

Guru Nanak Dev Engineering College, Ludhiana

Civil Engineering Department

Study Scheme of Post Graduate Program (Batch 2016 & Onwards)

M.Tech Environmental Science & Engineering							
S No	Subject Code	Course Title	Type	Contact Hours	Credits	Distribution of Marks	
				L-T-P		Ext	Int
First Semester							
1	MTEV-16501	Physico-Chemical Treatment Methods	Core	4-0-0	4	100	50
2	MTEV-16503	Environmental Chemistry and Microbiology	Core	4-0-0	4	100	50
3	MTEV-16505	Solid and Hazardous Waste Management	Core	4-0-0	4	100	50
4	MTEV-166xx	Program Elective-I	Program Elective	3-0-0	3	100	50
5	MTEV-166xx	Program Elective-II	Program Elective	3-0-0	3	100	50
6	MTEV-16507	Laboratory-I	Lab-I	0-0-4	2	50	50
Second Semester							
1	MTEV-16502	Biological Treatment Methods	Core	4-0-0	4	100	50
2	MTEV-16504	Research Methodology	Core	4-0-0	4	100	50
3	MTEV-16506	Air Pollution and Control	Core	4-0-0	4	100	50
4	MTEV-166xx	Program Elective-III	Program Elective	3-0-0	3	100	50
5	MTxxxx	Open Elective-I	Open Elective	3-0-0	3	100	50
6	MTEV-16508	Laboratory-II	Lab-II	0-0-4	2	50	50
Third Semester							
1	MTyyyy	Open Elective-II	Open Elective	3-0-0	3	100	50
2	MTEV-166xx	Program Elective-IV	Program Elective	3-0-0	3	100	50
3	MTEV-16509	Pre-Thesis Seminar	Pre-thesis seminar	0-0-2	1	-	100
4	MTEV-16510	Pre-Thesis Project	Pre-thesis project	0-0-3	3	50	50
Fourth Semester							
1	MTEV-16511	Thesis/Dissertation	Thesis	0-0-15	15	100	200

List of Program Electives for Environmental Science & Engineering

S. No.	Course Name	Course Code
1	Environmental Systems Engineering	MTEV-16601
2	Physics of Environment	MTEV-16602
3	Environmental Hydraulics and Hydrology	MTEV-16603
4	Environmental Remote Sensing and GIS	MTEV-16604
5	Urban Water Management	MTEV-16605
6	Biodegradation and Bioremediation	MTEV-16606
7	Climate Change and Sustainable Development	MTEV-16607
8	Rural Water Supply and Environmental Sanitation	MTEV-16608
9	Environmental Geotechnology	MTEV-16609
10	Energy Technology and Alternate Energy Systems	MTEV-16610
11	Strength of Materials	MTEV-16611
12	Burried Structures	MTEV-16612
13	Environmental Impact Assessment and Management	MTEV-16613
14	Disaster Reduction and Management	MTEV-16614
15	Site Investigations	MTEV-16615
16	Environmental Legislation and Auditing	MTEV-16616
17	Air and Water Quality Modeling	MTEV-16617
18	Environmental Biotechnology	MTEV-16618
19	Industrial Waste Management	MTEV-16619
20	Pollution Monitoring techniques	MTEV-16620
21	Numerical Methods in Engineering	MTEV-16621

***Department can float any above subject as Open elective as per the requirement of timetable.**

MTEV-16501: Physico-Chemical Treatment Methods

Course Credits --4

Internal Marks: 50

L T P

External Marks: 100

4 0 0

Total Marks: 150

Course Content	Contact Hours
Water – Quality, Standards and Criteria: Physical, chemical and biological water quality parameters; Water quality guidelines, criteria and standards; Wastewater Effluent standards	8
Purification of water- Natural treatment processes- Physical, chemical and biological processes. Water treatment technologies- overview, Primary, Secondary and tertiary treatment-Unit operations & unit processes	6
Screening & Grit removal: Screens; grit channels, aerated grit chambers	3
Settling Tanks, Coagulation and Flocculation: Theory of settling; Types of settling; settling Tanks; Coagulation-flocculation; Flash mixing tanks and flocculation tanks; larifiers and clariflocculators; Tube settlers and plate settlers.	10
Aeration: Diffused and surface and Gas transfer processes.	2
Filtration Systems: Filtration theory and filter hydraulics; Slow sand filters; Rapid gravity filters; Pressure filters; Multimedia filters.	7
Disinfection: Chlorination; Ozonation; UV radiation	4
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.	8

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-16502 Biological Treatment Methods

Course Credits --4

Internal Marks: 50

L T P

External Marks: 100

4 0 0

Total Marks: 150

Course Content	Contact Hours
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	12
Process Kinetics: Fundamentals of Process Kinetics, Zero order, First order, Second order Reactions, Enzyme reactions – Bio reactors- Types-Classification – Design principles	6
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	8
Suspended Growth Processes: Activated Sludge Process, Modifications including SBR and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements	7
Waste stabilization Ponds and Lagoons: Aerobic pond, facultative pond, anaerobic ponds, polishing ponds, aerated lagoons. Constructed wetlands and Duckweed ponds	5
Anaerobic processes -Process fundamentals-Standard, high rate and hybrid reactors Anaerobic filters -Expanded /fluidized bed reactors-Upflow anaerobic sludge blanket reactors, Design and Operation	5
Sludge Treatment and Disposal: Sludge Thickening, Sludge Digestion & disposal	3
Other Treatment Technologies: Advanced oxidation processes, Biological nutrient removal	4

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-16503: Environmental Chemistry and Microbiology

Course Credits --4

Internal Marks: 50

L T P

External Marks: 100

4 0 0

Total Marks: 150

Course Content	Contact Hours
Introduction and Scope: Air-water, water-sediment / soil and air – water – sediment interactions, physical water quality parameters.	3
Chemistry of Natural Water: Reaction stoichiometry, basic concepts from equilibrium chemistry, acid-base reactions, solubility of salts (soil chemistry) and related water quality parameters.	5
Nutrients and Organic Impurities in Water: Oxidation-reduction reactions, water and wastewater quality parameters (ORP, BOD, COD, TOC etc.).	6
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.	9
Microbiology - classification - identification – Taxonomy - Reproduction and growth -cultures & characteristics - Enzymes - Microbial metabolism - energy production –biosynthesis, Mixed and pure culture – Growth rate – Application.	10
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.	10

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 – 16504 Research Methodology

Course Credits --4

Internal Marks: 50

L T P

External Marks: 100

4 0 0

Total Marks: 150

Course Content	Contact Hours
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	10
Methods of Data Collection: Primary data and Secondary Data, methods of primary data collection, classification of secondary data,	10
Sampling Methods: Probability sampling: simple random sampling, systematic sampling, stratified sampling, cluster sampling and multistage sampling. Non-probability sampling: convenience sampling, judgment sampling, quota sampling. Sampling distributions	10
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	14
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	12

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-16505: Solid and Hazardous Waste Management

Course Credits --4

Internal Marks: 50

L T P

External Marks: 100

4 0 0

Total Marks: 150

Course Content	Contact Hours
Introduction: Definition of solid wastes and hazardous wastes, Nuisance potential and extent of solid waste problems, Objectives and scope of integrated solid waste management.	6
Characterization and Quantification: Types, composition, characteristics and quantities of wastes, Methods of quantification and characterization of wastes.	7
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.	8
Solid Waste Processing and Treatment: Waste processing – processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration	8
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.	9
Sanitary Landfills: Site selection and approval; design, development, operation and closure of landfills, Management of leachate and landfill gases, environmental monitoring of landfill sites.	6
Legal Requirements: Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, flyash, etc.	4

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 – 16506 Air Pollution and Control

Course Credits --4

Internal Marks: 50

L T P

External Marks: 100

4 0 0

Total Marks: 150

Course Content	Contact Hours
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	8
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.	8
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.	10
Particulate emission control - Settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators.	10
Control of gaseous pollutants – Removal of gaseous pollutants by adsorption, absorption, reaction and other methods.	6
Biological air pollution control technologies – Bio-scrubbers, bio-filters, and Indoor air quality.	8

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-16507: Laboratory-I

Course Credits --2

Internal Marks: 100

L T P

External Marks: 50

0 0 4

Total Marks: 150

Analysis of environmental samples by Gravimetric, Titrimetry, 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) and Fluorides

Experiment No.2: Estimation of Nitrogen (Ammonical Nitrogen, Nitrite, Nitrate, TKN)

Experiment No.3: Estimation of Phosphates and Sulphates

Experiment No.4: Conducting Break Point Chlorination Test

Experiment No.5: Determination of Residual Chlorine

Experiment No.6: Conducting Jar test for determining optimum dosage of coagulant

Experiment No.7: Determination of anions using Ion Chromatograph

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. B. Kotaiah and Dr. N. Kumara Swamy, Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007

MTEV-16508: 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, NO_x, SO_x and heavy metals.

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

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-16509: Pre-Thesis Seminar

Course Credits --1

Internal Marks: 100

External Marks: --

Total Marks: 100

L	T	P
0	0	2

This is an unstructured open-ended course where under the overall supervision of a faculty member of his discipline, each student must submit report as a culmination of his endeavor and investigation. The course will aim to evaluate student's actual ability to use the fundamentals of knowledge and to meet new unknown situations as demonstrated by the student's interaction with the teachers.

**The topic of seminar must be related to the thesis work of the student.*

MTEV-16510: Pre-Thesis Project

Course Credits --3

Internal Marks: 50

External Marks: 50

Total Marks: 100

L T P

0 0 3

This is an unstructured course where under the overall supervision of a faculty member of his discipline, each student must submit report as a culmination of his endeavor and investigation related to the topic of his/her discipline. The course will aim to evaluate student's actual ability to use the fundamentals of knowledge and to meet new unknown situations as demonstrated by the student's interaction with the teachers.

**The topic of Project must be related to the thesis work of the student.*

MTEV – 16601 Environmental Systems Engineering

Course Credits --3

Internal Marks: 50

L T P

External Marks: 100

3 0 0

Total Marks: 150

Course Content	Contact Hours
System approach: concept and analysis. Problem formulation, model construction and deriving solution from models.	7
Linear Programming Problem (LPP): Primal and Dual Simplex Method. Limitations of LPP. Sensitivity analysis	6
Application of linear programming to wastewater management systems, pesticide management problems, planning of municipal wastewater treatment, air quality management, and agricultural non-point source pollution	6
Lagrange's multipliers: Unconstrained and constrained optimization, Limitations of Lagrange's multipliers. Sequential search algorithms: Box algorithm.	6
Separable and integer programming: Application to multi-objective planning. Application of integer programming to municipal solid waste management. Transportation models.	6
Dynamic programming models: Application to land use planning and air pollutant emission control.	3
Present value concepts: Optimization over time.	2

References:

1. Operations Research: An Introduction - Hamdy A. Taha, Prentice Hall Pub.
2. Operation Research: theory & applications – J. K. Sharma, Macmillan India Ltd., 2009.
3. Environmental Systems Engineering – Henry R. Bungay, Kluwer Academic Pub., 1997
4. Environmental Systems Optimization – D.A.Haith , 1982, Wiley Sons, NY.
5. Techniques for Environmental System Analysis - R.H.Pantell Wiley, NY, 2001.
6. Handbook of Environmental and Ecological Modelling - SE Jorgensen, B Halling-Sorensen, and SN Nielsen, CRC Press, 1995.
7. Civil and Environmental Systems Engineering (2nd Ed.)- Charles S. Revelle, Earl Whitlatch, Jeff Wright, Pearson Publishers.

MTEV-16602: Physics of Environment

Course Credits --3

Internal Marks: 50

L T P

External Marks: 100

3 0 0

Total Marks: 150

Course Content	Contact Hours
Radiation Science 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.	10
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.	14
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.	12

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, lar.phys.appstate.edu/ep/ep2007.pdf

MTEV – 16609 Environmental Geotechnology

Course Credits --3

Internal Marks: 50

L T P

External Marks: 100

3 0 0

Total Marks: 150

Course Content	Contact Hours
Introduction and soil mineralogy: Scope of environmental geotechnology and its applications, 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, Role of Composition and soil structure in the engineering behavior of soils.	8
Contamination in soils: Subsurface contamination, Mass transport mechanisms, Mass transfer mechanisms, Governing equation for mass transport, Soil as a geotechnical trap, effects of subsurface contamination its detection and monitoring.	6
Mechanisms of soil-water interaction: Diffuse double layer and simple DDL models; Force of attraction and repulsion; Soil-water-contaminant interaction; Effect of contaminants on engineering properties of soil.	8
Site investigation: Introduction, Site investigation approach, phase investigations, Geophysical techniques, Hydro-geological investigations, Hydro-geochemical investigations, Geochemical data collection and analysis.	6
Concepts of waste containment facilities: Desirable properties of soil; contaminant transport and retention; containment of solid waste in landfills, environmental impact of slurry waste and containment of slurry wastes, contaminated site remediation.	4
Case histories: Case histories on geo-environmental problems pertaining to use of readily available local soils, bio-remediation of spills etc.	4

References:

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 – 16613 Environmental Impact Assessment and Management

Course Credits --3

Internal Marks: 50

L T P

External Marks: 100

3 0 0

Total Marks: 150

Course Content	Contact Hours
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.	8
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.	8
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.	10
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.	6
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.	4
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.	4

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 – 16619 Industrial Waste Management

Course Credits --3

Internal Marks: 50

L T P

External Marks: 100

3 0 0

Total Marks: 150

Course Content	Contact Hours
Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates – characterization – Toxicity and Bioassay tests.	4
Prevention vs Control of Industrial Pollution– Source reduction techniques – Waste Audit-Evaluation of pollution prevention options.	5
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	13
Individual and Common Effluent Treatment Plants – Zero effluent discharge systems -Wastewater reuse – Disposal of effluent on land – Quantification, characteristics and disposal of Sludge.	6
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.	10

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 – 16620 Pollution Monitoring Techniques

Course Credits --3

Internal Marks: 50

L T P

External Marks: 100

3 0 0

Total Marks: 150

Course Content	Contact Hours
Measurement and Monitoring of Pollutants: Detection and Occurrence of Indicators Organisms and Pathogens, Geographic Information Systems.	4
Analytical methods: Gravimetric analysis, volumetric analysis, precipitation methods, oxidation reduction methods.	10
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.	22

References:

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.

MTEV-16621: Numerical Methods in Engineering

Internal Marks: 50
External Marks: 100
Total Marks: 150

Course Credits --3
L T P
3 0 0

Course Content	Contact Hours
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 – Factorization 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.	12
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	10
Statistical Methods: Method of correlation and Regression analysis for fitting a polynomial equation by least square	10
Initial Value problem: Galerkin’s method of least square, Initial Value problem by collocation points, Runge-kutta Method	10

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