Guru Nanak dev Engineering College, Ludhiana

(An Autonomous College under UGC Act)

Civil Engineering Department

Course Scheme: M. Tech (Environmental Science & Engineering)—Full Time

Schedule of Teaching and Study Scheme

Semester	Subjects	Credits	Contact Hours/week			No. of subjects	Distribution of marks		Total Credits
			L	T	P		Ext	Int	
1	Core subjects	4	4	-	-	3	100	50	20
	Program elective	3	3	-	-	1	100	50	
	Open elective	3	3	-	-	1	100	50	
	Laboratory-1	2	--	-	2	1	50	50	
2	Core subjects	4	4	-	-	3	100	50	20
	Program elective	3	3	-	-	1	100	50	
	Open elective	3	3	-	-	1	100	50	
	Laboratory -2	2	--	-	2	1	50	50	
3	Program elective	3	3	-	-	1	100	50	10
	Program elective	3	3	-	-	1	100	50	
	Pre-thesis seminar	1	-	-	2	1	-	100	
	Pre-thesis project	3	-	-	3	1	50	50	
4	Thesis/Dissertation	15	-	-	15	--	100	200	15

List of Core Subjects

S. No.	Subject	Subject Code
1	Physico-Chemical Treatment Methods	MTEV-501
2	Environmental Chemistry and Microbiology	MTEV-502
3	Biological Treatment Methods	MTEV-503
4	Research Methodology	MTEV-504
5	Solid and Hazardous Waste Management	MTEV-505
6	Air Pollution and Control	MTEV-506

List of Laboratory/Practical work

S. No.	Subject	Subject Code
1	Laboratory-1	MTEV-507
2	Laboratory-2	MTEV-508
3	Pre-thesis seminar	MTEV-509
4	Pre-thesis project	MTEV-510
5	Thesis	MTEV-511

List of Program Electives

S. No.	Subject	Subject Code
1	Environmental Systems Engineering	MTEV-601
2	Physics of Environment	MTEV-602
3	Environmental Hydraulics and Hydrology	MTEV-603
4	Environmental Remote Sensing and GIS	MTEV-604
5	Urban Water Management	MTEV-605
6	Biodegradation and Bioremediation	MTEV-606
7	Climate Change and Sustainable Development	MTEV-607
8	Rural Water Supply and Environmental Sanitation	MTEV-608
9	Environmental Geotechnology	MTEV-609
10	Energy Technology and Alternate Energy Systems	MTEV-610
11	Strength of Materials	MTEV-611
12	Burried Structures	MTEV-612
13	Environmental Impact Assessment and Management	MTEV-613
14	Disaster Reduction and management	MTEV-614
15	Site Investigations	MTEV-615
16	Environmental Legislation and Auditing	MTEV-616
17	Air and Water Quality Modeling	MTEV-617
18	Environmental Biotechnology	MTEV-618
19	Industrial Waste Management	MTEV-619
20	Pollution Monitoring techniques	MTEV-620

List of subjects to be offered as 'Open Electives'

1	Experimental Methods in Engineering	MTCE-621
2	Numerical Methods in Engineering	MTCE-622
3	Instrumentation and model simulation	MTCE-623
4	Advanced Engineering Mathematics	MTCE-624
5	Probabilistic Methods in Engineering	MTCE-625
6	Limit Analysis	MTCE-626

MTEV-501: Physico-Chemical Treatment Methods

Course Credits --4

Internal Marks: 50 | **L T P**
External Marks: 100 | **4 0 0**
Total Marks: 150

Water – Quality, Standards and Criteria: Physical, chemical and biological water quality parameters; Water quality guidelines, criteria and standards; Wastewater Effluent standards
Purification of water- Natural treatment processes- Physical, chemical and biological processes. Water treatment technologies- overview, Primary, Secondary and tertiary treatment-Unit operations & unit processes
Screening & Grit removal: Screens; grit channels, aerated grit chambers;
Settling Tanks, Coagulation and Flocculation: Theory of settling; Types of settling; Settling Tanks; Coagulation-flocculation; Flash mixing tanks and flocculation tanks; Clarifiers and clariflocculators; Tube settlers and plate settlers.
Aeration: Diffused and surface and Gas transfer processes.
Filtration Systems: Filtration theory and filter hydraulics; Slow sand filters; Rapid gravity filters; Pressure filters; Multimedia filters.
Disinfection: Chlorination; Ozonation; UV radiation
Other Water Treatment Technologies: Ion-exchange process; Adsorption process- Adsorption equilibria- adsorption isotherms; membrane processes (nano-filtration, ultra-filtration and reverse osmosis); De-fluoridation units and household level water purification systems.

References:

1. "Wastewater Engineering – Treatment and Reuse", Metcalf and Eddy, Tata McGraw Hill.
2. "Water Works Engineering"- Planning, Design and Operation by Syed R. Qasim, Edward Motley, Guang Zhu, PHI, 2009
3. "Physico-chemical Processes for Water Quality Control", Weber W.J., John-Wiley, 1999.
4. "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
5. Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning, New Delhi, 2009
6. Hammer, M.J. and Hammer, M.J. Jr., "Water and Wastewater Technology", PHI

MTEV-502: Environmental Chemistry and Microbiology

Course Credits --4

Internal Marks: 50 | **L T P**
External Marks: 100 | **4 0 0**
Total Marks: 150

1. Introduction and Scope: Air-water, water-sediment / soil and air – water – sediment interactions, physical water quality parameters.
2. Chemistry of Natural Water: Reaction stoichiometry, basic concepts from equilibrium chemistry, acid-base reactions, solubility of salts (soil chemistry) and related water quality parameters.
3. Nutrients and Organic Impurities in Water: Oxidation-reduction reactions, water and wastewater quality parameters (ORP, BOD, COD, TOC etc.).
4. Heavy Metals: In water, complex formation, metal speciation.
5. Atmospheric Chemistry: Photochemical reactions in atmosphere, Redox reactions, sources of air pollution, Major chemical pollutants and their effects, Indoor air pollutants.
6. Microbiology - classification - identification – Taxonomy - Reproduction and growth - cultures & characteristics - Enzymes - Microbial metabolism - energy production – biosynthesis, Mixed and pure culture – Growth rate – Application.
7. Fungi, Bacteria, 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., McCarty P.L. and Parkin, G.F., "Chemistry for Environmental Engineering and Science", Tata McGraw Hill.
2. Baird, C., "Environmental Chemistry", W.H. Freeman.
3. Manahan, S.E., Environmental Chemistry, Lewis (2004)
4. Pani, B., Textbook of Environmental Chemistry, IK International (2007).
5. "Standard Methods for the Examination of Water and Wastewater", APHA, AWWA and WEF.
6. Pelczar, M.J., Chan E.C.S. and Krieg, N.R. *Microbiology*, Tata McGraw Hill, New Delhi, 1993.
7. Gaudy, A., Microbiology for Environmental Scientists and Engineers, McGraw Hill
8. Maier, R.M., Pepper, I.L. and Gerba, C.P., Environmental Microbiology. Academic Press (2006).

MTEV-503 Biological Treatment Methods

Course Credits --4

	L	T	P
Internal Marks: 50			
External Marks: 100	**4**	**0**	**0**
Total Marks: 150			

Wastewater Characteristics and Effluent Standards: Physical, chemical and biological parameters of water pollution, Solids (volatile and non-volatile solids; suspended, dissolved and colloidal solids), Biodegradable and non-biodegradable organic matter (DO, COD, BOD and BOD kinetics), Nutrients (TKN, total nitrogen, and total and ortho-phosphorus), Sulfides, phenols, cyanides, heavy metals, Effluent Standards.

Process Kinetics: Fundamentals of Process Kinetics, Zero order, First order, Second order Reactions, Enzyme reactions – Bio reactors- Types-Classification – Design principles.

Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Practices, Features and Design, Operational Difficulties and Remedial Measures, Rotating Biological Contactors. SAF, FAB and MBBR technologies.

Suspended Growth Processes: Activated Sludge Process, Modifications including SBR and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements.

Waste stabilization Ponds and Lagoons: Aerobic pond, facultative pond, anaerobic ponds, polishing ponds, aerated lagoons. Constructed wetlands and Duckweed ponds.

Anaerobic processes-Process fundamentals-Standard, high rate and hybrid reactors.

Anaerobic filters-Expanded /fluidized bed reactors-Upflow anaerobic sludge blanket reactors, Design and Operation.

Sludge Treatment and Disposal: Sludge Thickening, Sludge Digestion & disposal.

Other Treatment Technologies: Advanced oxidation processes, Biological nutrient removal.

References:

1. Metcalf, Eddy, Tchobanoglous, G., Burton, F.L., Stensel, H.D., *Wastewater Engineering – Treatment, Disposal and Reuse*, Tata McGraw Hill (2002) 4th ed.
2. *Environmental Engg.* - Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
3. Eckenfelder W.W. Jr., *Industrial Water Pollution Control*, McGraw Hill (2003) 3rd ed.
4. Arceivala, S. J. and Asolekar, S. R., *Wastewater Treatment for Pollution Control*, 3rd ed., McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2006.
5. *Wastewater Treatment: Concepts and Design Approach*, Karia G. L. and Christian R. A., PHI, 2nd Edition.
6. *Manual on Sewerage and Sewage Treatment*- Central Public Health and Environmental Engg. Organisation, Ministry of Urban Development, Govt. of India.

MTEV – 504 Research Methodology

Course Credits --4

	L	T	P
Internal Marks: 50			
External Marks: 100	**4**	**0**	**0**
Total Marks: 150			

OVERVIEW OF RESEARCH

Nature and Objectives of research; historical, descriptive and experimental, Study and formulation of research problem, Scope of research and formulation of hypotheses; Feasibility, preparation and presentation of research proposal

METHODS OF DATA COLLECTION

Primary data and Secondary Data, methods of primary data collection, classification of secondary data,

SAMPLING METHODS

Probability sampling: simple random sampling, systematic sampling, stratified sampling, cluster sampling and multistage sampling. Non-probability sampling: convenience sampling, judgement sampling, quota sampling. Sampling distributions

PROCESSING AND ANALYSIS OF DATA

Statistical measures and their significance: Central tendencies, variation, skewness, Kurtosis, time series analysis, correlation and regression, Testing of Hypotheses :Parametric (t, z and F) Chi Square, ANOVA. Measures of central tendency and dispersion: mean, median, mode, range, mean deviation and standard deviation. Regression and correlation analysis.

DESIGN OF EXPERIMENTS:

Basic principles, study of completely randomized and randomized block designs. Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography.

Note: Application and use of various software for case studies should essential be covered in the lectures.

References

Levin, R.I. and Rubin, D.S., Statistics for Management, 7th Edition, Pearson Education: New Delhi.

Malhotra, N.K., Marketing Research An Applied Orientation, 4th Edition Pearson Education: New Delhi.

Zikmund, W.G., Business Research Methods, 7th Edition, Thomson South-Western.

Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., Management Research Methodology, Pearson Education: New Delhi.

Kothari C.R., Research Methodology Methods and techniques by, New Age International Publishers, 2nd edition

MTEV-505: Solid and Hazardous Waste Management

Course Credits --4

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**4**	**0**	**0**
Total Marks: 150			

Introduction: Definition of solid wastes and hazardous wastes, Nuisance potential and extent of solid waste problems, Objectives and scope of integrated solid waste management.
Characterization and Quantification: Types, composition, characteristics and quantities of wastes, Methods of quantification and characterization of wastes.
Collection, Storage and Transportation of Wastes: Types of collection systems and their components, Concept of waste segregation at source and recycling and reuse of wastes; Household, street and community level collection bins and storage containers.
Solid Waste Processing and Treatment: Waste processing – processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration
Hazardous Waste Treatment and Disposal: Biological and chemical treatment of hazardous wastes; Solidification and stabilization of wastes; Incineration for the treatment and disposal of hazardous wastes; Land farming; Landfill disposal of hazardous waste; Bioremediation of hazardous waste disposal sites.
Sanitary Landfills: Site selection and approval; design, development, operation and closure of landfills, Management of leachate and landfill gases, environmental monitoring of landfill sites.
Legal Requirements: Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, flyash, etc.

References:

1. Pichtel, J., Waste Management Practices – Municipal, Hazardous and Industrial, CRC Press (2005).
2. Vesilind, P.A., Solid Waste Engineering, Thomson Learning Inc. (2008).
3. Tchobanoglous, G., Vigil, S.A. and Theisen, H., Integrated Solid Waste Management: Engineering Principles and Management Issues, Mc-Graw Hill (1993).
4. "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition
5. CPHEEO, *Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization*, Government of India, New Delhi, 2000.

MTEV – 506 Air Pollution and Control

Course Credits --4

	L	T	P
Internal Marks: 50			
External Marks: 100	**4**	**0**	**0**
Total Marks: 150			

Air pollutants – Sources and classification of pollutants and their effect on human health, vegetation and property- Effects - Reactions of pollutants and their effects-Smoke, smog and ozone layer disturbance - Greenhouse effect – Ambient and stack sampling.

Atmospheric Phenomena - Dynamism of atmosphere, Energy balance of atmosphere, Meteorological aspects, Wind and wind roses, Environmental and adiabatic lapse rates, Derivations of DALR, WALR and ELR, Atmospheric stability, Factors influencing stability, Temperature inversions, Mixing height.

Atmospheric diffusion of pollutants - Transport, transformation and deposition of air contaminants - Air sampling & pollution measurement methods - Ambient air quality and emission standards, Modelling- Gaussian model and equation, Air quality index.

Particulate emission control- Settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators.

Control of gaseous pollutants – Removal of gaseous pollutants by adsorption, absorption, reaction and other methods.

Biological air pollution control technologies – Bio-scrubbers, bio-filters, and Indoor air quality.

References:

1. Wark Kenneth and Warner C.F, *Air pollution its origin and control.* Harper and Row Publishers, NewYork, 1997.
2. Rao C.S., *Environmental Pollution Control Engineering*, New age international Ltd, New Delhi.
3. Perkins, H.C., Air Pollution, McGraw-Hill (2004).
4. Rao M.N. and Rao H.V.N., Air Pollution, Tata McGraw-Hill (2006).
5. Griffin R D, *Principles of Air Quality Management*, 2nd Edition, CRC Press, Boca Raton, USA, 2007.

MTEV-507: Laboratory-1

Course Credits --2

	L	T	P
Internal Marks: 100			
External Marks: 50	**0**	**0**	**4**
Total Marks: 150			

Analysis of environmental samples by Gravimetric, Titrimetry, DO meter, Conductimeter, Turbidity meter, Spectrophotometer, Flame photometer, AAS, pH/ISE meter; Microbial enumeration by membrane filtration techniques. An Indicative list is given below:

Experiment No.1: Estimation of Solids (TSS, TDS, VSS, FSS), Acidity, Alkalinity, Hardness, Chlorides and Fluorides
Experiment No.2: Determination of pH and Conductivity
Experiment No.3: Estimation of Nitrogen (Ammonical Nitrogen, Nitrite, Nitrate, TKN)
Experiment No.4: Estimation of Phosphates and Sulphates
Experiment No.5: Conducting Break Point Chlorination Test
Experiment No.6: Determination of Residual Chlorine
Experiment No.7: Determination of Dissolved Oxygen
Experiment No.8: Conducting Jar test for determining optimum dosage of coagulant
Experiment No.9: Determination of anions using Ion Chromatograph

References:

1. Standard methods for the examination of water and wastewater, 21st Edition, Washington: APHA., 2012
2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002
3. B. Kotaiah and Dr. N. Kumara Swamy, Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007

MTEV-508: Laboratory – 2

Course Credits --2

Internal Marks: 100 **L T P**
External Marks: 50 **0 0 4**
Total Marks: 150

Ambient air quality Analysis: Determination of RSPM, CO, NOx, SOx and heavy metals.

Soil Analysis**:** pH, Conductivity, Cation exchange capacity, Sodium Adsorption ratio.

Coagulation and flocculation of water – Optimization of dose / pH / time of flocculation Color removal from wastewater by adsorption

Settling column tests for primary and secondary clarifiers, BOD kinetic parameters, ASP kinetic parameters, Determination of MLSS and MLVSS in ASP

Municipal solid waste sampling, segregation and analysis

Modeling: Use of water and air quality modeling software. Use of design softwares like EPAnet, WaterGem, SewerCad, StormCad etc.

Books

1. Standard methods for the examination of water and wastewater, 21st Edition, Washington: APHA., 2012
2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002
3. Metcalf & Eddy, Inc., Waste water Engineering Treatment and Reuse, McGraw Hill Inc., New Delhi., 2003

MTEV-602: Physics of Environment

Course Credits --3

Internal Marks: 50 | **L T P**
External Marks: 100 | **3 0 0**
Total Marks: 150

UNIT-I Radiation Sciemce

Radiation spectrum (ionizing & non ionizing radiation), Laws of radioactive disintegration, Interaction of nuclear radiation with matter (qualitative discussion only), Dosimetry and effects of radiations, Radiation detectors (GM counter, Ionization counter, Proportional counter and Scintillation counter), Radioactive waste management.

UNIT – II Atmospheric Physics

Basic structure of atmosphere, Stefan Law, Wien's displacement law, Planck's Temperature, Earth's radiation budget, Atmospheric photosensitivity, Fundamental forces and apparent forces, mass, momentum and energy conservation, Hydrostatic equilibrium,
Adiabatic lapse rates and stability, Geostrophic balance, Planetary atmospheres.

UNIT – III Climate Physics

Green house effect, Feedback mechanisms, Ozone layer depletion and Global warming, Aerosols & Cloud formation, Precipitation, Ice age, Climate effects of ocean (Convection, Thermal Inertia & Ocean circulation), Remote sensing.

References:

1. Nuclear Physics, D.C. Tayal, Himalaya Pub. House
2. Physical Geography, Strahler & Strahler, J. Wiley Pub.
3. Introduction to Health Physics, H. Cember, McGraw-Hill.
4. INTERNATIONAL ATOMIC ENERGY AGENCY, The safe use of radiation sources, Training Course series, No. 6, IAEA Vienna, 1995.
5. INTERNATIONAL ATOMIC ENERGY AGENCY, Radioactive Waste Management, an IAEA Source Book, IAEA, Vienna (1992).
6. Mid-Latitude Atmospheric Dynamics, J. E. martin, J. Wiley Pub.
7. An Introduction to Dynamic Meteorology, J. R. Holton, Elsevier Academic Press.
8. Environmental Physics Notes: 2007, Dr. Richard O. Gray,
llar.phys.appstate.edu/ep/ep2007.pdf

MTEV – 609 Environmental Geotechnology

Course Credits --3

Internal Marks: 50 | **L T P**
External Marks: 100 | **3 0 0**
Total Marks: 150

Soil mineralogy: Soil Formation, Composition and Structure: Introduction, Soil formation, Solids composition and characterization, Mineral composition, Different scales of soil structure, Structural variations due to consolidation and compaction, Pore sizes associated with soil structure, single particle arrangements, Role of Composition and soil structure in the engineering behavior of soils.

Mass transport and transfer in soils: Introduction; Mass transport mechanisms, Mass transfer mechanisms, Governing equation for mass transport, Solutions for special cases of mass transport.

Mechanisms of soil-water interaction: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

Introduction to unsaturated soil mechanics: Water retention property and soil-water characteristic curve; flow of water in unsaturated soil.

Site investigation: Introduction, Site investigation approach, phase investigations, Geophysical techniques, Hydro-geological investigations, Hydro-geochemical investigations, Geochemical data collection and analysis.

Concepts of waste containment facilities: Desirable properties of soil; contaminant transport and retention; contaminated site remediation.

Books:-

1. Mitchell, J.K. and Soga, K., Fundamentals of Soil Behaviour, John Wiley & Sons, Inc., New Jersey., 2005
2. Reddy, L.N. and Inyang. H. I., Geoenvironmental Engineering –Principles and Applications, Marcel Dekker, Inc., New York., 2000
3. Mohamed, A.M.O. and Antia, H.E., Geoenvironmental Engineering, Elsevier, Netherlands., 1998
4. Hsai_Yang Fang and Daniels, J.L. Introductory Geotechnical Engineering an Environmental Perspective, Taylor & Francis, Oxon., 2006
5. Yong, R. N., Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate and Mitigation", CRC press LLC, Florida., 2001.
6. Fang, H.Y, Introduction to Environmental Geotechnology, CRC Press, 1997.
7. " Proceedings of the International symposium of Environmental Geotechnology (Vol. I and Vol. II) ",4. Environmental Publishing Co., 1986 and 1989.

MTEV – 613 Environmental Impact Assessment and Management

Course Credits --3

Internal Marks: 50 **L T P**
External Marks: 100 **3 0 0**
Total Marks: 150

Introduction: The Need for EIA, Indian Policies Requiring EIA , The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Identifying The Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.

EIA Methodologies: Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods.

Reviewing The EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System, Integrated Impact Assessment.

Review Of EMP And Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre-Appraisal and Appraisal.

Case Studies: Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

References:

1. Sadler, B. and McCabe, M., Environmental Impact Assessment: Training Resource Manual. UNEP (2002).
2. MOEF, India, EIA manual. Ministry of Environment and Forests, Government of India (http://www.envfor.nic.in/legis/eia/so195.pdf).
3. Canter, R. L., Environmental Impact Assessment, Tata McGraw-Hill (1981).
4. Rau J. G. and Wooten D. C., Environmental Impact Analysis Handbook, Tata McGraw-Hill (1980).

5. ISO 14001: 2004; ISO 14004: 2004; ISO 19011: 2002

MTEV – 619 Industrial Waste Management

Course Credits --3

Internal Marks: 50 | **L T P**
External Marks: 100 | **3 0 0**
Total Marks: 150

Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates – characterization – Toxicity and Bioassay tests.

Prevention vs Control of Industrial Pollution– Source reduction techniques – Waste Audit- Evaluation of pollution prevention options.

Waste minimization - Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal – adsorption – Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal

Individual and Common Effluent Treatment Plants – Zero effluent discharge systems - Wastewater reuse – Disposal of effluent on land – Quantification, characteristics and disposal of Sludge.

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Petrochemical -Pharmaceuticals – Sugar and Distilleries – Food Processing – fertilizers – Thermal Power Plants and Industrial Estates, ISO 14000:2003 – Waste Audit.

References:

1. Arceivala, S. J. and Asolekar, S. R., *Wastewater Treatment for Pollution Control*, 3rd ed., McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2006.
2. Eckenfelder, W.W., Industrial Water Pollution Control, McGraw Hill (2007)
3. Frank Woodard, *Industrial waste treatment Handbook*, Butterworth Heinemann, New Delhi, 2001.
4. *Industrial Pollution Prevention Handbook,* Freeman H.M., McGraw Hill Inc.
5. Patwardhan, *Industrial Waste water Treatment*, Prentice Hall of India, New Delhi (2008)

MTEV – 620 Pollution Monitoring Techniques

Course Credits --3

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**0**
Total Marks: 150			

1. Measurement and Monitoring of Pollutants: Detection and Occurrence of Indicators Organisms and Pathogens, Geographic Information Systems.

2. Analytical methods: Gravimetric analysis, volumetric analysis, precipitation methods, oxidation reduction methods.

3. Principle, brief working and applications of different instrumental methods: U V I R spectrophotometer, flame photometry, AAS, chromatography, gas chromatography, Liquid chromatography , polarography, mass spectrometry, NMR & ESR spectroscopy, radio activity measurement, x-ray diffraction, thermal analysis techniques: DTA, TGA, DSC.

Refernces:

1. Willard, Merritt, Dean and Settle, *"Instrumental Methods of Analysis"*, Wadsworth Pub. Co., USA.

2. Sawyer, C.N., McCarty P.L. and Parkin, G.F., "Chemistry for Environmental Engineering and Science", Tata McGraw Hill, New Delhi.

MTCE-622: Numerical Methods in Engineering

Course Credits --3

Internal Marks: 50	**L**	**T**	**P**
External Marks: 100	**3**	**0**	**0**
Total Marks: 150			

1. Equation: Roots of algebraic transcendental equation, Solution of linear simultaneous Equations by different methods using Elimination, Iteration, Inversion, Gauss-Jordan and Gauss Siedel iteration method – Factorisation method – Ill conditioned matrix. Numerical integration: Newton Cotes closed quadrature – Trapezoidal rule – Simpson's $1/3^{rd}$ rule – $3/8^{th}$ rule method. Homogeneous and Eigen Value problem, Non-linear equations, Interpolation.

2. Finite Difference Technique: Partial differential equation: Laplace, Poisson and wave equation – Explicit and implicit methods. Initial and Boundary value problems of ordinary and partial differential equations, Solution of Various types of plates and other civil engineering related problems

3. Statistical Methods: Method of correlation and Regression analysis for fitting a polynomial equation by least square

4. Initial Value problem: Galerkin's method of least square, Initial Value problem by collocation points, Runge kutta Method

References:

1. James B. Scarborough: Numerical Mathematical Analysis, Oxford and IBH Publishing, 1955.
2. S.S. Sastry : Introductory Methods of Numerical Analysis, PHI Learning (2012).
3. J.B Dixit : Numerical Methods, USP (Laxmi publication),
4. Akai T J: Applied Numerical methods for Engineers, John Wiley & Sons New York, 1994
5. Chapra S.C. and Canale R.P. Numerical methods for Engineers, Tata Mc.Graw Hill Publishing Co. Ltd., New York, 1985
6. Gerald: Applied Numerical Analysis, Pearson Education, New Delhi ,2003
7. Krishnamurthy E V and Sen S. K. :Numerical algorithms, East- West Press Pvt Ltd., New Delhi. 1986
8. Rajasekharan S. Numerical methods in Science and Engineering , Wheeler & Co. Pvt. Ltd., New Delhi. 1986
9. Rao S.S. *Optimisation theory and applications*, Wiley Eastern Ltd., New York. 1979