

Department of Environmental Science & Engineering

Approved Syllabus and Course Content
of

B.Tech (Environmental Engineering)

B.Tech (Environmental Engineering) – Honours

Minor in Environmental Engineering

by BOCS held on 27.03.2015

Effective from 2015-16



INDIAN SCHOOL OF MINES

DHANBAD- 826 004,

JHARKHAND

**Introduction of B.Tech (Env Eng), B.Tech (Env Eng with Honours),
and Minor in Env.Engg. syllabus as approved by the BOCS held
on 27.03.2015 at 10:00 AM**

The B. Tech in Environmental Engineering was started in the year 2006 and the last BOCS was held in the year 2012-13. The Academic Council meeting held on 24.01.2015 decided the implementation of Major and Minor Degree Programmes at ISM.

In this respect the following guidelines were followed vide notification dated 18.02.2015 by Dean (Acad).

1. No changes were made in the Course Structure and Syllabus for the first four Semester and cumulative contact hours at the end of fourth semester is **113**.
2. From V to VIII Semester the **contact hours** were changed as:

Semester	Only B.Tech (Env Engg)	B.Tech (EE with Hons)	Minor in Env Engg
V	18	18 + 6 = 24	6
VI	17	17 + 5 = 22	6
VII	15	15 + 6 = 21	6
VIII	15	15 + 6 = 21	5

B.Tech (Environmental Engineering): Semester - V

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC 15101	Environmental Geotechnology	3-0-0	3
2.	ESC 15102	Land Resource Management	3-0-0	3
3.	ESC 15103	Water Resources Planning and Management	3-0-0	3
4.	ACC 151 04	Instrumental Methods for Environmental Analysis	3-1-0	4
5.	ESC 152 01	Environmental Geotechnology (Practical)	0-0-2	2
6.	ESC 152 02	Land Resource Management (Practical)	0-0-2	2
7.	ACC 152 04	Instrumental Methods for Environmental Analysis (Practical)	0-0-2/2	1
8.	ESC 154 01	Project Work	0-0-0 (4)	
9.	ESC 156 01	Vocational Training *	0-0-0 (3)	
		Contact Hours	12-1-5	18

B.Tech Environmental Engineering (Honours): Semester - V

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC 15101	Environmental Geotechnology	3-0-0	3
2.	ESC 15102	Land Resource Management	3-0-0	3
3.	ESC 15103	Water Resources Planning and Management	3-0-0	3
4.	ACC 151 04	Instrumental Methods for Environmental Analysis	3-1-0	4
5.	ESC 152 01	Environmental Geotechnology (Practical)	0-0-2	2
6.	ESC 152 02	Land Resource Management (Practical)	0-0-2	2
7.	ACC 152 04	Instrumental Methods for Environmental Analysis (Practical)	0-0-2/2	1
8.	ESC 154 01	Project Work	0-0-0 (4)	
9.	ESC 156 01	Vocational Training *	0-0-0 (3)	
10.	<i>ESH 15101</i>	<i>Design of Air Pollution Control System</i>	<i>3-0-0</i>	<i>3</i>
11.	<i>ESH 15102</i>	<i>Environmental Engineering Design -I (S)</i>	<i>1-2-0</i>	<i>3</i>
Contact Hours			16-3-5	24

Environmental Engineering (Minor): Semester - V

1	ESM 15101	Introduction to Environmental Engineering	3-0-0	3
2	ESM 15201	Environmental Engineering (Practical)	0-0-2/2	1
3	ESM 15301	Environmental Chemistry (S)	2-0-0	2
Contact Hours			5-0-1	6

B.Tech (Environmental Engineering): Semester - VI

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC161 01	Principle and Design of Water Supply System	3-0-0	3
2.	ESC161 02	Solid Waste Management	3-0-0	3
3.	ESC161 03	Remote Sensing and GIS	3-0-0	3
4.	ESC161 04	Environmental Aspects of Industries	4-0-0	4
5.	ESC 16201	Principle and Design of Water Supply System (Practical)	0-0-2/2	1
6.	ESC 16202	Solid Waste Management (Practical)	0-0-2/2	1
7.	ESC162 03	Remote Sensing and GIS (Practical)	0-0-2	2
8.	ESC 16401	Project Work	0-0-0 (4)	
9.	ESC 16402	Seminar	0-0-0 (2)	
		Contact Hours	13-0-4	17

B.Tech Environmental Engineering (Honours): Semester - VI

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC161 01	Principle and Design of Water Supply System	3-0-0	3
2.	ESC161 02	Solid Waste Management	3-0-0	3
3.	ESC161 03	Remote Sensing and GIS	3-0-0	3
4.	ESC161 04	Environmental Aspects of Industries	4-0-0	4
5.	ESC 16201	Principle and Design of Water Supply System (Practical)	0-0-2/2	1
6.	ESC 16202	Solid Waste Management (Practical)	0-0-2/2	1
7.	ESC162 03	Remote Sensing and GIS (Practical)	0-0-2	2
8.	ESC 16401	Project Work	0-0-0 (4)	
9.	ESC 16402	Seminar	0-0-0 (2)	
10.	ESH161 01	<i>Noise Pollution and its Control</i>	3-0-0	3
11.	ESH 162 01	<i>Noise Pollution and its Control (Practical)</i>	0-0-2	2
		Contact Hours	16-0-6	22

Environmental Engineering (Minor): Semester - VI

1	ESM 16101	Water and Wastewater Engineering	3-0-0	3
2	ESM 16201	Water and Wastewater Engineering (Practical)	0-0-2/2	1
3	ESM 16301	Design of Water and Wastewater Treatment System (S)	2-0-0	2
		Contact Hours	5-0-1	6

B.Tech (Environmental Engineering): SEMESTER - VII

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC171 01	Municipal Wastewater Engineering	3-1-0	4
2.	ESC171 02	Environmental Policy and Legislation	3-0-0	3
3.	ESC171 03	Environmental Impact Assessment	3-0-0	3
4. Elective Papers		(any one)	3-0-0	3
a)	ESE 171 01	Hazardous and Biomedical Waste Management		
b)	ESE 171 02	Environmental Biotechnology		
c)	ESE 171 03	Environmental Economics		
d)	HSS 17345	Social and Ethical Issues in Engg		
5	ESC 172 01	Municipal Wastewater Engineering (Practical)	0-0-2	2
6	ESC 174 01	Project Work	0-0-0 (6)	
7	ESC 176 01	Vocational Training *	0-0-0 (3)	
		Contact Hours	12-1-2	15

B.Tech Environmental Engineering (Honours): Semester - VII

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC171 01	Municipal Wastewater Engineering	3-1-0	4
2.	ESC171 02	Environmental Policy and Legislation	3-0-0	3
3.	ESC171 03	Environmental Impact Assessment	3-0-0	3
4. Elective Papers		(any one)	3-0-0	3
a)	ESE 171 01	Hazardous and Biomedical Waste Management		
b)	ESE 171 02	Environmental Biotechnology		
c)	ESE 171 03	Environmental Economics		
d)	HSS 17345	Social and Ethical Issues in Engg		
5	ESC 172 01	Municipal Wastewater Engineering (Practical)	0-0-2	2
6	ESC 174 01	Project Work	0-0-0 (6)	
7	ESC 176 01	Vocational Training *	0-0-0 (3)	
8	ESH 171 01	<i>Environmental Systems Optimization and Modeling</i>	3-0-0	3
9	ESH 17102	<i>Environmental Engineering Design-II (S)</i>	1-2-0	3
Contact Hours			16- 3- 2	21

Environmental Engineering (Minor): Semester -VII

1	ESM 17101	Air and Noise Pollution	3-0-0	3
2	ESM 17201	Air and Noise Pollution (Practical)	0-0-2/2	1
3	ESM 17301	Air Pollution Control & Modeling (S)	2-0-0	2
Contact Hours			5-0-1	6

B.Tech (Environmental Engineering): Semester - VIII

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC 181 01	Industrial Wastewater Treatment	3-0-0	3
2.	ESC 181 02	Environmental Management System and Auditing	3-0-0	3
3	ESC 181 03	Occupational Health, Safety and Risk Assessment	4-0-0	4
4. Elective Papers		(any one)	3-0-0	3
a)	ESE 181 01	Environmental Toxicology & Health		
b)	ESE 181 02	Environmental Nanotechnology		
c)	ESE 181 03	Social Impact Assessment and R&R		
d)	MSC 173 51	Managerial Economics		
5	ESC 18201	Industrial Wastewater Treatment (Practical)	0-0-2	2
6	ESC 184 01	Project Work	0-0-0 (6)	
7	ESC 184 02	Seminar	0-0-0 (2)	
8	ESC 185 01	Composite Viva –Voce	0-0-0 (4)	
Contact Hours			13-0-2	15

B.Tech Environmental Engineering (Honours): Semester - VIII

SI No.	Subject Code	Name of the Course	L T P	Contact Hours
1.	ESC 181 01	Industrial Wastewater Treatment	3-0-0	3
2.	ESC 181 02	Environmental Management System and Auditing	3-0-0	3
3	ESC 181 03	Occupational Health, Safety and Risk Assessment	4-0-0	4
4. Elective Papers		(any one)	3-0-0	3
a)	ESE 181 01	Environmental Toxicology & Health		
b)	ESE 181 02	Environmental Nanotechnology		
c)	ESE 181 03	Social Impact Assessment and R&R		
d)	MSC 173 51	Managerial Economics		
5	ESC 18201	Industrial Wastewater Treatment (Practical)	0-0-2	2
6	ESC 184 01	Project Work	0-0-0 (6)	
7	ESC 184 02	Seminar	0-0-0 (2)	
8	ESC 185 01	Composite Viva –Voce	0-0-0 (4)	
9	ESH 181 01	<i>Climate Change and its Mitigation</i>	3-0-0	3
10	ESH 18102	<i>Environmental Engineering Design-III (S)</i>	1-2-0	3
Contact Hours			17-2-2	21

Environmental Engineering (Minor): Semester - VIII

1	ESM 18101	Environmental Management System	3-0-0	3
2	ESM 18301	Application of Environmental Management System(S)	2-0-0	2
Contact Hours			5-0-0	5

SEMESTER - V

ESC 151 01 Environmental Geotechnology [3-0-0]

Soil, Complexity of soil nature, formation, regional deposits, solid-water-air relationships and index properties. Classification of soil, soil structure and clay minerals, soil compaction, effective stress, capillarity and permeability, seepage through soils, flownets, drainage and dewatering, compressibility of soil and consolidation, shear strength of soils.

Geotechnical applications in slope stability, factor of safety. Site investigation and subsoil exploration. Application of soil mechanics in environmental engineering, land reclamation, soil erosion and control. Application of Geotextiles.

Books & References:

1. Environmental Geotechniques, Robert Sarsby, Thomas Telford Books.
2. The Nature and Properties of Soil, Nyle C Brady, Eurasian Publishing House (P) Ltd.
3. Basic and Applied Soil Mechanics II Edition, Gopal Ranjan & A.S.R Rao, New Age Publishers.
4. Geotechnical Engineering, S.K.Gulhati, Manoj K Dutta, McGraw Hill Co.

ESC 151 02 Land Resource Management [3-0-0]

Land use Planning – Objective and importance; Land use and capability classification systems; Land use Planning models and their limitations.

Impacts of natural and man-made activities on land characteristics and land use planning; Impact of soil erosion and sedimentation control.

Design of tailings dams, overburden dump and ash pond.

Land reclamation principles and requirement; Topsoil management – inventory, removal, preservation and redistribution; Ecological restoration technology – objectives and guidelines; Technical reclamation – stability, drainage and erosion control; estimation of sediment load and design of sedimentation pond; Factors effecting the development of vegetation cover in mine degraded areas; Selection of tree species for restoration purposes; importance of grass-legume mixture;; Application of mulches, geotextiles and Soil amendments; Monitoring and aftercare of restored sites; Evaluation of restoration success and indicator parameters; Post project land use monitoring. Ecological restoration and its components.

Forestry and biodiversity issues; Planning for biodiversity conservation on reclaimed lands.

Mine closure planning – environmental impacts of mine closure, development of closure plan, closure guidelines, mine closure activity, closure cost.

Books & References:

1. Ecorestoration of the coalmine degraded lands- Subodh Kumar Maiti, Springer (2013)
2. Analysis of Land Use Change: Theoretical and Modeling Approaches, Helen Briassoulis, University of the Aegean Lesvos , Greece, E-Book
3. Environmental Land use planning and Management, John Randolph, Island Press,
4. Land Use in Mining Areas of India, Rekha Ghosh, Envis, ISM Dhanbad, ISSN 0972-4656
5. Quarry Reclamation - NJ Coppin and A.D.Bradshaw, Mining Journal Books, London,1982

ESC 151 03 Water Resource Planning and Management [3-0-0]

Water Resources: Introduction, hydrological cycle, World water distribution, need for conservation & development of water resources, Hydrological analysis of precipitation: Precipitation, measurement of rainfall, index of wetness, design of rain gauge network, probable maximum precipitation curve, Infiltration, Infiltration Capacity Curve, Measurement & estimation of water losses, Runoff cycle, Runoff coefficients, Computation of runoff: unit hydrograph, Bernard's distribution, Unit Storm Method, Evapo-transpiration.

Streams & reservoir: Stream flow measurement: Notches, weirs, control meters, Ventur-Flumes, Velocity area method, slope area method, capacity elevation curve of river, Types of reservoirs, storage zones, catchment yield & reservoir yield, reservoir capacity, mass curve of inflow and outflow, reservoir sedimentations and losses, selection of site for a reservoir, economic height of dam, hydrological reservoir routing-Trial & Error Method, Modified Pul's method and Goodrich Method.

Groundwater hydrology: Measurement of yield, Laws of groundwater movement: Darcy's law, Thiens equilibrium formula, Duipuits formula etc.

Recharging of underground storage, infiltration galleries, infiltration wells, springs, wells.

Flood flows and management: Definition & causes of flood, estimation of design flood and flood flows for design of hydraulic structures, Flood control measures, Flood Routing

Water resources planning & management: Impact of climate change on water resources.

Books and References

1. Water Resources Engineering- Larry W. Mays, John Wiley and Sons
2. Water Resources Engineering - Ray K Linsley, Joseph B Franzini, David L Freyberg, George Tchobanoglous, Mc Graw Hill, 4th Ed.
3. Hydrology and Water Resources Engineering- S.K. Garg, Khanna Publishers
4. Hydrology- M.M. Das, M.D. Saikia, PHI Learning Pvt Ltd., New Delhi, 3rd Ed.

ACC 151 04 Instrumental Methods for Environmental Analysis [3-1-0]

Treatment of data in quantitative analysis: Accuracy, Precision, Standard deviation, and types of Errors, minimization of error, significant figures, criteria for rejection of data.

Principles of instrumentation; advantages, applications, and limitations of the following analytical techniques: Spectrophotometry, FTIR, NMR, Atomic absorption and Emission spectrophotometry, Flame photometry, Fluorimetry, Nephelometry, Inductively coupled plasma spectrometry and MS. Electrochemical methods: Polarography, Pulse polarography, Ion selective electrodes, Oscilloscopic Polarography, Cyclic voltametry, Anodic Stripping Voltametry.

Chromatography: Classification, general ideas about adsorption, partition, and column chromatography, paper and thin layer chromatography. Gas chromatography, High performance liquid chromatography (HPLC), Ion chromatography.

Particle size and shape analyser.

Auto- titration method

Books & References :

1. Instrumental Methods of Analysis - HH Willard & LL Dean, John Wiley, 1976
2. Modern Methods of Chemical Analysis - RL .Recsok & LD Shields, John Wiley & sons, Inc, 1990
3. Instrumental Methods of Chemical Analysis -GW Ewing, McGraw Hill Book Company, Inc. 1975
4. Modern Methods of Chemical Analysis - RL Pecsok & LD Shields, John Wiley & Sons, Inc. 1986

ESC 152 01 Environmental Geotechnology(Practical) [0-0-2]

Practical related to Moisture Content, Atterberg's limit test, Density and Specific Gravity, Particle Size analysis, Falling Head and Constant Head Permeability Tests, Compaction Tests, Consolidation Tests, Shear Tests, Triaxial Tests etc.

ESC 152 02 Land Resource Management (Practical) [0-0-2]

Principles of land surveying, Leveling and angular measurement instruments. Distance, elevation, and angular measurement techniques, Traversing and triangulation survey, Analysis of errors during measurement, Curve surveying, Land/mine plan development

ACC 152 04 Instrumental Methods for Environmental Analysis (Practical) [0-0-2/2]

Estimation of iron by Vis-spectrophotometer (including plotting of calibration curve using least square method), Detection of PAH by FTIR, Estimation by flame photometer, Conductometric titration, Potentiometric titration, Determination of distribution coefficient of I₂ in water and CCl₄, Estimation of free chlorine in water.

ESC 154 01 Project Work [0-0-4]

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

Review of general principles of air pollution control; Control of Particulate Matter; Fundamentals of emitted particulate matter and flue gas characteristics; Design and operation of Gravity Settling Chambers, Cyclones, Wet Scrubber- Column Scrubbers, Jet Scrubbers, Vortex Scrubbers, Rotating Disc Scrubbers, and Venturi Scrubbers, Electrostatic Precipitators, and Fabric Filters; Dust control and abatement measures in industries and mines– fugitive dusts; dust suppression, dust extraction and dust consolidation.

Design of stack and duct system.

Design of control devices for gaseous pollutants with special emphasis on adsorption, absorption, mass transfer, condensation and combustion. Fuel and Flue gas desulphurization, sulphur recovery.

Control technologies of motor vehicle emissions and indoor air pollution.

Economics and trends of air pollution control.

Books and References

- 1 Air Pollution Control Equipment - H.Brauer & YBG Verma, Springer-Verlag, Berlin Heidelberg, NY, latest Ed.
- 2 Environmental Pollution Control Engineering - C.S.Rao, Wiley Eastern Ltd., New Delhi, 1996.
- 3 Air Pollution Control Engineering - Noel de Nevers, McGraw Hill, Singapore, 1995.
- 4 Air Pollution Control in Industries, Vol. 1 & 2 – T. K. Ray, Technip Books International, 2003.

Design and Numerical problems on Air Pollution, Water Pollution, Environmental Geotechnology etc.

Course content for Minor in Environmental Engineering - V Sem. (For other branches)

ESM 15101 Introduction to Environmental Engineering [3-0-0]

National and International Environmental issues. Structure and Composition of atmosphere, Greenhouse effect and Global Warming, Carbon Dioxide Sequestration, etc.

Material and energy balances: state of mixing, reactor analysis and thermal pollution in river.

Ecosystems – functioning and types of ecosystem; hot spots and fragile ecosystem, Bio-geochemical cycles; Biodiversity – importance, threat, measurement and conservation.

Hydrology: Hydrologic mass balance, rainfall fall analysis, storage of reservoirs, hydrological properties of aquifers, groundwater contamination.

Monitoring and Analysis of pollutants, Hazardous substances and Risk analysis (Dose response assessment), Human exposure assessment.

Solid waste management: Types and characteristics, collection, transportation and disposal of solid waste; .Conversion of waste-to-energy; Composting, design concept of landfill and inclinators.

Books & References

- 1 Introduction to Environmental Sc. & Engineering – G.M. Masters and W.P. Ela. Pearson Printing Hall.
- 2 Environmental Engineering – HW Peavy, DR Rowe & G Tchobanoglous, McGraw- Hill Int.
- 3 Environmental Chemistry for Scientist and Engineers – Sawyer and McCarty

ESM 15301 Environmental Chemistry (S) [2-0-0]

Chemistry of atmosphere, Aqueous Phase Chemistry (Acid Rain formation), Aerosol Chemistry, criteria pollutants and formation of secondary pollutants.

Acid and Base reactions, Titrations, Buffers and Buffer Intensity, Alkalinity, Reaction kinetics, gas transfer, Chemical Equilibrium Calculations, pC-pH diagram. Precipitation and Dissolution, Water Softening and Water Conditioning, coagulation and zeta potential, Disinfection and formation of disinfection by products, Oxidation and Reduction reaction stoichiometry, Detergents and pesticides;

States of solution impurities; Behaviour of organics in the environment.

Books & References

- 1 Sawyer, C.N., McCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering and Science, 5th Ed., McGraw Hill.
- 2 Jacob, D.J., Introduction to atmospheric chemistry. Princeton University Press Princeton, New Jersey.
- 3 Morel, F.M.M., and Hering, J.G., Principles and Application of Aquatic Chemistry, John Wiley & Sons, Inc, NY, 1993.

ESM 15201 Environmental Engineering (Practical) [0-0-2/2]

Calibration and Standardization - pH meter, Conductivity Meter and Nephelometer.

Determination of Acidity-alkalinity, Total Suspended Solids, Total Dissolved Solids, Total Hardness, Ca and Mg hardness, Dissolved Oxygen.

Demonstration of Gas Chromatograph, Total Organic Carbon Analyzer, Atomic Absorption Spectrophotometer (AAS), Flame Photometer, UV-Vis Spectrophotometer, HPLC, etc.

SEMESTER - VI

ESC 161 01 Principle and Design of Water Supply System

[3-0-0]

Overview of Water Works- Sources, water quality requirements, treatment unit process and Indian standards; Estimation of design discharge: Water Demand, factors affecting water demand, variations in water demand. design periods and design population, design capacities for various water supply components; Design of Water Distribution system: Components, Overhead Reservoirs, Design of Distribution Network using Hardy Cross Method, Equivalent pipe method

Design of Unit operations for Treatment of Water: Aeration, Sedimentation tank: Coagulation & flocculation-clariflocculator Filtration: Filter hydraulics, slow and rapid sand filters, Pressure filter, Dual-media filter and mixed media filter. Disinfection- chlorination and other methods of disinfection.

Water softening- Lime treatment, Lime soda Process, Ion exchange, Removal of dissolved solids, Fluoride, Iron and Manganese

Books & References:

- 1 Environmental Engineering - HS Peavy, DR Rowe & G Tchobanoglous, MGH., Singapore
- 2 Water Supply Engineering – B.C. Punmia, Ashok Jain, Arun Jain- Laxmi Publications, New Delhi, 2nd Ed.
- 3 Water Supply Engineering- S.K. Garg, Khanna Pub., Delhi, 6th Ed.

ESC 161 02 Solid Waste Management

[3-0-0]

Municipal Solid Waste Management - Sources, nature and characteristics; quantitative and qualitative aspects; Engineering principles, assessment and management. Solid waste problems - Industrial, Mining, Agricultural, Domestic (urban) wastes, Biomedical waste, E-waste, Plastic Waste and Construction Waste , Management of lead acid battery.

Hydrological aspects of solid waste. Solid waste disposal - Sanitary landfill planning, site selection, design and operation, equipment, costs, landfill stabilization. Thermal Conversion Technologies, Combustion, Pyrolysis; and Gasification, storage of refuse, waste reduction and environmental control. BioChemical Transformation, Aerobic and Anaerobic Composting, Chemical transformation processes.

Source specific solid waste management: Agriculture, Process industry, Mineral and Metallurgical industry, Disposal of industrial and mill tailings, Separation, Transformation and Recycling of solid waste.

Resource and energy recovery; Waste minimization and utilization.

Regulatory aspects of solid waste management.

Books & References :

1. Solid Waste: Engineering Principles & Management Issues- G.Tchobanoglous, GH. Theisen & R. Eliassen, McGraw Hill Int. Ed. Singapore, 1977.
2. Environmental Engineering - HS Peavy, DR Rowe & G Tchobanoglous, McGraw-Hill Int. Ed., Singapore, 1985.
3. Hazardous Waste Management (2nd ed) - Lagrega, MD, PL Buchingham & JC Evans, McGraw Hill, NY, 2001.
4. Solid Waste Management – Mantell, CL, John Wiley, NY

ESE 161 03 Remote Sensing and GIS

[3-0-0]

Introduction , Types , Application and importance of Remote Sensing; Physics of Remote Sensing; The Electromagnetic spectrum; Spectral Reflectance Curves; Spectral signatures; Resolution.

Remote Sensing Platforms: Ground, airborne and satellite based platforms; Some important Remote Sensing Satellites.

Sensors: Passive and Active Sensors; Major Remote Sensing Sensors; Satellite band designations and principal applications; Colour / False Colour; Aerial Photography/ Aerial Photo Interpretation.

Digital Image Processing: Pixels and Digital Number; Digital Image Structure; Format of Remote Sensing Data; Image Processing functions: Image Restoration, Image Enhancement, Image Transformation, Image Classification and Analysis; Image interpretation strategies. Geographic Information System: Introduction; Preparation of thematic map from remote sensing data; Co-ordinate systems; GIS components: Hardware, software and infrastructures; GIS data types: Data Input and Data Processing; DEM/ DTM generation.

Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed Management – Resources Information Systems. Spatial planning approach. Global Positioning System – an introduction.

Books & References :

1. Remote Sensing and GIS - Anji Reddy M., The Book Syndicate, Hyderabad, 2000.
2. Principles of Geographical Information Systems - P A Burrough and R. A. McDonnell, OUP, Oxford, 1998.
3. Remote Sensing for Earth Resource- Rao, D.P., AEG Publication, Hyderabad, 1987.
4. Geographic Information System- Kang Tsung Chang, Tata Mc Graw Hill, Publication Edition, 2002.

ESC 161 04 Environmental Aspects of Industries

[3-0-0]

Mining : Mineral production, history of environmental problems. Mining Methods- Opencast and underground mining. Unit operations: site clearance, drilling, blasting, transportation, reclamation.

Mineral beneficiation and their environmental impacts.

Air pollution, water pollution, noise and air blast, land degradation, subsidence due to mining activities and their control measures. Mining disasters, mine safety and role of DGMS.

Social impacts of mining & its management. R&R Policy.

Mine Closure: Principles, planning, financial provisions, implementation, standards for closure criteria, developing closure plans, progressive and final mine closure. Environmental laws related to mining environment: Overview; provisions of MMDR Act, MCR and MCDR. EIA of Mining sector, general and specific environmental standards applicable to mining under various laws.

Metallurgical Industries and their Environmental Aspects: Unit operations, sources and management of pollution in integrated steel plants, ferrous and non-ferrous metals.

Thermal Power Plants: Introduction: site selection, layout and unit operations; Fuel and fuel handling - types of fuels, solid, liquid and gaseous. Fuel burning equipments; Pollution control devices- ash handling systems, electrostatic precipitation (ESP) system; Fly ash management and its utilisation. Captive power plants. Petroleum Industry: Production and consumption of the oil and gas, Unit operations involved in exploration and production of petroleum and natural gas; Major environmental problems in on-land and off-shore exploration; Oil Industry Safety Directorate (OISD); Standard guidelines; Environmental impacts; Dow and Toxicity index, Vapour Cloud Explosions (VCE), Boiling Liquid Vapour Cloud Explosion (BLEVE).

Disaster management, Spill Response Program,

Environmental laws related to oil and gas exploration and production.

Books & References:

1. Environmental Impact of Mining – Down CG and Stocks J. Applied Science Publishers, London, 1978.
2. Best Practices Environmental Management in Mining” - EPA (Australia): 1997-2004.
3. Tailings Management - Ritcey GM, Elsevier, 1997.
4. Environmental Management in Mining Areas– Saxena NC, Singh Gurdeep and Ghosh R, (Ed.), Scientific Publishers (India), Jodhpur 2003.

ESC 162 01 Principle and Design of Water Supply System (Practical) [0-0-2/2]

Hardness removal through Lime-Soda Treatment Method; Determination of Chlorine Demand; Break-Point Chlorination and Residual Chlorine; Determination of Coagulation Dose by Jar Testing methodology; Removal of Iron and Manganese through aeration; Removal of Fluoride; Removal of dissolved substances by Activated Carbon; Phosphorous removal; Nitrogen Removal

ESC 162 02 Solid Waste Management (Practical) [0-0-2/2]

Sample preparation; sampling techniques; coning and quartering method; overburden and other wastes sampling. Profile sampling, Characterisation of Solid Waste, Proximate Analysis and Ultimate Analysis, Calorific Value;

Determination of coarse fraction,; pH & buffered pH, KCl & CaCl₂ solution; EC & CEC; exchangeable Na & K; non-exchangeable K & HNO₃-soluble-K. ESP and SAR. mineralisable -N and total nitrogen in profile samples. Determination of organic matter and organic carbon C:N ratio; Determination of plant available P and total P; DTPA -extractable micronutrients and trace elements in OB samples; Leachate Analysis.

ESC 162 03 Remote Sensing and GIS (Practical) [0-0-2]

Study and Analysis of Aerial Photographs, Introduction of various GIS software's, Geometric Corrections and Geo-referencing of Data; Enhancements; Image Mosaicing Creation of Shape Files, Layers; On-Screen Digitization of Polygons, Points and Lines and adding attributes; Topology Building

Sub setting; Vegetation Indices; Use of Filters and PCA; Supervised and Unsupervised Classifications; Map Composition; DEM and 3D Visualization and Virtual Image, Source Data Registration; Query building; Network Analysis; TIN/DEM models and derivatives; 3D Virtual GIS; GPS and DGPS Survey and Plotting.

ESC 164 01 Project Work [0-0-4]

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

ESC 164 02 Seminar [0-0-0](2)

Seminar of Industrial Applications, Industrial Case studies, Environmental aspects of air, water, soil pollution. Global Warming, Current Issues, Environmental Disasters.

ESH 161 01 Noise Pollution and its Control [3-0-0]

Fundamentals of Noise: Basics of Acoustics: Sound power, Sound intensity and Sound pressure levels; Plane, Point and Line sources, Multiple sources; Outdoor and indoor noise propagation; Effects of noise – noise induced deafness, presbycusis, acoustic trauma, other physiological and psychological effects; Special noise environments – infrasound, ultrasound, impulsive sound and sonic boom. Noise standards and indices.

Noise monitoring: Occupational, ambient and road traffic noise monitoring; noise exposure/dose analysis; vibration monitoring, data analysis techniques and methods. Noise Control measures - General principles of noise pollution control. Design of Sound Absorption, Acoustic Barrier, Vibration Isolation, Vibration Damping, Muffling, Personal Protector and Green Belt for noise attenuation.

Noise pollution and management in different industries, e.g., mines, power plants, etc. Whole Body Vibration problems in surface mines and control measures. Ground Vibration and Air Blast - Environmental impacts, strategic planning and abatement/ prevention.

Noise propagation and modelling Atmospheric stability/instability and associated physics of sound wave propagation. Derivation of noise model with due consideration of determination of source power levels of different noise sources; assessment of atmospheric attenuation with respect to enclosures, barrier, geometric spreading, air absorption, wind & temperature gradient, ground effect, shielding by vegetation/greenbelt; and projections of noise contouring of the concerned area.

Features and applications of salient noise models, e.g., ENM, Sound PLAN, etc.

Books & References:

1. Industrial Noise Control and Acoustics – Randall F Barron, Marcel Dekker, Inc., New York, 2003.
2. Engineering Noise Control: Theory and Practice – David Bies et. al., Routledge Publishers, 2003 .
3. Vibrations – Balakumar Balachandran and Edward B. Magrab, Thomson Asia Pte. Ltd., Singapore, 2003.
4. Noise control: Principles and Practice - Bruel & Kjaer, 2nd ed. B & K Pub., Denmark, 1986

ESH 162 01 Noise Pollution and its Control (Practical) [0-0-2]

Demonstration of noise pollution monitoring instrument, Noise survey and development of noise profile in a multiple noise sources situation, Ambient noise monitoring, Frequency noise monitoring of machine noise, Audiometry survey for assessing hearing acuity, Traffic noise monitoring, Human vibration (whole body vibration) monitoring

Course content for Minor in Environmental Engineering VI Sem.

(For other branches)

ESM 16101 Water And Wastewater Engineering [3-0-0]

Overview of Water Works- sources, water quality requirements, Indian standards, Water Demand, overview of Water Treatment process: Sedimentation, Coagulation and Flocculation processes, Water Softening, Filtration, Disinfection, removal of Dissolved Solids, Fluoride, Iron and Manganese.

Wastewater Characteristics, Treatment flow -sheets. Sewage Treatment process, Reactor type, preliminary Treatment- Screening and Grit Chamber, Sedimentation, PST, Chemical Precipitation.

Principle of Biological Treatment, Activated Sludge process (ASP) and its modification, Secondary Settling Tank. Septic Tank, Oxidation Ditch, Extended Aeration System, SBR, Mechanically Aerated Lagoon, Waste Stabilization Pond, Post-chlorination, Sludge disposal, CETP, Effluent Discharge Standards.

Books & References :

- 1 Environmental Engineering – Peavy, Rowe, Tchobanoglous, TMH
- 2 Water Quality and Treatment Handbook – American Water Works association, Mc Graw Hill Pub., 1999.
- 3 Water Supply and Sewerage – Steel and MaGhee, MacGraw Hill Pub., Latest Edition

ESM 16201 Water And Wastewater Engineering (Practical) [0-0-2/2]

Determination of Chloride, Sulphate, Total Kjeldhal Nitrogen (TKN), Nitrate, Oil and Grease, BOD, COD, Chlorine Demand, Break-point Chlorination and Free Residual Chlorine, TOC.

Analysis of Sewage, determination of MLSS, MLVSS, SVI; Sludge Settling characteristics curve, Jar-test, Total & Faecal Coliform in drinking water.

ESM 16301 Design of Water and Wastewater Treatment Systems (S) [2-0-0]

Population Forecasting, Estimation of Design Discharge, selection of sources. Design of Unit Operations: Design of Silt Excluder, Aeration and Softening, Design of Clariflocculator, Secondary Settling Tank, Rapid Sand Filter, Pressure Filter, Design of Disinfection Unit and Pump House

Estimation of Waste Water Flow, Design of Unit operations: Design of Screens, Grit Chamber and Primary Settling Tank, Design of Aerobic Treatment Processes (ASP, Trickling Filters), design of Anaerobic Treatment Processes (UASB), design of Anaerobic Digesters, Sludge Disposal and Polishing units.

Books & References :

- 1 Environmental Engineering – Peavy, Rowe, Tchobanoglous, TMH
- 2 Manual of Water Supply and Treatment (3rd Edition) – Minister of Urban development, New delhi, 1991.
- 3 Manual on sewage and sewerage treatment - CPHEEO - MoUD (1993)

SEMESTER - VII

ESC 171 01 Municipal Wastewater Engineering

[3-1-0]

Introduction: Characteristics and flow Hydraulic Design of Sewer: Types & Design of sewerage, construction laying and testing of sewer lines

Design of Sewage Pumping Station, Maintenance of sewerage system

Conventional Treatment of Sewage: Design and operation of screening, flow equalisation and grit chamber; Design and operation of PST

Biological treatment: Operation and design aspects of ASP and its modifications types of aerators,; secondary settling tank, oxidation ditch, SBRs, trickling filter, RBC, Aerated lagoons, waste stabilization ponds, Anaerobic Reactors: UASB and hybrid bioreactors, Aquatic plant system: constructed Wetlands.

Design of sludge disposal facility: Gravity Thickener, Anaerobic digester, and Sludge drying bed.

Disposal and Reuse of Treated effluent, Effluent Standards

Books & References :

1. Wastewater Engineering: Treatment, disposal, Reuse - Metcalf & Eddy Inc.4th ed.TMGHI, New Delhi, 2003.
2. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. New York, 1985.
3. Wastewater Treatment for Pollution Control - Soli J Arceivala, Tata McGraw Hill, 2nd ed.1998
4. Wastewater Treatment Plants: Planning, Design and Operation- S.R..Qasim, Holt, Rinehart & Winston, NY, 1985

ESC 171 02 Environmental Policy and Legislation

[3-0-0]

Environmental Policies; National and International trends, Changes in global perspective, International treaties. National Policies: National Environmental Policy, National Forest Policy, National Water Policy, Rehabilitation and Resettlement Policy, CSR policy.

Evolution of environmental legislation in India, Legal provisions for environmental protection; various Acts, Rules and Regulations. Notifications issued under various Acts and Rules.

Environmental standards; Criteria for standards setting.

Public Liability Insurance Act and legal aspects relating to hazardous and toxic substances.

Books & References :

1. Environmental Legislation in India, Ulla Roiha, Finpro, Region Asia
2. Pollution control acts, rules and notifications issued thereunder, CPCB-India
3. Environmental Law of India, S.K. Choudhuri, Oxford & IBH Publishers
4. Handbook of Environmental laws, Acts, Guidelines, Compliances & Standards Policy, Trivedy, BS Publishers

ESC 171 03 Environmental Impact Assessment

[3-0-0]

National environmental policy act and its implementation; Planning and management of impact studies; Screening, scoping and baseline studies.

Simple methods for impact identification-matrices, networks, and checklists; Description of environmental setting (affected environment); Environmental indices and indicators for describing the affected environment;

Assessment and Prediction of impacts on the air, water,; soil , noise; and biological environment;

Prediction and assessment of impacts on the socioeconomic environment; Decision methods for evaluation of alternatives;

Public participation in environmental decision making;

Strategic Environmental Assessment,; Cumulative Impact Assessment; Risk and Uncertainty in EIA.

Documentation of EIA and EMP.

Books & References :

1. Environmental Impact Assessment -Larry, W. Canter (2nd ed), McGraw Hill Inc. Singapore, 1996.
2. Strategic Environmental Assessment - Riki Therirvel, E.Wilson, S.Thompson, D.Heaney, D. Pritchard. Earthscan, London, 1992.
3. Environmental Impact Assessment-Cutting edge for the 21st century - Alan Gilpin, CUP, London, 1994.
4. Environmental Impact Assessment-Theory & Practice - Peter Wathern, Unwin Hynman, Sydney, 1988.
5. Renewable Energy Environment and Development-Maheswar Dayal Konark Pub. Pvt.Ltd. 1998

ELECTIVE PAPERS

ESE 171 01 Hazardous and Biomedical Waste Management [3-0-0]

Hazardous Wastes: Landmark episodes, classification, generation, guidelines of

HWM, Regulatory frame work, Basal Convention and other international statistics Monitoring of critical parameters/provide risk-analysis. HAZON, HAZOP, Consequence Analysis. Faculty and eventry analysis. Emergency Management: Indian and foreign legislation in respect of the above. Case studies, leakage, explosion, oil-spills and fire of hazardous chemical storage. Leakage in atomic reactor plants,

Hazardous Chemicals: Toxic chemicals, flammable chemicals, pesticides, explosives, reactive substances, Cyanide wastes, water-soluble chemical compounds of heavy metals, & toxic metals. Hydrocarbons, point pigment dyes, oil emulsion tars, phenols, asbestos, acid/alkaline slurry, Physical properties, and chemical composition and lethal dose and concentration on human life flora and fauna. Storage, collection, transport,

Hazardous Waste Treatment: waste reduction, neutralization, Incineration, combustion and Pyrolysis, unit operations, supply of air, products of combustion, furnace temperature, furnace calculation, and environmental control, disposal. Precautions in collection, reception, treatment, transport, storage, and disposal, and import procedure for environmental surveillance

Biomedical Waste: categorization, generation, collection, transport, treatment and disposal. Radioactive wastes generated during mining, processing of atomic minerals, and in atomic reactors, and disposal of spent fuel rods. Treatment and disposal; remediation of contaminated sites.

Books & References:

- 1 Standard Handbook of Hazardous Waste Treatment and Disposal – Freeman, HW, McGraw Hill, NY, 1989.
- 2 Hazardous Waste Management Engineering – Martin EJ & Johnson JH, Van Nostrand-Reinhold, NY, 1987.
- 3 Hazardous Waste Management (2nd ed) – Wentz, CA, McGraw Hill , NY, 1995.
- 4 Solid Waste Management – Mantell, CL, John Wiley, NY, 1975.

ESE 171 02 Environmental Biotechnology [3-0-0]

Introduction to environmental biotechnology, Cell genetic material, Nucleic acid-based methods of analysis- Polymerase chain reaction, Recombinant DNA techniques- Cloning, metagenomics, Sequence analysis, Comparative genomics. Bacterial genetic recombination, Recombinant DNA technology, Applications in Environmental Engineering.

Bioremediation for Soil Environment- Biotechnologies for Ex-Situ Remediation of Soil, Biotechnologies for in-Situ Remediation of Soil, Phytoremediation Technology for Soil Decontamination.

Bioremediation for Water Environment- Ex-situ Decontamination of Groundwater, In-situ Bioremediation of Groundwater, Landfill Leachate, Industrial Wastewater Biotreatment Technologies, Biotreatment of Surface Waters.

Bioremediation for Air Environment- Atmospheric Environment for Microorganisms, Microbial Degradation of Contaminants in Gas Phase, Biological Filtration Processes for Decontamination of Air Stream, Bioscrubbers.

Biotreatment of Metals- Microbial Transformation of Metals, Biological Treatment Technologies for Metals Remediation, Bioaccumulation, Oxidation/Reduction Processes, Biological Methylation, Recovery of metals.

Biological energy sources, Microbially mediated oil recovery.

Books & References:

1. B. E. Rittmann and P. L. McCarty, Environmental Biotechnology: Principles and Applications, 1st Edn., McGraw-Hill Publishing Co., 2001.
2. B. Bhattacharya and R. Banerjee, Environmental Biotechnology, 1st Edn., Oxford University Press, 2008.
3. Prescott, L. M., Harley, 3. P., and Klein, D. A., Microbiology, Second Edition, Wm. C. Brown Publishers, Dubuque, Iowa, 1993.
4. R. W. Pickup and J. R. Saunders, Molecular Approaches to Environmental Microbiology, 1st Ed., Prentice Hall, 1996.

ESE 171 03 Environmental Economics [3-0-0]

Economy and Environment -the historical development of environmental economics; circular economy, sustainable economy. Economics of Pollution: optimal level of pollution, market achievement of optimal pollution, Taxation and optimal pollution, Environmental standards, Taxes and subsidies, Marketable pollution permits, Measuring environmental damage -Total economic volume and valuation methodology, pollution control policy in mixed economics. Environmental Values Ethics; discounting the future, alternative to adjusting discounting rates.

Economics of Natural Resources;-Renewable resources, Extinction of species, Optimal use of exhaustible resources Measuring and mitigating natural resource scarcity. Development and Environment;- Development, Preservation and conservation, Irreversibility and sustainability, Environment and the developing countries. Carrying capacity based development planning. Cost Benefit Analysis of Environmental Change; Appraisal of Sustainable development Projects; Principles of Cost Allocation, Preventive, Punitive and social costs.

Books & References:

- 1 Environmental Economics in Practice , Gopal K. Kadekodi, Oxford University Press
- 2 Values for the Environment: A Guide to Economic Approach – Winpeny JT, Overseas Development Institute, London, HMOS, 1991.
- 3 Economic Analysis of Environmental Impacts – Dixon, John, A, Scura LF, Carpenter RA and Sherman PB, Earthscan Publications Ltd., London 1995.
- 4 Environmental Assessment Source Book (Vol – 1)- World Bank, Environment Department, Washington DC, The World bank, 1991.

HSS 173 45 Social and Ethical Issues in Engineering

[3-0-0]

Introduction to Ethical Theories and Ethical Analysis

Engineering as a Profession: a) some history; b) The workplace in which Engineering is situated; c) Ethical Standards of the Profession, the Codes of Ethics. Professional Ethics in relation to Law, Common Morality, and the Market. Ethical Responsibility, Loyalty: critical and uncritical The standard of reasonable care The Engineer's Perspective alongside the Business Manager's Perspective Professional dissent and whistle blowing.

Honesty, sharing and withholding information, confidentiality, secrecy. Conflict of interest, Bribery, Extortion, Grease, Gifts Managing risk to Humans and the Environment How Government/ the Legal System influences Engineering Practice. Design, Innovation, and Emerging Technologies, especially Disruptive Technologies, e.g, Information Technology, Nanotechnology, etc. Engineering and

Sustainable Development, Issues associated with Globalization

Books & References :

- 1 Social Strains of Globalization in India, Merlin A. Taber, Sushma Batra, New Concepts International publishers, New Delhi
- 2 General Sociology, K E Verghese, Macmillan India Limited

ESC 172 01 Municipal Wastewater Engineering (Practical) [0-0-2]

Pre – and post chlorination, analysis of sewage, Determination of MLSS, MLVSS, SVI,; sludge settling characteristics curve, BOD5: TKN ratio, Nitrifier fraction, Jartest, Total coliform, FS & FC in raw sewage.

ESC 174 01 Project Work [0-0-0] (6)

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

ESC 176 01 Vocational Training [0-0-0] (3)

The vocational training taken during the summer vacation of previous year, training report has to be submitted to the Teacher-in- charge and students have to give a power point presentation. The vocational training could be taken in the industries, research institute in India and abroad.

ESH 171 01 Environmental Systems Optimisation and Modeling [3-0-0]

Systems approach - concept and analysis. Problems formulation, model construction and deriving solution from models using LPP-primal and Dual Simplex method, Limitations of LPP, sensitivity Analysis. Applications of LPP.

Lagrange multipliers- unconstrained and constrained optimisation, limitations of Lagrange's multipliers, Sequential search algorithms- box algorithm

Separable and integer programming- application to multi-objective planning. Application of integer programming

Transportation models, Dynamic programming models- application of Dynamic programming, Present value concepts- optimization over time.

Fate and Transport of contaminants in surface and sub surface environment, Streeter - Phelps model and introduction of various available software's.

Books and References

1. Operation Research: An Introduction – Hamdy A. Taha, Prentice Hall Pub.
2. Environmental Systems Optimization- Douglas. A.Haith, 1982, Wiley Sons, NY
3. Handbook of Environmental and Ecological Modelling, Halling-Sorensen B., Nielsen S.N. and Jorgensen S.E., Lewis Publishers Inc., 1995.
4. System Analysis and Design – RJ Aguilar, Prentice Hall, Englewood Cliffs, N.J., 1993
5. Environmental modeling: Finding simplicity in complexity- John Wainwright and Mark Mulligan, John Wiley and Sons

ESH 171 02 Environmental Engineering Design –II (S) [1-2-0]

Design and Numerical problems on Wastewater Engineering, Water Supply Engineering, Solid Waste Management etc.

Course content for Minor in Environmental Engineering VII Sem.

(For other branches)

ESM 17101 Air and Noise Pollution [3-0-0]

Classification of Air Pollutants, Particulates and Gaseous pollutants, Sources of air pollution, Effects of air pollution on Human Beings, Materials, Vegetation, Animals. Major Global and Regional impacts.

Atmospheric Meteorology, Structure of atmosphere and layer classification, Planetary Boundary Layers, Energy Budget of atmosphere, Wind Profiles, Topographic Effects, Temperature Profiles in atmosphere, Stability, Inversions, Plume Behavior, Turbulent Diffusion, Concept of Mixing Height and determination of Stability Class.

Air Quality Monitoring - Objectives, time and space variability in air quality; Analysis and Interpretation of air pollution data, guidelines for design of monitoring network, Stack monitoring, Emission factor and Inventory; Vehicular Pollution. Air pollution Standards and Indices, Comprehensive Air Pollution Index.

Noise Pollution, its Sources, Effects, Assessment, Standards, Control & Prevention.

ESM 17201 Air and Noise Pollution (Practical) [0-0-2/2]

Calibration of Respirable Dust Sampler (RDS) and Fine Particulate Matter (FPM); Determination of SPM; PM_{2.5}, PM₁₀; SO₂; and NO_x in ambient air; Demonstration of Stack Monitoring kits; Demonstration of Flue Gas Analyzer, Indoor Air Quality, CO, VOC and Aerosol Monitors; Determination of Atmospheric Stability Class using portable anemometers; Development of Wind Rose Diagram.

Demonstration of noise pollution monitoring instrument, Noise survey and development of noise profile in a multiple noise sources situation, Ambient noise monitoring.

ESM 17301 Air Pollution Control & Modeling (S) [2-0-0]

Air Pollution Control- Principles and Design of Control Measures for Particulates and Gaseous Pollutants, Properties of Flue Gas and Particulates, selection criteria for Air Pollution Control Equipment, concept of Green Fuel, Carbon Capturing & Sequestration (CCS).

Dispersion of Air Pollutants and Modeling – Purpose, Types and Classification of Air Quality Modeling, Box Models, Gaussian Dispersion Model – Assumptions, Modifications for ground reflection, line sources and complex terrain.

Indoor Air Quality Modeling, features and application of Regulatory Models,

Books & References:

1. Environmental Engineering Arcadio P. Sincero and Gregoria A. Sincero, Prentice Hall of India, 1999.
2. Environmental Pollution Control Engineering- C S Rao, Wiley Eastern Ltd., New Delhi, 1996.
3. Environmental Noise Pollution. P E Cunniff, McGraw Hill, New York, 1987.
4. Air Pollution Control Equipment. H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York, latest edition.

SEMESTER - VIII

ESC 181 01 Industrial Wastewater Treatment

[3-0-0]

Sources and characteristics of industrial wastewater; management of Industrial wastewater- volume reduction, neutralization, equalization and proportioning, treatment and disposal, Chemical Treatment

Design and operation of advanced treatment process-adsorption, activated carbon column, ion exchange, RO process, stripping towers (ammonia stripping), Ozonation Unit operation, wastewater treatment methodologies and

environmental issues for specific industries - chlor-alkali, electroplating, distillery, dairy, tannery, pulp and paper, textile, dye, fertilizer, refinery, pharmaceutical, iron & steel, coke ovens, coal washeries, mine wastewater. Management and treatment of acid mine drainage; Industrial complexing for zero pollution attainment, Common effluent treatment plant (CETP): design, operation and maintenance aspects.

Books and References

1. Wastewater Treatment Plants: Planning, Design and Operation- S.R..Qasim, Holt, Rinehart & Winston, NY, 1985
2. Industrial Water Pollution Control –WW Eckenfelder, Jr., McGraw -Hill , 2nd Edition, NY 1989
3. Wastewater Engineering (including Air Pollution)- B.C. Punmia, Ashok Jain, Arun Jain- Laxmi Publications, New Delhi, 2nd Ed.
4. Sewage disposal and air pollution Engineering,- S.K. Garg, Khanna Publishers, Delhi, 8th Ed.

ESC 181 02 Environmental Management System and Auditing [3-0-0]

Environmental Audit: Objectives, Types, Features, Planning and Organising Audits; Pre-visit data collection, Audit Protocol; Onsite Audit; Data Sampling - Inspections - Evaluation and Presentation; Exit Interview; Audit Report - Action Plan - Management of Audits; Waste Management Contractor Audits;

Life Cycle Approach (LCA). Introduction and Formulation of ISO Guidelines in Environmental Management Systems; ISO 14000 Series, Principles; Accreditation Process, Environmental Auditor Criteria, Benefits of EMS; Aspect-Impact Analysis, Continual Improvement, Environmental Performance, Environmental Policy, Vision and Mission, Objective and Target, Environmental Management Planning, Implementing EMS, Plan-Do-Check-Act (PDCA), Quality Assurance(QA) and Quality Control (QC), Preventive and Corrective Action, Internal and External Audits, Documentation, Roles and Responsibilities, Management Reviews & Improvements; Legal and Regulatory Concerns; Integrating ISO 9000 & ISO 14000, BS 7750, EMAS. Preparation of ISO Manuals for Industry.

Corporate Social Accountability: Requirements, Social Accountability (SA) 8000, Certification, Elements of Social Management System, Social policy, Planning, Implementation, Business Benefits, Corporate Social Responsibility (CSR), different Models

Books and References :

1. Planning and Implementation of ISO14001, Environmental Management System- Girdhar Gyani & Amit Lunia Raj Publishiong House, Jaipur, 2000.
2. ISO 14001 Auditing Manual – Gayle Woodside and Patrick Aurrichio, McGraw-Hill.
3. “The ISO: 14000 Handbook” - Joseph Caseio (Ed), Published - CEEM Information Services. 2000
4. INSIDE ISO: 14000 – The Competitive Advantage of Environmental Management - Don Sayre, Vinity Books International, New Delhi, 2001.
5. A Guide to the Implementation of the ISO: 14000 Series on Environmental Management – Ritchie, I and Hayes W, Prentice Hall, New Jersey, 1998.

ESC 181 03 Occupational Health, Safety and Risk Assessment [4-0-0]

Occupational Health and Safety concern and problems. National and International protocols and concerns, policies and legislation. Ergonomics; Stress-strain concept; Assessment of human capabilities and limitations; Human Physiological Work Capacity and its evaluation.

Sources of work stress (a) intrinsic to the jobs, (b) work environmental stressors like heat & humidity, noise & vibration, dust, illumination, etc.; Methodologies for evaluating different types of stresses.

Human Error and Accidents: Different Classification of Human Error, Theories of Accident Causation, Human Error Audit. Accident analysis.

Education and Training in Occupational Hygiene.

Need to evolve an integrated Occupational Health and Safety Programme for specific industries.

Occupational Health & Safety Management Systems: OHSAS 18001 guidelines, Legal requirements; Occupation Health and Safety Policy; OH & SMS Documentation. Safety at work place: Managing health and safety in industries, slips and trips, general fire safety, work at height, building work, machinery safety, plant and equipment maintenance, gas and oil-fired equipment, flame-proof equipments, intrinsically safe equipments, pressurized plant and equipment, workplace transport, lifting and handling, noise, vibration, electricity, radiations, harmful substances, flammable and explosive substances, managing health, safe ways of working, selection and training; Special groups of workers, contractors and agency workers, personal protective equipment, accidents and emergencies, useful contacts and information for safety, role of health and safety executives.

Risk Assessment and Management: Perception of Risk in Industries: Theories and Human Adjustment. Environmental and Industrial Risk assessment: Introduction, identification of potential hazards, assessment of the risk, consequence analysis, hazard identification methods: check list, hazard and operability studies (HAZOP), hazard analysis methods, failure modes and effect analysis, hazard indices, models, regulatory priorities. Emergency preparedness and response.

Books & References:

1. Fundamental principles of occupational health and safety, Benjamin O. Alli, The Synergist, , USA
2. Occupational Health and Safety Management: A Practical Approach, Charles D. Reese, CRC Press
3. Safety Management, A Comprehensive Approach to Developing a Sustainable System, Chitram Lutchman, Rohanie Maharaj, Waddah Ghanem, CRC Press
4. Practical Guide to Occupational Health and Safety by Paul A Erickson, Academic Press, (Elsevier Science) USA, UK
5. OHSAS- 18001, Guidelines, British Standards Institute, 2007
6. Good Practice Guidance on Occupational Health Risk Assessment, International Council on Mining and Metals, 2009, ISBN 978-0-9559983-2-4

ELECTIVE PAPERS

ESE 181 01 Environmental Toxicology & Health

[3-0-0]

Behavior of chemicals in the environment: physical and chemical properties, transformation and degradation process; Distribution of toxic chemicals in air, water, sediments, soil and biota; Routes and mechanisms of toxicant entry into organisms; Distribution of toxicants within organisms; Biotransformation of toxicant within organisms; Elimination of toxicants from organisms. Infections – Salmonella; Intoxications – Botulism, Staphylococcus aureus, Clostridium perfringens; Non-bacterial parasites - tapeworms-beef, pork, fish; Roundworms Trichinosis; Chemical Hazards-additives, pesticide residues, toxic metals.

Control of food and waterborne diseases: Introduction to major disease-causing microorganisms in the environment and their transmission through water, food, and air. Description of the organisms, pathogenesis, clinical disease, reservoirs, modes of transmission, and epidemiology. Transport, survival, and fate of pathogens in the environment; the concept of indicator organisms as surrogates for pathogens; and the removal and inactivation of pathogens and indicators by water and wastewater treatment processes. Examples of the public health impact of environmental transmission routes of these pathogens in developed and developing countries.

Books & References:

1. Environmental Toxicology- David A. Wright, Cambridge University Press.
2. Environmental toxicants- Morton Lippmann, Wiley
3. Environmental Risk and Hazards, Susan L. Cutter, Prentice Hall of India Pvt. Ltd. , New Delhi
4. Environmental Toxicology: Organic Pollutants, J. K. Fawell and S.Hunt, Ellis Horwood Limited.

ESE 181 02 Environmental Nanotechnology

[3-0-0]

Nanotechnology and the environment, nanotechnology and our energy challenge; nanomaterials fabrication; methods for structural and chemical characterization of nanomaterials; instrumentation for nanotechnology, reactive oxygen species generation on nanoparticulate material; principles and procedures to assess nanomaterial toxicity; toxicological impacts of nanomaterials; nanoparticle transport, aggregation, and deposition; nanomaterials for groundwater remediation; membrane processes; nanomaterials as adsorbents; assessing lifecycle risks of nanomaterials, longevity of nanoparticles.

Books & References:

1. Nanotechnology: Fundamentals and Applications by Manasi Karkare, I. K. International Pvt Ltd.
2. Nanotechnology and the environment: applications and implications by Barbara Karn. American Chemical Society.
3. Nanotechnology and the Environment by Kathleen Sellers, Christopher Mackay, Lynn L. Bergeson, Stephen R. Clough, Marilyn Hoyt, Julie Chen, Kim Henry, Jane Hamblen Press.
4. Environmental and Human Health Impacts of Nanotechnology by Jamie R. Lead, Emma Smith John Wiley & Sons.
5. Environmental Nanotechnology: Applications and Impacts of Nanomaterials- Mark Wiesner, Jean-Yves Bottero, Mc Graw Hill

ESE 181 03 Social Impact Assessment and R & R [3-0-0]

Introduction: Evolution of Social Impact Assessment (SIA), SIA Policy in Indian Context, Provision of SIA in Fair Compensation Transparency in Land Acquisition and R&R, 2013 SIA Policy. Need and Advantages

Legal Mandates and Administrative Procedures for Social Impact Assessment

Basic Model for Social Impact Assessment: SIA Framework, Project Policy Development, Type and Setting, Identification of Assessment Variables

Note:- Basis of Evaluation of Social Costs: Quality of Life [Value Function Curve and Pearson Correlation using SPSS] QoL, Basis of Evaluation of Social Costs.

Steps in the Social Impact Assessment Process: Public Involvement, Identification of alternatives, Baseline Conditions, Scoping, Projection of Estimated Effects - Investigate the probable impacts, Predicting Responses to Impacts, Indirect and Cumulative Impacts, Mitigation Plan, Monitoring

Social impacts of industrial and developmental activities.

Social surveys and socio-economic data generation. Social cost of environmental pollution.

Rehabilitation and resettlement of project affected people. Policies and guidelines of rehabilitation planning, corporate social accountability/responsibility. National Policy of Resettlement and Rehabilitation, R&R policy of Coal India-, its critical evaluation, objectives and general principles, PAPs, Types of compensations, Case studies. Specific case studies from various sectors including mining.

Books & References:

- 1 Development-induced Displacement, Rehabilitation and Resettlement in India: Current Issues and Challenges- Sakarama Somayaji, Smrithi Talwar Routledge Contemporary South Asia Series
- 2 Rehabilitation of Displaced Villagers, B.C. Muthayya, R.N.Tripathy, M.L. Santhanam, O.N. Srivastava, National Institute of Rural Development.
- 3 http://www.nmfs.noaa.gov/sfa/social_impact_guide.htm
- 4 General Sociology, K E Verghese, Macmillan India Limited
- 5 Environmental Management in Mining Areas– Saxena NC, Singh Gurdeep and Ghosh R, (Ed.), Scientific Publishers (India), Jodhpur 2003.

MSC 17351 Managerial Economics [3-0-0]

Nature, scope and methods of managerial economics.

Managerial Economics Concepts- Incremental concept; Opportunity Cost concept; Equi-marginal concept; Equi-marginal concept; Discounting concept; Risk & Uncertainty

Law of Diminishing Marginal Utility, Demand Analysis- Meaning & Type; Law of Demand- Features; Exceptions; Market Demand Schedule & Curve; Elasticity of Demand- Price elasticity, cross elasticity & income elasticity. Indifference Curve approach and its properties. Supply- its law, elasticity & curve. Types of markets; Pricing under various market conditions – Perfect competition, imperfect competition and monopolistic competition. Profit & Profit measurement. Inflation- meaning; Demand- pull, cost-push inflation; Inflationary gap; causes and steps to control inflation. National income- Concepts & methods of measurement; Difficulties in measuring national income.

ESC 182 01 Industrial Wastewater Treatment (Practical) [0-0-2/2]

Analysis of specific pollutants in different types of industrial wastewater, design of activated carbon column, coagulation and flocculation test. Zeta Potential Analysis, Ozonation of Textile Effluent, Hardness Removal by Ion Exchange, Reverse Osmosis.

ESC 184 01 Project Work [0-0-6]

Practical solution of environmental problems Prototype Development, Environmental Software Development, Sensors etc, with reference to environmental parameters.

ESH 181 01 Climate Change & its Mitigation [3-0-0]

Climate Change Mitigation: Way and means, Concept of Carbon Sequestration. Carbon Sequestration projects, Carbon Sequestration Modalities and Procedures. Global Carbon Cycle: Stocks and Fluxes of Carbon in terrestrial and marine ecosystems and anthropogenic impact. Policy Perspective: UNFCCC, Role and Function of IPCC, Kyoto Protocol and its implication on Developed and developing countries, function of Kyoto Protocol. National action plan on climate change; National missions on climate change.

Clean Development Mechanism (CDM) and its operation, modalities and procedures for CDM Project. Forestry Perspective: Source or Sink of Carbon, Measuring of Carbon Dioxide. The Climate Mitigation potential of Forest and its evaluation, Land use, Land use Change and Forestry (LULUCF), Evolution of LULUCF in CDM. Emissions trading of clean development mechanism (CDM),

Difficulties with the CDM, Financial issues with the CDM, prototype carbon funds (PCF), Carbon Credits and it's trading, carbon finance, and evaluation of Carbon Credit of solar energy systems. Emissions trading under different article, Carbon foot prints.

Books and References

- 1 Carbon Capture: Sequestration and Storage (Issues in Environmental Science and Technology), by R E Hester and R M Harrison.
- 2 Carbon Capture and Sequestration Integrating Technology, Monitoring, Regulation by Elizabeth Wilson and David Gerard.
- 3 Voluntary Carbon Markets by Ricardo Bayon Amanda Hawn and Katherine Hamilton.

ESH 181 02 Environmental Engineering Design - III (S) [3-0-0]

Design and numerical problems on Industrial Wastewater Engineering;

Terms of Reference, Draft EIA, Case Studies, Application for NOC, Consent to Establish, Operate, Preparation of ISO, OHSAS Manuals, NABET/QCI, Etc.

Course contents for Minor in Environmental Engineering-VIII Sem

For other branches

ESM 18101 Environmental Management System [3-0-0]

Principles of Environmental Management, Environmental concerns in India, Policy and legal aspects of Environmental Management, Introduction to Environmental Policies, Environmental Laws and Legislations.

Environmental Impact Assessment (EIA), Impact Prediction, Evaluation and Mitigation; Environmental Clearance (EC) procedure in India; Environmental Auditing, Life Cycle Assessment (LCA), Environmental Management System, EMS Standards: ISO 14000 series and OHSAS 18000.

Books and References:

1. Environmental Legislation in India, Finpro, Region Asia.
2. Gayle, W. and Patrick A., ISO 14001 Auditing Manual, Mcgray Hill Inc.
3. Kulkarni V and Ramachandra T V, 2009. Environmental Management, TERI Press, New Delhi
4. Larry, W. C. 1996, Environmental Impact Assessment, McGraw Hill Inc. Singapore, 1996.

ESM 18301 Application of Environmental Management System (S) [2-0-0]

Structure of EIA/EMP documentation, Preparation of TOR, Public Hearing, Forecasting of Environmental Changes; Waste Audits and Pollution Prevention Assessments; Forest clearance; Environmental Audit in Industrial Projects; Different Applications of LCA, Implementation of EMS Conforming to ISO 14000 series and OHSAS 18000; Application of Remote Sensing and GIS in Environmental Management.

Books and References:

1. Gayle, W. and Patrick A., ISO 14001 Auditing Manual, Mcgray Hill Inc.
2. Hansen, P.E. and Jorgensen, P.E., 1991, Introduction to Environmental Management, Elsevier, Amsterdam.
3. Larry, W. C. 1996, Environmental Impact Assessment, McGraw Hill Inc. Singapore, 1996.