DEPARTMENT OF ENVIRONMENTAL SCIENCE & ENGINEERING
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR -125001

Name of M.Tech. Programme	**Environmental Science & Engineering**	**w.e.f. Session 2018 onwards**

Distribution of Total Credits

Program Core(PC)	Program Elective(PE)	Open Elective (OE)	Total Credits
53	**22**	**3**	**78**

Semester-wise Schedule

Semester-I

S.N	**Course No.**	**Title**	**Type**	**L-T-P**	**Credits**	**Max. Marks**
1	ESE-701(a)/ ESE-701(b)	Foundation of Environmental Engg. /Foundation of Environmental Science	PE	3-1-0	4	100
2	ESE-702	Environmental Chemistry	PC	3-1-0	4	100
3	ESE-703	Environmental Policy and Impact Assessment	PC	3-1-0	4	100
4. 5.	ESE-704 ESE-705	Industrial Health and Safety Energy & Environment	PE PE	3-1-0 3-1-0	4 4	100
6.	ESE-706	Lab-I (Environmental Chemistry)	PC	0-0-6	3	100
7.	ESE-707(a)/ ESE-707(b)	Lab-II (Foundation of Environmental Engg./ Foundation of Environmental Science	PE	0-0-6	3	100
8.	ESE-708 ESE-709	Lab-III (a)Industrial Health and Safety Lab-III (b)Energy & Environment	PE PE	0-0-6 0-0-6	3 3	100
9.		Audit Course I (Any One)*		2-0-0	0	100
Total Credit					**25**	

Semester-II

1.	ESE-711	Environmental Microbiology	PC	3-1-0	4	100
2.	ESE-712	Air Pollution & Control	PC	3-1-0	4	100
3.	ESE-713	Industrial Pollution Management	PC	3-1-0	4	100
4.	ESE-714	Design of Pollution Control Systems	PC	3-1-0	4	100
5.	ESE-715	Water & Sewage Treatment	PC	3-1-0	4	100
6.	ESE-716	Lab-IV (Environmental Microbiology)	PC	0-0-6	3	100
6.	ESE-717	Lab-V (Industrial Pollution Management)	PC	0-0-6	3	100
7.	ESE-718	Lab-VI (Water & Sewage Treatment)	PC	0-0-6	3	100
8.		Audit Course II (Any One)*		2-0-0	0	100
Total Credit					**29**	

Semester-III

1.	ESE-721	Unit Operations & Processes	PE	3-1-0	4	100
2.	ESE-722	Instrumentation & Applications to Environmental Engg.	PE	3-1-0	4	100
3.	ESE-723	Solid & Hazardous Waste Management	PE	3-1-0	4	100
4.	ESE-724	Environmental Management System	PE	3-1-0	4	100
5.	ESE-725	Watershed Management	PE	3-1-0	4	100
6.	ESE-726	MOOC Courses (Available on SWAYAM website from time to time)	PE	3-1-0	4	100
7.	ESE-790	Credit Seminar	PC	0-0-0	1	100
8.	ESE-791	In-plant training (S/US)	PC	0-0-0	0	000
9.	ESE-800	Dissertation	PC	0-0-6	3	100
10.	3OE06	Open Elective (Any one)	OE	3-0-0	3	100
Total Credit					**15**	

Semester-IV

1.	ESE-800	Dissertation	PC	0-0-18	9	100
Total Credit					**9**	

*****Qualifying and non-credit course

Note: (i) In-plant training (6 weeks) to be undertaken at the end of IInd semester, the report of which has to be submitted before commencement of the 3rd semester.

(ii) Students with M.Sc. (Env.Sc.) background will take Foundation of Env. Engg. (ESE-701(a) and those with Engg. background will take Foundation of Env.Sc (ESE-701(b).

(iii) Students will have to take one PE (out of ESE-704, 705) in Ist Semester and corresponding practical paper ESE-708 or ESE-709. Two PE is to be taken (out of ESE-721 to 726) in 3rd Semester.Open Elective Course has to be taken from the list of Open Elective Courses proposed. Students have to take one audit course in 1st Semester and one in 2nd Semester out of above mentioned list of audit courses proposed by AICTE.

(iv) Each paper will be evaluated internally 30% (Two minor tests), and externally 70% (Major Test)

(v) In case of dissertation, work load will be ½ hours per credit up to a minimum of 5 hours.

(vi) Each unit of each course should be covered within 12-15 lectures.

ESE-701 (a) FOUNDATION OF ENVIRONMENTAL ENGINEERING
(for students with Env. Science background)

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Basic mathematics for environmental Engineers, Concept & domain of environmental engineering, concept of unit operations and processes, concept of material and energy balance, Concepts of flow diagrams and layout of wastewater treatment plants, Basic concept of Environmental Modeling, Examples of applied nature (Environmental Modeling), Basic concept of Suveying.

Unit-II
Fluid and its properties, fluid static on submerged surfaces, buoyancy and floatation, Fluid kinematics and dynamics, Equation of continuity, various forms of energy present in fluid flow, Basic equations of heat, energy and momentum, Examples of applied nature.

Unit-III
Laminar and turbulent flow, theory of Boundary layer, boundary layer separation, Navier storkes and momentum equation for boundary layer, Aerodynamics with some examples.

Unit-IV
Discharge measurement in pipes and channels. Concepts of dimensional analysis, methods of dimensional analysis, model testing, Concept of dimensionless numbers, pumps and its types, Calculation of different head losses and heat exchangers.

Reference Books:

1. Mathematics manual for Water and Wastewater Treatment Plant by Frank R. Spellman
2. Dynamics of Environmental Bioprocesses by J.B. Snape & I.J. Dunn
3. Fundamentals of Fluid Mechanics by Munson,Young and Okiishi,John Wiley & Sons,Inc
4. Introduction to Fluid Mechanics,Fox and Mcdonald,John Wiley & Sons,Inc
5. Mechanics of Fluids by Shames,McGraw-Hill Inc.
6. Fluid Mechanics through problems by Garde,New Age International (P) Limited
7. Fluid Mechanics by Frank M.White, Mc-Graw Hill.Inc.
8. Unit Operations by Warren

ESE-701 (b) : FOUNDATION OF ENVIRONMENTAL SCIENCES
(for students with Engg. background**)**

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Biosphere: Concept of biosphere, characteristics of hydrosphere, lithosphere and atmosphere.
Population and communities: Population characteristics and models, human population growth, demographic projections, dimensions of world food problems, community characteristics, ecological succession, ecological niche, Ecotone.

Unit-II
Ecosystem : Structural and functional attributes, energy flow, food web, productivity and decomposition, biogeochemical cycles (C,N,P.& S), Theories of ecosystem stability, Ecological regulation, basic concepts of systems analysis and ecological modeling.

Unit-III
Industrial Ecology : Definition, goals and key concepts of industrial ecology, ecological & economic efficiency, materials and energy flow, strategies of environmental impact reduction-system tools to support industrial ecologies, industrial symbiosis.

Unit-IV
Environmental Resources : Concept of sustainable growth; water resources-surface water and ground water (brief account), water conservation strategies; land resources, soil erosion, water logging, soil reclamation and biodrainage; Forest Resources and management, mineral resources-reserves, prospects and problems.
Biodiversity: Importance, threats to biodiversity, conservation practices, Indian Scenario.
Basic concept of remote sensing, GIS and its applications (In brief).

Reference Books:

1. Fundamentals of Ecology by E.P. Odum
2. Basic Ecology by E.P. Odum
3. Living in the Environmental by T.J. Miller
4. National Resource Conservation by Oliver S Own & Chiras

ESE-702: ENVIRONMENTAL CHEMISTRY

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Soil Chemistry: Nature, composition and properties of Soil, Chemical Weathering, soil clays, CEC, humus-metal interaction, soil acidity, salinity and sodicity, Effects of modern agriculture on soil geochemistry.

Unit-II
Atmospheric Chemistry : Chemical composition of atmosphere, the changing global atmosphere, green house gases and global warming, gaseous transformation in the atmosphere and removal mechanisms, residence-time, acid-rain, ozone layer depletion, nuclear winter.
Atmospheric Photochemical Reactions: Monoatomic oxygen and ozone formation, role of nitrogen in photooxidation, hydrocarbons in atmospheric photo-chemistry, oxidants in photochemical smog. Hydrocarbon reactivity.

Unit-III
Water Chemistry: Ground and surface water chemistry, water ion balancing, water pollution due to heavy metals, organic pollutants, pesticides and radionuclides**.**

Unit-IV
Instrumentation: Basic principle and working of following instruments (In breif) : **A**tomic absorption spectrophotometer, atomic emission spectrophotometer, gas chromatography, high performance liquid chromatography, mass spectrometry, SEM, TOC analyser, ICP, Ion chromatography, FTIR, RDS.

Reference Books

1. Environmental Soil Chemistry by Donald L. Sparks
2. Introduction to Soil & Plant by R.W. Miller & R.L. Dowhan
3. Climate Change by J.T. Honghton, B.A. Callander & S.K. Varney
4. Fundamentals of Air Pollution by Boubel Fox, Turner & Stern
5. Environmental Chemistry by S.C. Manhan
6. Introduction to Environmental Sc. & Engg. by Gilbert M. Masters
7. Environmental Chemistry by Colin Baird
8. Soils and the Environment by Wild
9. Composition, Chemistry and Climate of the atmosphere by H.B. Singh
10. Fundamentals of Analytical Chemistry by Skoog, West & Holler

ESE-703: ENVIRONMENTAL POLICY & IMPACT ASSESSMENT

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Environmental Policy and Laws: Constitutional provisions for environmental protection. Some laws for environment protection with amendments e.g. Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention & Control of Pollution) Act, 1981, Environmental (Protection) Act, 1986; Wild Life (Protection) Act, 1972, National Environment policy, 2006.

Unit-II
Environmental Conventions and Treaties : Chronological order of Environmental Conventions(in brief): Stockholm Conference, The Rio Earth Summit, 1992 ; Convention on climate change ; Agenda 21; Montreal Protocol, Kyoto Summit, 1997 ; World Summit on sustainable development, 2002 ; Rio+ 20, COP 21 or Paris summit

Public Interest Litigation, Concept of National green tribunal, Sustainable development goals and Movements (Chipko, Apiko & Khejarli Ka Khadana)

Unit-III
Environmental Impact Assessment: Introduction: Principles, Origin and development of EIA. Essential components of EIA: Project screening, establishing the environmental baseline, impact identification, impact prediction, evaluation and mitigation, participation, presentation and review, monitoring and auditing in EIA processes.

Unit-IV
Case Studies: Thermal power plant, refineries and water reservoir.
Eco-labeling communication to the public, EIA guidelines of Ministry of Environment and Forest and climate change (MoEFCC), 2006 and its amendments, EMP and Environment audit (in brief).

Reference Books:

1. Larry. W. Canter : Environmental Impact Assessment
2. Glasson T : Environmental Impact Assessment
3. Petter Morris: Environmental Impact Assessment
4. Eceleston, C.H. : Environmental Impact Statement
5. Paras Dewan : Environmental Administration Law & Judicial Attitude
6. K.C. Aggarwal : Environmental Law
7. Revesy, R., Sands, P.& Stewarts, B: Environmental Law & Sustainable Development
8. Khanna, P. : Primer on Environmental Management
9. Soyre, D. : Inside ISO 14000

ESE-704: INDUSTRIAL HEALTH AND SAFETY

4Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will of 14 marks.

Unit-I
Introduction: - Occupational environment and its relation to health, physiological response of man to different environmental stresses.
Occupation Health: - Types of interaction of man in occupation environment, Types of hazards associated with occupation environment- Physical, chemical, biological, mechanical and psychosocial hazards, Occupational diseases, Ergonomics, Healthy workplace and its principles.

Unit-II
Hazardous chemicals: Classification of hazardous chemicals, transportation of hazardous chemicals, hazchem code, Storage and handling of hazardous substances, Emergency preparedness (on site & offsite), Safety audit, Concept of fire and explosion, Major accidents involving hazardous substances.

Unit-III
Health and Safety Measures: - Medical and engineering measures, Stress at work and its management, Personal protection equipment, Risk Assessment with numerical, Risk management: organization and administration ; techniques and practices.

Unit-IV
Legislation Measures :- Occupational Health and Safety Standards, OHSAS-18001, The factory Act,1948 and its amendments, Manufacturing, storage and import of hazardous chemical rules, 1989 and its amendments.
Reference Book:

1. Environmental Health by M.T.Morgan
2. Textbook of Preventive and Social medicine by J.E.Park and K.Park
3. Industrial safety and Environment by A. Prashar and P. Bansal
4. Industrial Hygiene and Chemical Safety by M.H. Fulekar
5. Aspects of Labour Welfare and Social Security by A. M. Sharma
6. Safety at work by John Ridley and John Channing.
7. Hazardous Chemicals Handbook by Phillip Carson and Clive Mumford.

ESE-705 ENERGY & ENVIRONMENT

4Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I

Overview of energy. Indian scenario, Energy sources and their impact on environment.

Solar Energy: Characteristics of solar radiations, solar radiation measurements, solar energy conversion techniques: Solar collectors.

Photo-Voltaics: Introduction, Principle of solar cell, Physics of semi-conductor junction, Hierarchy of PV system, development of amorphous silicon solar cells technology, application of solar photovoltaic for lighting and water pumping.

Solar Thermal Energy: Thermal electric conversion system, Principle and description of solar water heating, solar distillation, solar cooking and solar pond.

Unit-II

Wind Energy: Origin of wind, quantification of wind energy in India, wind energy conversion systems, introduction to wind mill and wind electric generators.

Hydro-Power: Introduction, hydro-power generation, hydro-power potential in India, Micro, Mini & Mega-power projects potential & prospects.

Geothermal Energy: Introduction and nature of geothermal fields, geothermal energy, Physics of geothermal resources. Technology for exploiting geothermal resources. Potential and prospects in India.

Unit-III

Tidal Energy: Introduction and principle of tidal power generation, potential and prospects of tidal energy in India.

Bio-Energy: Biomass potential and production in India, biomass conversion processes. Introduction to biogas plants, biomass gasifiers and smokeless chullah.

Energy from fossil fuels: Sources, properties, production & processing.

Unit-IV

Nuclear Energy: Introduction, Fusion and Fission, chain reactions, a brief account of nuclear reactors.

Major alternative fuels: Liquefied Petroleum Gas (LPG), Compressed Natural Gas (CNG), Methanol, Ethanol and Hydrogen as a fuel, biofuels.

Energy Conservation & Economics: Principles of energy conservation and its impact on environment, energy conservation approaches/techniques, energy auditing and economic assessment.

Reference Books:

1. Renewable energy by Godfrey Boyle
2. Renewable energy by N.K. Bansal
3. Non-Conventional energy system by K.M. Mittal
4. Renewable Energy Sources and their environmental impact by S.A. Abbasi & Nassema Abbasi
5. Non –conventional energy by Ashok K. Desai

6. Energy by Hinrices R.A. & Kleinbach, M
7. Advances in renewable energy technologies by S.H. Pawar & L.A. Ekal.
8. Solar energy by Jeffrey Gordon
9. Green Energy by Ajit Verma & Basant Behera

ESE-711: ENVIRONMENTAL MICROBIOLOGY

4Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Classification of microbes, Characteristics of major groups of micro-organisms-bacteria, fungi, algae, protozoa, viruses and bacteriophages (in brief), role of microbes in C, N, S & Fe cycling,. Microbial Growth - Methods of determining growth, factors affecting growth, types of growth, continuous, discontinuous, synchronus and non-synchronus.

Unit-II
Control of micro-organisms-physical control by biofiltration, irradiation, temperature (high & low), chemical control by antimicrobial agents and chemotherapeutic agents (a brief account).

Unit-III
Microbiology of aerobic waste water treatment process-Activated sludge process, trickling filter and rotating biological contactors & anaerobic waste water treatment process-fermentation and upflow anaerobic sludge blanket process.

Unit-IV
Bioremediation-approaches and techniques, Role of microbes in solid waste disposal, composting, degradation of xenobiotics and pesticides, Minerals and petroleum recovery.

Reference Books:

1. Microbiology by Michael J.Pelczar, Jr. E.S.S. Chan, Noel r. Krieg
2. Microbiology : Principles and Applications by Jacquelyn, G. Black
3. Microbiology by Nester
4. Microbial Ecology Fundamentals & Applications R.M. Atlas & R. Bastha
5. Wastewater Microbiology by Gabriel Bitton
6. Micro-organisms in bioremediation by Dilip K.Markandey and N.Rajvaidya Markandey
7. Biological degradation and bioremediation of toxic chemicals by G.Rasul Chaudhary

ESE-712: AIR POLLUTION & CONTROL

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will of 14marks.

Unit-I
Introduction: Definition, air quality, classification of air pollutants, air pollution episodes.
Air Pollution Sources and their Inventory: Particulate matter, carbon dioxide, carbon monoxide, oxides of sulphur, oxides of nitrogen, hydrocarbons, photochemical oxidants, asbestos and metals(Lead,Mercury,Cadmium).

Unit-II
Meteorology and Dispersion of Pollutants: Winds, wind-rose, maximum mixing depth, lapse rate, stability conditions, plume behaviour, calculation of effective stack height, The Gaussian dispersion model, heat island effect.

Unit-III
Air Pollution Monitoring: Sampling of gaseous and particulate air pollutants, measurement of SO2, Nitrogen oxides, carbon monoxide, Oxidants and Ozone, Hydrocarbons and particulate matter.
Effect of Air Pollution: Effect of air pollution on humans, animals, vegetation & materials.

Unit-IV
Control of Air Pollution: General methods of control of Gaseous pollutants(basic design & principles): scrubbers, condensers, control equipments for particulate matter-gravity settling chambers,cyclone, fabric filters, electrostatic precipitators, scrubbers, incinerator and catalytic converters
Concept of biofilters, Basics of noise pollution and its control.
Green belt development.

Reference Books:

1. Air Pollution by Boubel Fox, Turner & Stern.
2. Air Pollution & Control by C.S. Rao
3. Introduction to Environmental Engineering & Science by Gilbert M. Masters

ESE-713: INDUSTRIAL POLLUTION & MANAGEMENT

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Introduction: Standards for industrial wastes (MINAS), methods for the treatment of industrial wastes, reduction of volume and strength, neutralization, equalization and proportioning of the wastes.

Unit-II
Processes for removal of suspended solids: Sedimentation and co-agulation, colloidal solids and dissolved inorganic solids: Evaporation, Vaccum evaporation, dialysis and electrodialysis, ion exchange, membrane filtration like reverse osmosis and removal of organic solids by aerobic treatment processes: oxidation ponds, trickling filter, rotating biological contactors and activated sludge processes and anaerobic treatment processes like UASB reactor.

Unit-III
Environmentally balanced Industrial Complexes: Pulp and paper mill complex, Sugarcane complex, Textile complex, Slaughter house-tannery-rendering complex, Fertilizer-cement complex, Steel mill-Fertilizer-cement complex.

Unit-IV
Characteristics and Processes involved for the treatment of wastes from major industries like Food Processing (cannery, dairy, brewery, distillery and cane sugar), apparel (Textile, Tannery), Material Processing (Pulp and paper, steel, Metal-Plating, oil refineries, cement), chemical (Pesticide and fertilizer) and energy (Thermal Power plant).

Reference Books:

1. Industrial & Hazardous waste treatment by Nelson L. Nemerow and Avijit Dasgupta
2. Industrial Pollution Preventive Handbook by Freeman
3. Industrial water pollution control by W. Wesley Echenfelder, Jr.

ESE-714: DESIGN OF POLLUTION CONTROL SYSTEMS

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Industrial and domestic effluent characteristics, Basic concepts of organic and inorganic effluent treatment, line of treatment .Basic design consideration and general procedure for design calculations. Reaction and reactors.

Unit-II
Design of preliminary Units: Design of sump and pump well, Approach channel, Equalization Tank, Screen Chamber, Grit Chamber, Aerated Grit Chamber and Oil & Grease Tank (Skimming Tank). Primary treatment units: Concepts of Primary settling Tank, Design Criteria for Primary Treatment and design examples.

Unit-III
Design of secondary biological treatment units: Design criteria of Aerobic Process, Calculation of Bio-Kinetics of coefficients of Aerobic Process, design consideration and application of Bio-kinetics of coefficients, design of Suspended growth processes: Activated sludge processes, secondary settling tank and stabilization pond, Design of Trickling Filters and Rotating Biological Contractors.

Unit-IV
General design criteria for Anaerobic Treatment Process, Design of Suspended and Attached Growth anaerobic Process, Design of Upflow anaerobic sludge blanket process (UASB), Design of sludge treatment units and sludge drying beds.

Reference Books:

1. Mathematics Manual for Water and Waste Water Treatment Plant by Frank R. Spellman
2. Dynamics of Environmental Bioprocesses by Snape and Dunn
3. Waste water engineering: Treatment, Disposal, Reuse by Metcalf and Eddy.
4. Industrial Wastewater Pollution Control by Wesley
5. Basic Environmental Technology by Jerry
6. Waste Water Treatment by Edward
7. Design of Anaerobic Process for the Treatment of Industrial Municipal wastes by Joseph F. Reddy
8. Elements of Chemical Reaction Engineering by H.Scott Fogler
9. Air Pollution Control by Johnson

ESE-715: WATER AND SEWAGE TREATMENT

4Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Water Treatment: Introduction: Quality standard of domestic and industrial water, sources and classification of water pollutants. Sedimentation: Principle of sedimentation, Design of sedimentation tank, Design example of sedimentation tank. Coagulation: Coagulation process, the constituents of coagulation-sedimentation plant, Floculation process, Design examples, methods for determining Optimum coagulation dose.

Unit-II
Filtration : Slow and filter, Rapid sand filter, Pressure filter, filter media, components, Filter operation, cleaning & backwashing process the under drain system and filter control, Design examples.
Color, Taste & odor Control: Sources of color, taste and odor-Natural and synthetic and their removal.
Disinfection and fluoridation: Introduction, objectives, primary disinfection technologies; chlorination, chloramination, chlorine dioxide, ozonation, potassium permanganate, ultraviolet radiation, advanced oxidation process.
Miscellaneous techniques: Water softening, demineralization, deflurodation, iron, manganese & arsenic removal.

Unit-III
Waste water treatment: Introduction, objective, classification of waste water treatment.
Primary treatment: Screening, sedimentation.
Secondary treatment (Aerobic & Anaerobic processes**):** Objective, design of the activated sludge process, trickling filter rotating biological contactors, Up flow anaerobic sludge blanket (UASB), Stabilization ponds & aerated lagoons.

Unit-IV
Tertiary treatment: Removal of dissolved inorganics, ion exchange, membrance processes, reverse osmosis, ultra filtration, electro-dialysis, removal of nitrogen and phosphorus (all processes in brief)
Sludge treatment & Disposal: digestion process, composting, thickening, Dewatering, Drying beds, Management and disposal of residues.

Reference Books:

1. Waste water engineering: Treatment, Disposal and reuse by Metcalf and Eddy.
2. Water supply and Sewerage by Terence J.Mc. Ghee
3. Industrial Water Pollution Control by W. Wesley and Eckenfelder, Jr.
4. Water works Engineering by Qasim, S.R., Motley and E.M. Zhu. G.
5. Water supply and sanitary Engineering by G.S. Birde and J.S. Birde

6. Water supply, Waste disposal and Environmental Engineering by A.K. Chatterjee.
7. Basic Environmental Technology by Jerry. A. Nathanson.

ESE-721: UNIT OPERATION & PROCESSES

4Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Introduction: Concept of unit process and operations, Standard & requirement, water treatment process & system, waste water treatment process & treatment.
Reactors: A simplistic view of reactors. Homogeneous reactions, Non homogeneous reactions. Effectiveness factor models. Continuous homogeneous reactors, conversion. Nonhomogeneous reactors. Problems.

Unit-II
Physico-chemical removal of dissolved materials: Adsorption, Ion exchange, Membrane Processes, chemical oxidation, precipitation, problems.
Gas transfer: Mass- transfer models, bubble aeration, temperature effects. The effect of surface-active agents. Agitation resulting from aeration , aeration by mechanical mixers, Maximum oxygen transfer rates and comparison of operating systems, film-flow oxygen transfer, gas stripping, air requirements for gas stripping, problems.
Solids removal: Ideal sedimentation, coagulation, flocculation, discrete particle sedimentation, flocculent sedimentation, hindered setting and thickening, configurations used in sedimentation tanks, centrifugation, filtration, problems.

Unit-III
Activated sludge and other suspended culture processes: Activated sludge, process parameters, mass-transfer limitations on removal rate , cell yield, process operation-performance and control, extended aeration processes, step aeration, high-rate activated sludge, biosorption on contact stabilization, pure-oxygen-activated sludge-aerated lagoons,aerobic digestion, centrifugal screens, nitrification, anaerobic bacterial denitrification, oxidation lagoons, problems,
Biological film-flow processes: Trickling filters, development of a design equation at maximum influent concentrations, airflow rate, physical factors in trickling filter design, rotating biological contractors, FDAS, IFAS.

Unit-IV
Anaerobic processes: Biological process characteristic, cell production, pH effects, temperature, process operating parameters, fermentation rates, application of anaerobic process, loading rates, anaerobic digestion, anaerobic contact process, anaerobic packed beds, anaerobic ponds.
Process selection and system synthesis: Waste waters, industrial waste waters, interaction of system components, mixing waste waters and regional plants, system economics, water treatment systems, experimental studies.

Reference Books:

1. Waste Water Treatment by Edward
2. Unit Operations in Environmental Engg. by R. Elangovan
3. Design of anaerobic processes for the treatment of industrial and municipal wastes by Joseph F. Malina.
4. Waste Water Engg. by Metcalf and Eddy.
5. Elements of Chemical Reaction Engg. by H. Scott. Fogler
6. Dynamics of Environmental Bio-processes by J.B. Snape and I J Dunn

ESE-722 INSTRUMENTATION AND ITS APPLICATIONS TO ENVIRONMENTAL ENGINEERING

4 Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Introduction and applications of instruments in the field of environmental engg., units and standards of measurement of various quantities, generalized measurement systems, their types, calibration and sensitivity of instruments.

Unit-II
Performance characteristics of instruments (static and dynamic), errors and uncertainties in performance parameters. Transducer and its types, detectors, sensor systems, types of sensors (mechanical, hydraulic, pneumatic, electrical and electronic etc) modifying and transmitting methods.

Unit-III
Indicating system for static and dynamic quantities, recorders and data storage system.

Unit-IV
Applications of instruments, leakage detector, corrosion detector, flow measuring devices for air and water, sound level meter.
Principal structure and working of pH meter, nepthalo-meter, fluoride meter, electronic conductivity meter, Bomb calorimeter and Spectrophotometer.

Reference Books:

1. Principles of measurement system by John P. Bentley
2. Principles of measurement and instrumentation by Morries
3. Principle of industrial instrumentation by Patranabis
4. Industrial instrumentation and control by Singh

ESE-723-SOLID AND HAZARDOUS WASTE MANAGEMENT

4Credits (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Introduction: Types, sources and characteristics of solid wastes. Solid waste generation, handling and storage. Collection of solid wastes-Collection services, types of collection system and their analysis, transfer and transport. Solid waste management. An overview, reduction, reuse and recovery.

Unit-II
Processing Techniques- Shredding and pulverizing, baling, component separation, incineration, gasification and pyrolysis.
Disposal: Dumping, land filling- site selection, Leachate contamination, land filling methods, design and operation of landfills, occurrence and movement of gases and leachate in landfills, treatments of leachates, land farming, Biogas plant, Deep well injection, Utilization of fly ash, Economics of waste disposal.
Processing of recyclable materials, metals recovery from solid wastes.

Unit-III
Hazardous Waste Management : Definition and classification of Hazardous Waste, Characteristics and Transportation of Hazardous Waste, treatment, storage and disposal, Hazardous Waste Minimization and Remediation Techniques.

Unit-IV
Biomedical waste: Generation, risk to human health and storage, transportation and treatment.
E-Waste: Definition, Environmental impacts, recycling and management.
The Hazardous waste (Management, Handling and Transboundary movement) Rules, 2008 and its amendments.

Reference Books:

1. Environmental Hazards-Smith, Keith
2. Environmental Hazards-Iqbal, M,Srivastava, A.S. and Siddiqu, T.Q.
3. Basic Environmental Technology-Nathanson, J.A.

ESE-724 ENVIRONMENTAL MANAGEMENT SYSTEM

Credit 4 (3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
The evolution of environmental management standard, British Standard 7750, Technical Committee 207, ISO 9000 and ISO 14000 series, origin, objective, scope and applicability of ISO 14000, components parts of ISO 14000 and their relationship, legal considerations and requirements of ISO 14000.

Unit-II
ISO 14000 based Environmental Management System : definition, principle, elements, structure and benefits of Environmental Management System, preparation of documents for ISO 14000, sites, implementation steps, internal audit for ISO 14000 compliance.

Unit-III
ISO 14010: EMS Audit-definition, objective, general principles, scope, types and guidelines of environmental auditing process. Registration process for implementing ISO 14000: organization decision to implement ISO 14000, potential registration problems, minimizing registration costs, steps to registration, ISO 14024: Eco-labelling communication to the public. How a company will participate in ISO 14024 based eco-labelling programme.

Unit-IV
ISO 14031: Evaluating the organization environmental performance. ISO 14020: Guidelines & standards on environmental claims & declarations.
ISO 14040: Guidelines standards for a company's management system; general principle of conducting life cycle assessment (LCA), definition, stages and scope of LCA and LCA inventory. ISO guide 64: its purpose. ISO 14000 checklist.

Reference Books:
Khanna, P. : Primer on Environmental Management
Soyre. D. : Inside ISO 14000

ESE-725 WATER SHED MANAGEMENT

Credit 4(3-1-0)
Maximum Marks: 100
Internal Marks: 30
External Marks: 70
Time: 3 Hours

Note:
Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

Unit-I
Elements of hydrology, measurement of precipitation, losses and run off, statistical analysis of rainfall and run off data-prediction of desired magnitudes-methods of estimating run off from rainfall. Flood forecasting, analysis of storage requirements, sediment inflow-selection of reservoir sites-Flood moderation damage mitigation, computation of height of dam.

Unit-II
Hydrology of ground water-common aquifers. Hydraulics of ground water flow-Darcy's Law, Measurement of permeability of formation-Well equations, unconfined and confined-Evaluation of formation constants-Aquifer Interference, design, construction and maintenance of wells and infiltration galleries-well strainer and its functions and selection-development of wells-yield tests-hydraulics of salt water and their prevention-Ground Water recharge. Soil erosion & control.

Unit-III
Distribution of water- Pressure and capacity requirements of system-provision for the fire fighting-field and office analysis of distribution net works. Service and equalizing storage-capacity requirements-Maintenance of distribution systems-Detection and prevention of faults: Emerging disinfection of mains. Transmission of Water: types and materials of conduits- Hydraulic characters-size, capacity, number and shape of conduits.

Unit-IV
Hydraulics of sewers-open channel flow with special reference of sewers, length of side weirs and capacity of street inlets. Measurement of flowing sewers. Rational method of estimating storm drainage-intensity-duration. Relationship-time of concentration-frequency of storms.

Reference Books:
Water Supply Engineering by S.K.Garg
Sewage disposal and Air Pollution Engineering by S.K. Garg
Water Shed Management and Water Studies by Michael
Engineering Hydrology by Subramanye
Water Supply and Sewerage 628.I/MC 173 W
Ground water contamination 628.16/B 399
Water flow on soils 631.432/M 699 W