluent disposal systems.
- **Select** appropriate pretreatment and resource recovery methods for specific industrial wastewater streams.
- **Apply** advanced treatment processes such as reverse osmosis, ion exchange, and flotation for pollutant removal.
- **Analyze** the sources, characteristics, and treatment requirements of effluents from major industries like sugar, dairy, distilleries, paper, textiles, and steel.

UNIT - I
Introduction: General Characteristics of Industrial Effluents, Effects on Environment - ISI tolerance limits for discharging industrial effluents into surface water, into public sewers and onto land for irrigation - Toxic chemicals from industry, Zero waste approach

UNIT - II
Pretreatment of Industrial Wastewater: Necessity of pretreatment - Equalization - Segregation - Process Changes - Salvaging - By product Recovery.

UNIT - III
Removal by Reverse Osmosis, Ion Exchange, Electrodialysis, Solvent Extraction, Floatation- Removal of Refractory Organics - Removal of Nitrogen and Phosphorus.

UNIT - IV
Major Industrial Effluents: Sources, Characteristics and Treatment. Food Industries: Sugar, Dairy, Distilleries

UNIT - V
Chemical Industries: Paper and Pulp, Tanneries, Textiles, Fertilizers, Pharmaceuticals, Cement and Steel.

REFERENCES:

1. Numersorn, N.L.: "Liquid Waste from industry - theories, Practice and Treatment"
2. Benefield L.D. and Randall C.D.: "Biological Process Designs for Wastewater Advanced Waste Treatment Methods: Removal of suspended solids - Dissolved solid Treatment", Prentice Hall Pub. Co., 1980.
3. Metcalf and Eddy: "Wastewater Engineering - Collection, Treatment, Disposal and Reuse", Mc Graw Hill Pub. Co., 1995.
4. Rao, M.N. & Dutta, A.K. (1982) *Wastewater Treatment,* IBH Publishers.
5. Bhide, A.D. & Sunderesan, B.B. (1994) *Solid Waste Management*, INSDOC, NEERI, Nagpur.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
REMEDIATION TECHNOLOGIES (PE - IV)

Course Objectives: The course aims to:

- Introduce the fundamental principles, concepts, and types of remediation technologies for contaminated soil and groundwater.
- Familiarize students with physical, chemical, thermal, and electrokinetic remediation methods and their field applications.
- Develop understanding of bioremediation mechanisms and technologies for in-situ and ex-situ treatments.
- Explore phytoremediation processes, plant-based pollutant removal mechanisms, and their advantages and limitations.
- Provide knowledge on integrated remediation systems, remedy selection, and risk assessment strategies.

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

- **Explain** the principles and working of various remediation technologies for soil and groundwater.
- **Analyze** the applicability of electrokinetic remediation, considering soil pH, enhancement agents, and site conditions.
- **Apply** bioremediation techniques to treat specific contaminants using suitable microorganisms and amendments.
- **Evaluate** phytoremediation strategies for removal or stabilization of different pollutants.
- **Select and justify** appropriate remediation systems, considering site characterization, risk assessment, and environmental regulations.

UNIT - I
Introduction to remediation technologies, principles of remediation, site characterization, soil vapor extraction, Soil Flushing, Stabilization/ Solidification, thermal desorption, vitrification.

UNIT - II
Electrokinetic remediation: Different theories of electrokinetic remediation, The importance of soil pH in electrokinetic remediation of soil, Use of enhancement agents in electrokinetic remediation.

UNIT - III
Bioremediation: Mechanism, electron acceptor, electrondonors, Biodegradability, Biostimulation, Bioremediation technologies for soil, composting, Biopiles, Bioventing, Bioremediation technologies for ground water, Amendments for introduction and creation anaerobic conditions, existu and insitu treatment

UNIT - IV
Phytoremediation, overview, advantages, limitations, phyto-accumulation, phyto-volatilisation, phytostabilisation, Rizodegradation, phytoextraction, treatment of various pollutants using phytoremediation

UNIT - V
pump and treat system, Solvent Vapor Extraction, Air, Funnel and Gate Systems, permeable treatment walls, natural attenuation, remedy selection and risk assessment.

REFERENCES:

1. Ergas, S. J., Chang, D. P. Y., Schreoder, E.D., and Eweis J.B., Bioremediation Principles, WCB/McGraw-Hill, 1998
2. Rittmann, B.E., and McCarty, P.L., Environmental Biotechnology: Principles and Applications, McGraw Hill, 2001

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
AIR QUALITY MANAGEMENT LAB

Course objective:

- To teach advance techniques of determination of air pollutants.
- To enhance understanding on role of measured parameters in local air quality, health and climate assessment.

List of experiments:

1. Monitoring of TSP using HVS
2. Monitoring of PM2.5 using cyclone-based sampler
3. Size segregated particle collection with mini MOUDI (56 nm to 10 micrometer) and data analysis using histogram, inversion program
4. Personal exposure assessment and link with indoor air quality parameters
5. Determination of count and geometric mean diameter using optical particle counter and Scanning mobility particle sizer (10 nm-20 micrometer)
6. Determination of chemical species ions, trace elements, total organic carbon, water soluble organic carbon, polycyclic aromatic hydrocarbon using (IC, AAS, HPLC, GC, TOC) in air samples
7. Determination of emission factors of particle and gases for combustion sources, 4 8 Determination of TVOC and bioaerosol;

REFERENCES:

1. Hinds W. C. Aerosol Technology: Properties, Behaviour, and measurement of airborn particles, 2nd edition, Wiley-Interscience Publication, New York, USA, 1998.
2. Aerosol measurement: Principles, Techniques, and applications, 2nd edition, Wiley Interscience Publication, New York, USA, 2005.
3. Methods for determination of indoor air pollutants, Wiliam T Winberry, Jr. et.al. Noyes Data Corporation, New Jersey, USA, 1992
4. Introduction to Environmental Analysis, Roger Reeve, Wiley, 2002 Page 3 Sampling and Calibration for Atmospheric Measurements, Johm K Taylor, ASTM, 1987
5. Air Pollution: Measurement, Modelling and Mitigation, Third Edition, Jeremy Colls, Abhishek Tiwary, 2010, Routledge, NY, USA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – IISem. (Env. Engg.)
COMPUTATIONAL LAB

List of Experiments:

1. Analysis of Precipitation Data Design problem
2. Analysis of Distribution Networks Design problem
3. Design of water Treatment plant Design problem
4. Design of Wastewater Treatment plant Design problem
5. Design of Air Pollution Control Devices Design problem
6. Determination of Rate Constants and Ultimate BOD Design problem
7. Kinetics of Biological Processes Design problem
8. Kinetics of Chemical Processes Design problem
9. Design integrated solid waste management system

References:

1. Metcalf & Eddy, Inc., Waste water Engineering Treatment and Reuse, McGraw Hill Inc., New Delhi., 2003 2. Peavy, H.S, Rowe, D.R., and G. T

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – II Year – I Sem. (Env. Engg.)
ENVIRONMENTAL BIOTECHNOLOGY (PE – V)

Course Objectives

The course aims to:

- Provide knowledge of fundamental principles and mechanisms involved in the degradation and detoxification of toxic environmental pollutants.
- Familiarize students with microbial and biotechnological approaches for the remediation of contaminated soil, water, and solid wastes.
- Develop understanding of biofertilizers, composting processes, and biological nutrient removal methods.
- Introduce modern biotechnological tools such as rDNA technology, microbial strain improvement, and enzyme applications in environmental management.
- Create awareness of the ethical, environmental, and safety aspects of genetically engineered microorganisms and microbial containment.

Course Outcomes: Upon successful completion of the course, students will be able to:

- **Explain** the degradation pathways and detoxification mechanisms for various classes of pollutants including hydrocarbons, halogenated compounds, and metals.
- **Apply** microbial and enzymatic technologies for bioremediation, composting, and groundwater decontamination.
- **Analyze** the role of biofertilizers, algal biotechnology, and extracellular polymers in sustainable environmental practices.
- **Utilize** rDNA technology, microbial strain improvement, and molecular tools for environmental applications.
- **Evaluate** the environmental impact, risks, and ethical considerations of genetically engineered microorganisms and microbial technologies.

UNIT- I

Principles and Concepts - Usefulness to Mankind - Degradation of High Concentrated Toxic Pollutants - Halogenated, Non Halogenated, Petroleum Hydrocarbons, Metals - Mechanisms of Detoxification - Oxidation –

UNIT-II

Dehalogenation - Biotransformation of Metals - Biodegradation of Solid Wastes - Biotechnological Remedies for Environmental Pollution - Decontamination of Groundwater - Bioremediation - Production of Proteins –

UNIT-III

Biofertilizers - Physical, Chemical and Microbiological Factors of Composting - Health Risk - Pathogens - Odor Management - Microbial Cell/Enzyme Technology - Adapted Microorganisms - Biological Removal of

UNIT-IV

Nutrients - Algal Biotechnology - Extra Cellular Polymers - Biogas Technology - Concept of rDNA Technology - Expression Vectors - Cloning of DNA - Mutation - Construction of Microbial Strains - Radioactive Probes –

UNIT-V

Protoplast Fusion Technology - Applications - Environmental Effects and Ethics of Microbial Technology - Genetically Engineered Organisms - Microbial Containment - Risk Assessment.

REFERENCES:

1. Chaudhury, G.R., Biological degradation and Bioremediation of toxic chemicals, Dioscorides Press, Oregon, 1994. Department of Civil Engineering, National Institute of Technology, Tiruchirappalli – 620 015 M.Tech. / Environmental Engineering 47 |
2. Bhattacharya, B. C. and Banerjee R., (2007) Environmental Biotechnology, Oxford University Press, India
3. Martin. A.M, Biological degradation of wastes, Elsevier Applied Science, London, 1991.
4. Blaine Metting.F (Jr.,) Soil Microbiology Ecology, Marcel Dekker Inc., 1993.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – II Year – I Sem. (Env. Engg.)
INSTRUMENTAL METHODS OF ANALYSIS (PE – V)

Course Objectives

- To introduce the fundamental principles, classification, and performance characteristics of various instrumental methods used in analytical sciences.
- To provide knowledge on the working principles, instrumentation, and applications of spectrophotometric and electrochemical techniques.
- To explain the principles, types, and quantitative applications of chromatographic separation methods.
- To familiarize students with advanced analytical techniques such as HPLC, GC-MS, SEM, TEM, XRD, and FTIR for material characterization.
- To develop skills in error analysis, calibration procedures, and interpretation of analytical data for improved accuracy and precision.

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

- Explain the performance characteristics, limitations, and calibration methods of different analytical instruments.
- Apply spectrophotometric and electrochemical techniques for qualitative and quantitative analysis of samples.
- Utilize chromatographic techniques (TLC, GC, HPLC, ion chromatography) for separation and analysis of compounds.
- Operate and interpret results from advanced instrumentation such as GC-MS, SEM, TEM, XRD, FTIR, and thermal analysis.
- Analyze, minimize, and interpret measurement errors to improve the reliability of analytical results.

UNIT- I

Classification of Instrumental Methods - Performance Characteristics of Instruments (Static And Dynamic) - Errors and Uncertainties in Performance Parameters - Noise Reduction - Sensitivity and Detection Limit - Errors -Types - Expression of Errors - Precision and Accuracy - Calibration of Instrumental Methods

UNIT-II

Spectrophotometry - Electromagnetic Radiation - Atomic Absorption and Emission Spectrometry - Ultraviolet - Visible Spectrophotometry Principle and Instrumentation - Atomic Absorption Spectroscopy Principle and Instrumentation - Flame Photometer - Fluorimetry - Nephelometry and Turbidimetry - Principles,

UNIT-III

Chromatography - Principle and Classification - Column Efficiency and Resolution - Quantitative Determination - Column Chromatography - Thin Layer Chromatography - Principle and Application of Ion chromatography - Application Gas Chromatography (GC) –

UNIT-IV

Principle and Application of High Precision Liquid Chromatography (HPLC) - Ion Chromatography Mass Spectroscopy - Gas Chromatography Mass Spectroscopy (GCMS) - Electro Chemical Methods - Electrochemical Cell - Reference Electrodes - Cyclic Votametry - Polarograph - Oscilloscopi Polarography –

UNIT-V

Ion Selective Electrodes - Conductometry - Electrolytic Conductivity - Specific Equivalent and Molar Conductance - Working Principles of pH, EC, TDS Meters - Material Characterization Techniques - SEM, TEM, XRD, FTIR, Thermal Analysis - Working Principles and Applications.

REFERENCES:

1. D. A. Skoog, D.M. West and T.A. Nieman, Principles of Instrumental Analysis,5th Ed. Thomson Asion (P) Ltd. Singapore, 2004.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, 7th Ed. CBP Publishers and Distributors, New Delhi, 1988.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – II Year – ISem. (Env. Engg.)

RURAL WATER SUPPLY AND ENVIRONMENTAL SANITATION (PE - V)

Course Objectives

- To provide comprehensive knowledge of rural water supply systems, including design, treatment, and public health considerations.
- To impart an understanding of vector control methods, their engineering applications, and limitations in disease prevention.
- To develop awareness of food and milk sanitation practices, associated health risks, and applicable legislative frameworks.
- To familiarize students with industrial hygiene principles, occupational hazards, and radiological safety measures.
- To equip students with skills in environmental sanitation planning, rural waste disposal methods, and low-cost wastewater treatment technologies.

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

- Design and evaluate rural water supply schemes considering health, economic, and environmental factors.
- Identify vector-borne diseases, their transmission mechanisms, and implement appropriate control measures.
- Apply food and milk sanitation standards to ensure safety and compliance with public health regulations.
- Assess occupational and radiological hazards and recommend suitable preventive and safety measures.
- Plan and implement environmental sanitation systems, including excreta disposal and decentralized wastewater treatment methods for rural communities.

UNIT-I

Rural Water Supply: Basic Objectives, Development of Water Supply Schemes for Rural Areas - Health and Economic Aspects in Design of the Scheme, Disinfection of Wells, Specific Problems in Rural Water Supply and Treatment and Remedies, Design of Distribution Systems Rural Areas.

UNIT-II

Vector Control: Fundamentals of epidemiology - vector borne diseases - types of vectors - mosquitoes, flies, rodents - rationale of control and naturalistic methods of control - uses and limitations of pesticides - engineering methods of vector control.

UNIT-III

Food Sanitation: Introduction to food and drugs act - Food poisoning - Food storage and preservation - sanitation of eating and drinking places - slaughter houses and market sanitation.
Milk Sanitation: Diseases transmitted through milk -Pasteurization- Inspection - Sampling and testing of milk.

UNIT-IV

Industrial Hygiene: Effects of environmental factors on health - Occupational hazards - Comfort and production.Radiological Health: Radio activity - Harmful effects of radiation - Safety measures - Radioactive waste disposal.

UNIT-V

Environmental Sanitation Sanitation: Basic Objectives, Public Health Significance, Environmental Health Programmes and Organization, Control of Communicable Diseases, Environmental Health Planning, Rural Excreta Disposal - Method of Disposal of Night Soil, Types of Privies, Bore Hole Latrine, Septic and Aqua Privy, Septic Tank and Effluent Disposal Arrangements, Low Cost Wastewater Treatment Systems, Biogas Plants.

REFERENCES:

1. Municipal and Rural Sanitation: EulersV.M. and Steel E.W.
2. Wastewater, collection, treatment, disposal and reuse: Metcalf and Eddy
3. Environmental Sanitation: J.A. Salvato

4. Public Health Engineering: E.B. Phelps
5. Text Book of Preventive and Social Medicine: J.E. Park and K. Park
6. Ehlers, V.M. and Steel, E.W.: Municipal and Rural Sanitation, Mc Graw Hill Company Inc., New York, 1964.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech. II Year I Sem. Environmental Engineering

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.

REFERENCES:

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech. II Year I Sem. Environmental Engineering

ENVIRONMENTAL POLLUTION AND CONTROL (Open Elective)

Course Objectives:

- Impart knowledge on aspects of air pollution & control and noise pollution.
- Impart concepts of treatment of waste water from industrial source.
- Differentiate the solid and hazardous waste based on characterization.
- Introduce sanitation methods essential for protection of community health.
- Provide basic knowledge on sustainable development.

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

- Understand the fundamentals of solid waste management, practices adopted in his town/village and its importance in keeping the health of the city.
- Identify the air pollutant control devices and have knowledge on the NAAQ standards and air emission standards.
- Differentiate the treatment techniques used for sewage and industrial wastewater treatment.
- Inventing the methods of environmental sanitation and the management of community facilities without spread of epidemics.
- Appreciate the importance of sustainable development while planning a project or executing an activity.

UNIT – I:
Air Pollution:
Air pollution Control Methods – Particulate control devices – Methods of Controlling Gaseous Emissions – Air quality standards. Noise Pollution: Noise standards, Measurement and control methods – Reducing residential and industrial noise – ISO:14000.

UNIT – II:
Industrial waste water Management:
Strategies for pollution control – Volume and Strength reduction – Neutralization – Equalization – Proportioning – Common Effluent Treatment Plants – Recirculation of industrial wastes – Effluent standards.

UNIT – III:
Solid Waste Management: solid waste characteristics – basics of on-site handling and collection – separation and processing – Incineration- Composting-Solid waste disposal methods – fundamentals of Land filling. Hazardous Waste: Characterization – Nuclear waste – Biomedical wastes – Electronic wastes – Chemical wastes – Treatment and management of hazardous waste-Disposal and Control methods.

UNIT – IV:
Environmental Sanitation: Environmental Sanitation Methods for Hostels and Hotels, Hospitals, Swimming pools and public bathing places, social gatherings (melas and fares), Schools and Institutions, Rural Sanitation-low cost waste disposal methods.

UNIT – V:
Sustainable Development: Definition- elements of sustainable developments-Indicators of sustainable development- Sustainability Strategies- Barriers to Sustainability–Industrialization and sustainable development – Cleaner production in achieving sustainability- sustainable development.

TEXT BOOKS

1. Peavy, H. S., Rowe, D.R, Tchobanoglous, “Environmental Engineering”, Mc-Graw Hill International Editions, New York 1985.
2. J. G. Henry and G.W. Heinke, “Environmental Science and Engineering”, Pearson Education.

REFERENCES:

1. G. L. Karia and R.A. Christian, “Waste water treatment- concepts and design approach”, Prentice Hall of India
2. M. N. Rao and H. V. N. Rao, “Air pollution”, Tata McGraw Hill Company.
3. Ruth F. “Weiner and Robin Matthews Environmental Engineering”, 4th Edition Elsevier, 2003.
4. K. V. S. G. Murali Krishna, “Air Pollution and Control” by, Kousal & Co. Publications, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

Prerequisite: None

Course objectives: Students will be able to:

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

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

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

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

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

UNIT-V:
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS/ REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
DISASTER MANAGEMENT (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

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

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

TEXT BOOKS/ REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Prerequisite: None

Course Objectives:

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

Course Outcomes: Students will be able to

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

UNIT-I:
Alphabets in Sanskrit,

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

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

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

TEXT BOOKS/ REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
VALUE EDUCATION (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

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

Course outcomes: Students will be able to

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

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

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

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

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

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

TEXT BOOKS/ REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
CONSTITUTION OF INDIA (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

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

Course Outcomes: Students will be able to:

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

UNIT-I:
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble**,** Salient Features.

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

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

UNIT-IV:
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

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

TEXT BOOKS/ REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
PEDAGOGY STUDIES (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

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

Course Outcomes: Students will be able to understand:

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

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

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

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

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

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

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

Prerequisite: None

Course Objectives:

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

Course Outcomes: Students will be able to:

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

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

UNIT-II:
Yam and Niyam.

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

UNIT-IV:
Asan and Pranayam

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

TEXT BOOKS/ REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. Environmental Engineering
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - I & II)

Prerequisite: None

Course Objectives:

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

Course Outcomes: Students will be able to

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

UNIT-I:

Neetisatakam-Holistic development of personality

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

UNIT-II:

Neetisatakam-Holistic development of personality

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

UNIT-III:

Approach to day to day work and duties.

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

UNIT-IV:

Statements of basic knowledge.

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

UNIT-V:

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

TEXT BOOKS/ REFERENCES:

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