

DEPARTMENT OF CIVIL ENGINEERING

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**PERIYAR
MANIAMMAI
UNIVERSITY**

(Under Section 3 of UGC Act, 1956)

NACC ACCREDITED



CURRICULUM & SYLLABUS

FOR

M.Tech – ENVIRONMENTAL ENGINEERING

(PART TIME- 3 Years)

REGULATION - 2016

CURRICULUM FOR M.Tech.**REGULATIONS – 2016**

(Applicable to the students admitted from the Academic year 2016– 2019)

SEMESTER – I

S.No.	Subject Code	Subject Title	L	T	P	C
1.	QEN 101	Statistical and Numerical Methods	3	1	0	4
2.	QEN 102	Chemistry for Environmental Engineers	3	1	0	4
3.	QEN 103	Microbiology for Environmental Engineers	3	0	1	4
		Total	9	2	1	12

SEMESTER – II

S.No.	Subject Code	Subject Title	L	T	P	C
1.	QEN 201	Transport of Water and Wastewater	3	0	1	4
2.	QEN 202	Unit Operation in Environmental Systems	3	1	0	4
3.	QEN 203	Elective - I	3	0	0	3
		Total	9	1	1	11

SEMESTER – III

S.No.	Subject Code	Subject Title	L	T	P	C
1.	QEN 301	Theory and Practice of Water and Waste Water Treatment	3	1	0	4
2.	QEN 302	Solid and Hazardous Waste Management	3	1	0	4
3.	QEN 303	Elective - II	3	0	0	3
		Total	9	2	1	11

SEMESTER – IV

S.No.	Subject Code	Subject Title	L	T	P	C
1.	QEN 401	Environmental Impact Assessment	3	1	0	4
2.	QEN 402	Air Pollution and Control	3	0	0	3
3.	QEN 403	Elective - III	3	0	0	3
		Total	9	2	1	10

SEMESTER – V

S.No.	Subject Code	Subject Title	L	T	P	C
1.	QEN 501	Project Work - Phase I	0	0	8	8
		Total	0	0	8	8

SEMESTER – VI

S.No.	Subject Code	Subject Title	L	T	P	C
1.	QEN 601	Project Work - Phase II	0	0	15	15
		Total	0	0	15	15

Note:

1. The credit distribution is followed as per the guidelines given by AICTE/UGC.

Course type	Credits				Contact Hours			
	L	T	P	Total	L	T	P	Total
Lecture course	3	0	0	3	3	0	0	3
Lecture + Practical course	3	0	1	4	3	0	2	5
Lecture + Tutorial course	3	1	0	4	3	2	0	5
	2	1	0	3	2	2	0	4
Lecture + Tutorial + Practical course	3	1	1	5	3	2	2	7

TOTAL CREDITS: 67

LIST OF ELECTIVES

ELECTIVE – I

S.No.	Subject Code	Subject Title	L	T	P	C	Hrs
1.	QEN 203 A	Energy and Environment	3	0	0	3	3
2.	QEN 203 B	Environmental Sanitation and Public Health	3	0	0	3	3
3.	QEN 203 C	Water Resources Management	3	0	0	3	3

ELECTIVE – II

S.No.	Subject Code	Subject Title	L	T	P	C	Hrs
1.	QEN 303 A	Instrumental Methods and Analysis of Environmental Pollutants	3	0	0	3	3
2.	QEN 303 B	Ground Water Contamination and Transport Modeling	3	0	0	3	3
3.	QEN 303 C	Theory and Practice of Industrial Waste Treatment	3	0	0	3	3

ELECTIVE – III

S.No.	Subject Code	Subject Title	L	T	P	C	Hrs
1.	QEN 403 A	Remote sensing and GIS	3	0	0	3	3
2.	QEN 403 B	Environmental Biotechnology	3	0	0	3	3
3.	QEN 403 C	Environmental Legislation and Pollution Control Management	3	0	0	3	3

Semester I
Subject Name STATISTICAL AND NUMERICAL METHODS
Subject Code QEN 101
Designed by Department of Civil Engineering
Prerequisite Engineering Mathematics
L –T –P –C Credits : 4 Contact Hour : 60 hrs
3- 1 – 0- 4

COURSE CONTENT

UNIT I STATISTICS 12

Tests based on normal, t and f distributions for testing of means, variance and proportions- Multiple and Partial correlation – Method of least squares – Plane of Regression – Properties of residuals – Coefficient of multiple correlation.

UNIT II DESIGN OF EXPERIMENTS 12

Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of equation – Fixed point iteration: $x=g(x)$ method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordon methods – Iterative methods – Gauss-Seidel methods – Inverse of a matrix by Gauss Jordon method – Eigen value of a matrix by power method and by Jacobi method for symmetric matrix.

UNIT IV INTERPOLATION AND APPROXIMATION 12

Interpolation - Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton's forward and backward difference formulas.

UNIT V RESEARCH METHODOLOGY 12

Definition of Research - Components of Research Problem - Various Steps in Scientific Research - Types of Research - Hypotheses Research Purposes - Research Design - Survey Research - Case Study Research - Data Collection - Sources of Data - Primary Data - Secondary Data - Research Reports - Structure and Components of Research Report - Types of Report - Publication in Journals - Ethical issues related to publishing.

Text books

1. Gupta. S.C., and Kapoor. V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and sons, Eleventh Edition, 2002.
2. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 6th Edition, 2007.
3. Sankar Rao K, Numerical Methods For Scientists And Engineers, PHI, NewDelhi, 2007.

References

1. P. Kandasamy, K. Thilagavathy and K. Gunavathy, ‘Numerical Methods’, S.Chand Co. Ltd., NewDelhi, 2003.
2. Jain M.K., Iyengar S.R.K. and Jain R.K., “Numerical Methods for Scientific and Engineering Computation” New Age International Publisher, Fourth Edition, 2003.
3. Kothari: “Research Methodology: Methods and Techniques”, New Age International, 2004

Semester SEMESTER I
Subject Name Chemistry for Environmental Engineers
Subject Code QEN 102
Designed by Department of Civil Engineering
Prerequisite Engineering Chemistry

L –T –P –C Credits : 4 Contact Hour : 60 hrs

3- 1 – 0- 4

COURSE CONTENT

UNIT I FUNDAMENTALS ON ANALYTICAL CHEMISTRY 12

oxidation and reduction reactions, balancing equation by electron method -Colloids – Redox potentials – partition co-efficient – Beer – Lambert’s Law – Limitations – Electrode potential – Applications of potentiometry – pH measurements, glass electrodes, ion selective electrodes – Instrumentations- Atomic spectroscopy – Flame photometry – Atomic Adsorption Spectrophotometry – principle- UV-visible spectrophotometer -Application in determination of mercury, lead and cadmium in water samples. Chromatography – Gas chromatography – simple instrumentation – Application in measuring SO₂, NO₂ & H₂S by spectrophotometry.

UNIT II DEGRADATION OF CHEMICALS 12

Transport and transformation of chemicals – DO, BOD and COD – Photo catalysis - Degradation of foodstuffs, detergents, pesticides and hydrocarbons

UNIT III AQUATIC CHEMISTRY 12

Metals- Removal of heavy metals- complex formation, oxidation and reduction and sorption – E^h – p^H diagrams - chemical speciation – QSAR – Risk evaluation of chemicals.

UNIT IV ATMOSPHERIC CHEMISTRY 12

Regions of atmosphere - Chemical and photochemical reactions – photochemical smog, ozone layer depletion – Greenhouse gases and global warming – Acid rain.

Soil properties, clay minerals - acid-base and ion-exchange reactions in soil - salt affected soil and its remediation

Text books

1. Sawyer, C.N., MacCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering and Science, Tata McGraw – Hill, Fifth edition, New Delhi 2003.
2. Colin Baird 'Environmental Chemistry', Freeman and company, New York, 2011.
Manahan, S.E., Environmental Chemistry, Eighth Edition, CRC press, 2009.

References

1. Des W. Connell, "Basic Concepts of Environmental Chemistry", CRC Press, 2nd Edition, 2005
2. Finar, I.L. "Organic Chemistry" Vol-I, Pearson, 6th Edition, 2002
Gary W VanLoon, Stephen J Duffy," Environmental Chemistry: A Global Perspective", Oxford University Press, 2010

Semester SEMESTER I

Subject Name Microbiology for Environmental Engineers

Subject Code QEN 103

Designed by Department of Civil Engineering

Prerequisite Microbiology

L –T –P –C

Credits : 4

Contact Hour : 60 hrs

3- 0 – 1- 4

COURSE CONTENT

UNIT I INTRODUCTION TO MICROORGANISMS 7

Basic principles of microbiology- structure and function of microbial cell-pure and mixed cultures-metabolism-Aerobic and Anaerobic pathways- Microbial growth and growth kinetics-Classification and morphological aspects of Bacteria, Fungi, Protozoa and algae.

UNIT II MICROBIAL NUTRITIONAL REQUIREMENTS 15

Microbial Nutrition –Growth of micro-organism in different media, growth curve, methods of enumeration of micro-organisms, sterilization and disinfection.

UNIT III AQUATIC MICROBIOLOGY

Ecotoxicology - toxicants and toxicity - factors influencing toxicity, effects, acute, chronic, concentration response relationships, test organisms, toxicity testing bioconcentration - bioaccumulation - bio-magnification - bioassay - biomonitoring

UNIT IV MICROBIOLOGY IN WASTE WATER

Biological methods to treat waste water-Microbiology in air pollution control (biofilter and bio scrubber), biodegradation of toxic pollutant. Practical: culture, identify and explain microorganisms in environmental cultures

UNIT V APPLICATION

Application:- Recycling of waste biomass- Biofertilizer, Biopesticides, bioremediation. Biofuels: - Role of microorganism role in algal biofuel, consortia of anaerobic digester Agriculture and Health, Vermi - composting.

Text books

1. Pelczar, Jr, M.J., E.C.S., Krieg, R.Noel., and Pelczar Merna Foss. "Microbiology 5th edition., Tata McGraw Hill Publishing Company Limited, New Delhi-2001
2. Maeir, R.M., I.L.Pepper and C.P. Gerba, " Environmental Microbiology", Academic Press, New York, 2008
3. Stainer, R.Y., Ingraham, J.L., Wheelis, M.C and Painter, P.R. " General Microbiology", Mac Millan Edn., Ltd., London, 2007.

References

1. Reddy S. Ram Reddy S. M. "Microbial Physiology" by Scitech publishersa, 2005
2. Talaro K and Talaro A Cassida Pelzar and Reid, Foundations in Microbiology, by W.C.Brown Publishers, 2008.
3. Gerard J. Tortora, Microbiology : An Introduction, by Pearson 9th Edition, 2008

Semester SEMESTER I
Subject Name TRANSPORT OF WATER AND WASTEWATER
Subject Code QEN 201
Designed by Department of Civil Engineering
Prerequisite Environmental Engineering – I & II
L –T –P –C Credits : 4 Contact Hour : 60 hrs
3- 0 – 1- 4

COURSE CONTENT

UNIT I TRANSPORT OF WATER 20

Water Storage and Transmission, Storage- requirements, impounding reservoirs- intakes, pressure conduits, hydraulics - pumps and pumping units, capacity - selection of water pumps -economic design of pumps and economic design of gravity and pumping mains- Analysis of physical and Chemical characteristics of Water.

UNIT II MATERIALS FOR PIPES 9

Specification for pipes, merits and demerits, pipe appurtenances, types of loads and stresses, water hammer, causes and prevention, control devices, laying, jointing and Testing of pipes.

UNIT III DISTRIBUTION SYSTEM 10

Principles of design, analysis of distribution networks, Hardy Cross, equivalent pipe and Newton Raphson methods, computer applications in distributions network analysis, optimal design of networks, maintenance of distribution systems, methods of control and prevention of corrosion, storage, distribution and balancing reservoirs.

UNIT IV SANITARY SEWERAGE 12

Storm Drainage: Basic philosophy in storm drainage - drainage layouts - storm runoff estimation - Rainfall data analysis - hydraulics of flow in storm water drains - storm water drain materials and sections - design of storm drains - storm water inlets - Sanitation technology selection - sanitary sewage flow estimation - sewer materials - hydraulics of flow in sanitary sewers - partial flows - sewer design - sewer layouts. - Analysis of physical and Chemical characteristics of Waste water.

Maintenance requirements of sanitary sewerage - storm drainage systems - manpower requirement - Equipment requirement - preventive maintenance - monitoring safety requirements- corrosion in sewers - prevention and control - Specific problems related to waste water pumping - pumping - pump selection - wastewater pumping networks

Text books

1. G.S.Bridie & J.S. Bridie, Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, New Delhi, 2010.
2. Hammer, M.J. Water & Waste water Technology, John Wiley & Sons, New York, 7TH edition, 2012.
3. Garg, S.K., "Environmental Engineering I & II", Khanna Publishers, New Delhi 2007
4. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 2000
5. Manual on Sewage and Sewerage system, CPHEEO, Government of India, New Delhi, 2000

References

1. 'Water supply and wastewater removal' Vol.I. John Wiley and Sons Manual on Water Treatment, CPHEEO, Government of India, New Delhi, 2010
2. Hussain S.K. A Text book of water supply and sanitary Engineering, Oxford and IBH Publishing Co., New, 2010.
3. Larry W. Mays, Mays Larry." Water Distribution System Handbook, "McGraw-Hill Professional Publishing, 1999.

Semester SEMESTER I
Subject Name UNIT OPERATION IN ENVIRONMENTAL SYSTEMS
Subject Code QEN 202
Designed by Department of Civil Engineering
Prerequisite Environmental Engineering – I & II
L –T –P –C Credits : 4 Contact Hour : 60 hrs
3- 1 – 0 4

COURSE CONTENT

UNIT I	PRIMARY TREATMENT METHODS	12
	Screening-Solid Separation-Floatation – Equalization – measurement – Mixing – Coagulation and flocculation	
UNIT II	SEDIMENTATION AND FILTRATION	12
	Principles – Types of settling – Thickening – Dick’s theory , Talmadge theory, principle of filtration – Carman – Kozeny equation – Types of filters	
UNIT III	AERATION	12
	Two film theory – Mass transfer – Fixed and floating aerators – Designing of aerator – Air stripping – packed columns and trays	
UNIT IV	ADSORPTION	12
	Theory of adsorption – Isotherms – fixed and fluidized beds – break through curves – Leaching – Definition and types, ion exchange studies, Determinations of adsorption kinetics	
UNIT V	BIOLOGICAL TREATMENT	12
	Fundamentals of microbiology of wastewater – kinetics of aerobic and anaerobic, anoxic process – suspended growth and attached growth – Biological reactors – Batch, plug flow – completely mixed.	

Text books

1. Metcalf Eddy ,Inc. George Tchobanoglous, Franklin Burton H, David Stensel,” Wastewater Engineering”, Tata McGraw-Hill Education ,2002
2. Hendricks,” Water Treatment Unit Processes: Physical and Chemical,” CRC, 2006.
3. Pelczar Jr. Michael,” Microbiology”, Tata McGraw-Hill Education,2001

References

1. Tushar p," Adsorption: Surface Chemistry," Rajat Publications, 2004.
2. Ajey Kumar Patel, Achanta Ramakrishna Rao," Aeration Systems for Wastewater Treatment", Lap Lambert Academic PublishinG,-2011
3. James Cappucciono, Natalic Sherman," Microbiology: A Laboratory Manual," Pearson, 2007.

Semester SEMESTER II
Subject Name Theory and Practice of Water and Waste Water Treatment
Subject Code QEN 301
Designed by Department of Civil Engineering
Prerequisite Transport of water and waste water , Unit operation in Environmental Systems
L –T –P –C Credits : 4 Contact Hour : 60 hrs
3- 1 – 0- 4

COURSE CONTENT

UNIT I	PHYSICAL TREATMENT	12
	Principles and Design of Screening – Grit Chamber, Skimming Tank	
UNIT II	CHEMICAL TREATMENT	12
	Principles and Design of Equalisation, chemical dosing tanks, Flash mixers, Flocculators, Sedimentation tanks, Clariflocculators.	
UNIT III	ADVANCED WATER TREATMENT	12
	Principles and Design of filter units - Nano filtration, ultra filtration and hyper filtration - Disinfection units - Reverse Osmosis, Electro dialysis and distillation	
UNIT IV	BIOLOGICAL TREATMENT	12
	Design of Aerobic and anaerobic treatment : Trickling filters, Rotating Biological contactor, activated sludge process, Septic tank, aerated lagoons, waste stabilization ponds and oxidation pond – UASB Reactor and Fluidized Bed Reactor	
UNIT V	SLUDGE TREATMENT AND DISPOSAL	12
	Sludge Processing and management - Effluent Disposal in natural water - Operational problems – Trouble shooting, Planning, Organising and Controlling of plant operations	

Text books

1. David Hendricks,” Fundamentals of Water Treatment Unit Processes: Physical, Chemical, and Biological”, CRC Press, 2010.
2. Manual on " Water Supply and Treatment ", CPHEEO, Ministry of Urban Development ,GOI, New Delhi, 1999
3. Metcalf Eddy ,Inc. George Tchobanoglous, Franklin Burton H, David Stensel,” Wastewater Engineering”, Tata McGraw-Hill Education ,2002.
4. Arceivala.J, Shyam, Asolekar R,” Wastewater Treatment For Pollution Control”, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2006.

References

1. Casey, T.J. Unit treatment processes in water and wastewater Engineering, John Wiley and Sons, London 1997.
2. Edward M. Motley, Guang Zhu, Syed R. Qasim,” Water Works Engineering: Planning, Design and Operation”, Prentice Hall, 2000.
3. Ronald L. Droste,” Theory And Practice of Water And Wastewater Treatment,” Wiley India Pvt Ltd, 2011

Semester SEMESTER II
Subject Name Solid and Hazardous Waste Management
Subject Code QEN 302
Designed by Department of Civil Engineering
Prerequisite None
L –T –P –C Credits : 4 Contact Hour : 60 hrs.
3- 0 – 1- 4

COURSE CONTENT

UNIT I SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK

9

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Elements of integrated waste management and roles of stakeholders - Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, electronic wastes , plastics and fly ash – Financing waste management.

UNIT II WASTE CHARACTERIZATION AND SOURCE REDUCTION 20

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse
Practical: Composition of MSW, Determination of Physical and Chemical Properties of MSW

UNIT III STORAGE, COLLECTION AND TRANSPORT OF WASTES 9

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport

UNIT IV WASTE PROCESSING TECHNOLOGIES 12

Objectives of waste processing – material separation and processing technologies – biological & chemical conversion technologies – methods and controls of Composting - thermal conversion technologies, energy recovery – incineration –

UNIT V WASTE DISPOSAL

10

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation

Text books

1. George Tchobanoglous et al, "Integrated Solid Waste Management", McGraw - Hill, 2014.
2. Manual on Municipal Solid waste Management, CPHEEO, Ministry of Urban Development, Govt. Of. India, New Delhi, 2000.
3. Tchobanoglous Thiesen Ellasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.

References

1. R.E.Landrefh and P.A.Rebers," Municipal Solid Wastes-Problems & Solutions" ,Lewis, 1997.
2. Blide A.D.& Sundaresan, B.B,"Solid Waste Management in Developing Countries", INSDOC, 1993.
3. Georges E. Ekosse, Rogers W'O Okut-Uma, Pollution control & Waste management in Developing Countries, Commonwealth Publishers, New Delhi, 2000.
4. B. B. Sundaresan, A. D. Bhide – Solid Waste Management, Collection, Processing and Disposal, Mudrashilpa Offset Printers, 2001.

Semester SEMESTER II
Subject Name Environmental Impact Assessment
Subject Code QEN 401
Designed by Department of Civil Engineering
Prerequisite None
L –T –P –C Credits : 4 Contact Hour : 60 hrs
3- 1 – 0- 4

COURSE CONTENT

- UNIT I UNIT I-INTRODUCTION TO EIA 12**
Environmental Impact Assessment (EIA)- Environmental Impact Statement - Environmental Risk assessment -Legal and Regulatory aspects in India - Types and limitations of EIA - Terms of reference in EIA - Issues in EIA - National - Cross sectoral - social and cultural.
- UNIT II METHODOLOGIES 12**
Methods of EIA –Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives – Case Studies.
- UNIT III PREDICTION AND ASSESSMENT 12**
Assessment of Impact on land, water and air, noise, social, cultural flora and fauna; Mathematical models; public participation – Rapid EIA.
- UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 12**
Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People – ISO 14000
- UNIT V CASE STUDIES 12**
EIA for infrastructure projects – Bridges – Stadium – Highways – Dams – Multi-storey Buildings – Water Supply and Drainage Projects

Text books

1. Canter, L.W., “Environmental Impact Assessment”, McGraw-Hill, New York. 2006.
2. Lawrence, D.P., “Environmental Impact Assessment - Practical solutions to recurrent problems”, Wiley-Interscience, New Jersey 2003.
3. Petts, J., “Handbook of Environmental Impact Assessment”, Vol., I and II,

Conwell Science London. 2009.

References

1. Biswas, A.K. and Agarwala, S.B.C., “Environmental Impact Assessment for Developing Countries”, Butterworth Heinemann, London. 2004.
2. The World Bank Group, “Environmental Assessment Source Book Vol. I, II and III. The World Bank, Washington. 2001.

Semester SEMESTER II
Subject Name Air Pollution and Control
Subject Code QEN 402
Designed by Department of Civil Engineering
Prerequisite None
L –T –P –C Credits : 3 Contact Hour: 45 hrs.
3-0-0-3

COURSE CONTENT

UNIT I INTRODUCTION TO AIR POLLUTANTS 9

Air resource management system - Air quality management - Scales of air pollution problem - Sources and classification of pollutants and their effect on human health vegetation and property - Global implications of air pollution - Meteorology Fundamentals - Atmospheric stability – Micrometeorology - Atmospheric turbulence - mechanical and thermal turbulence - Wind profiles - Atmospheric Diffusion - Atmospheric diffusion theories - Steady-state atmospheric diffusion equation – Plume rise - Diffusion models - Ambient air quality and emission standards – Air pollution indices – Air Quality Sampling and Monitoring.

UNIT II CONTROL OF PARTICULATE CONTAMINANTS 9

Settling chambers - Filters, gravitational, Centrifugal – multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory – ESP design – Operational Considerations – Process Control and Monitoring – Case Studies.

UNIT III CONTROL OF GASEOUS CONTAMINANTS 9

Absorption – principles - description of equipment-packed and plate columns - design and performance equations – Adsorption - principal adsorbents - Equipment descriptions – Design and performance equations – Condensation - design and performance equation – Incineration - Equipment description - design and performance equations - Biological Air Pollution Control Technologies –

Bio-Scrubbers, Biofilters – Operational Considerations – Process Control and Monitoring – Case Studies.

UNIT IV EMERGING TRENDS 9

Process Modification – Automobile Air Pollution and its control – Fuel Modification - Mechanical Particulate Collectors – Entrainment Separation – Internal Combustion Engines – Membrane Process – Ultraviolet Photolysis – High Efficiency Particulate Air Filters – Technical & Economic Feasibility of selected emerging technologies for Air pollution control

UNIT V INDOOR AIR QUALITY 9

Sources and Causes of Indoor Air Quality Problems- Risk due to Indoor Air pollutants- sources of indoor Air pollutants- Indoor Air Quality Regulations- Indoor Air Quality Models- Indoor Air Quality Control- Case Studies

Text books

1. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 2010.
2. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
3. Anjaneyulu. Y, 'Air Pollution and Control Technologies', Allied Publishers (P) Ltd., India, 2002.

References

1. David H.F. Liu, Bela G. Liptak 'Air Pollution', Lweis Publishers, 2000.
2. Arthur C.Stern, ' Air Pollution (Vol.I – Vol.VIII)', Academic Press, 2006.
3. Wayne T.Davis, 'Air Pollution Engineering Manual', John Wiley & Sons, Inc., 2000

Semester III
Subject Name PROJECT WORK -- PHASE I
Subject Code QEN 501
Designed by Department of Civil Engineering
L –T –P –C Credits : 8
0- 0 – 8- 8

COURSE CONTENT

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

Semester IV
Subject Name PROJECT WORK -- PHASE II
Subject Code QEN 601
Designed by Department of Civil Engineering

L –T –P –C Credits : 15
0 –0-15-15

COURSE CONTENT

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external.

Semester I
Subject Name ENERGY AND ENVIRONMENT
Subject Code QEN 203 A
Designed by Department of Civil Engineering
Prerequisite Environmental science and Engineering
L –T –P –C Credits : 3 Contact Hour : 45 hrs
3- 0 – 0- 3

COURSE CONTENT

UNIT I	GENERAL	9
	Trends in waste generation-Processing Philosophy- Typical waste composition and its uses-Waste recovery methods-Waste recycling methods-Energy recovery methods	
UNIT II	RECOVERY OF WASTE MATERIAL	9
	Recovery of waste materials-Plastic recovery –Energy recovery-Metal recovery-Glass recovery-Non ferrous metals recovery-Composting-Check list	
UNIT III	RECYCLING OF WASTE MATERIAL	9
	Separation and recycling of waste – Principles - separation-Air classifier – Screening-Hammer mill-Products of recycling-Recycling applications-Case histories-House hold waste recycling –Scrap fragmentation Process	
UNIT IV	WASTE HANDLING SYSTEMS	9
	Waste handling and storage-Supply and demand-Compacting and storage-Storage hoppers-Waste handling systems-Access and safety –Compactors	
UNIT V	DISOPAL OF WASTE	9
	Waste disposal-Management- Conveyance – Specific examples- Refractories-Development-Chimneys-Control and instrumentation-Operation and safety.	

Text books

1. Vaish Troloki, Eney, Environment and Ecology, Vayu Education of India, New Delhi, 2001
2. Salvato, “Environmental Sanitation”, John Wiley & Sons, NewYork, 1982

3. David Kut and Gerard Hare, "Waste recycling for energy recovery", Architectural Press, 1981.

References

1. Metcalf & Eddy, "Wastewater Engineering Treatment Disposal Reuse", Tata McGraw-Hill, New York, 2003.
2. Arcievala S.J., Wastewater treatment and Disposal – Engineering and Ecology in pollution control, Marcel Dekker. Inc., New York, 1981.
3. Chandra and Adab,"Rubber and plastic Waste",Cbs,2004.

Semester I
Subject Name ENVIRONMENTAL SANITATION AND PUBLIC HEALTH
Subject Code QEN 203 B
Designed by Department of Civil Engineering
Prerequisite None
L –T –P –C Credits : 3 Contact Hour : 45 hrs
3- 0 – 0- 3

COURSE CONTENT

- UNIT I EPIDEMIOLOGY 4**
Communicable diseases, Micro-organisms, Methods of communication. Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control.
- UNIT II INSECTS AND RODENT CONTROL 12**
Mosquitoes, life cycles, factors of diseases control methods –natural and chemical, Fly control methods and prevention of fly breeding, Rodents and public health, plague control methods, engineering and bio-control methods, disinfectants (Phenols, Lime, Chlorine, Ammonium compounds), Insecticides (DDT, BHC).
- UNIT III INDUSTRIAL SANITATION 12**
Sanitation in public places restaurants - hotels - hostels - schools - hospitals - nursing homes - research laboratories - railway stations - bus stands - cinema theatres - auditoriums - public bathing places - comfort stations – standards.
- UNIT IV INDUSTRIAL HYGIENE 12**
Occupational Hazards, Industrial poisons, Dust, Noise, Heat, Compressed air, Vibrations and shocks- Industrial plant sanitation. Ventilation - objects of ventilation - composition of air - combustion and respiration - quantity of air required - comfort by ventilations - systems of ventilation - air conditioning - lighting - natural and artificial - insulation of buildings - disinfection of air in occupied rooms - noise abatement measures - outdoor and indoor.
- UNIT V RURAL SANITATION 8**
Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems- Rural sanitation improvement schemes. Case studies on sanitation.

TEXT BOOKS

1. Victor Ehalers & Earnest W Steel, "Municipal and Rural sanitation".
Mcgraw-hill Education,2009.
2. Bhatia H. S.," Text book on Environmental Pollution and Control",
Galgotia Publication Pvt. Ltd., New Delhi,2003.
3. Adelaide M. Lusambili," Environmental Sanitation and Gender Among the
Urban Poor", Vdm Verlag,2008.

REFERENCES

1. Salveto J.A., "Environmental Sanitation", John Wiely,2006.
2. Dhameja S.K., "Environmental Engineering & Management",2004
3. Vivek Pandey, .. Dwivedi A. K, Dr. Rekha Nair, Dr. Sama Jain,"
Environmental Engineering & Disaster Management", Neelkanth
Publishers,2010

Semester I
Subject Name WATER RESOURCES MANAGEMENT
Subject Code QEN 203 C
Designed by Department of Civil Engineering
Prerequisite Transport of Water and Wastewater
L –T –P –C Credits : 3 Contact Hour : 45 hrs
3- 0 – 0- 3

COURSE CONTENT

- UNIT I INTRODUCTION TO WATER RESOURCE 9**
Water in the urban eco-system-Urban water resources-Four major problems-Urban hydrological cycle-Storm water management objectives and limitations-Storm water policies-Feasibility consideration
- UNIT II URBAN WATER RESOURCES MANAGEMENT MODELS 9**
Types of models-Physically based-Conceptual or unit hydrograph based-Urban surface runoff models- Management models for flow rate and volume control rate-Quality models
- UNIT III URBAN STORM WATER MANAGEMENT 9**
Storm water management practices(Structural and Non-Structural Management measures)-Detention and Retention concepts-Modeling concept-Types of storage-Magnitude of storage-Hydraulics analysis and design guidelines-Flow and storage capacity of urban components-Temple tanks
- UNIT IV MASTER PLANS 9**
Planning and organizational aspects-Inter dependency of planning and implementation of goals and measures- Measures of Urban drainage and flood control benefits-Effective urban water user organizations
- UNIT V OPERATION AND MAINTENANCE 9**
General approaches to operations and maintenance-Complexity of operations and need for diagnostic analysis- Operation and Maintenance in urban water system-Maintenance management systems-Inventories and conditions assessment-Social awareness and involvement

TEXT BOOKS

1. Geiger.W.F., Marsalek F., Rawls.W.J., and Zuidena.F.C., (Ed), " Manual on Drainage in Urbanised areas-Vol-1 and Vol.II ", UNESCO, 2000.
2. Hengeveld H. and De Vocht.(Ed)., " Role of Water in Urban Ecology ", 1999.
3. Martin P.Wanelista and Yousef., "Storm Water Management and Operations ",JohnWiley and Sons, 1993.

REFERENCES

1. Neil S. Grigg., " Urban Water Infrastructure Planning - Management and Operations",John Wiley and Sons, 1986.
2. Overtens D.E. and Meadows M.E., "Storm Water Modelling ", Academic Press, NewYork, 1976.
3. Shobha Rastogi, Rajesh K Yadav," Water Quality and Water Resources", Oxford Book Company,2011

Semester II
Subject Name INSTRUMENTAL METHODS AND ANALYSIS OF ENVIRONMENTAL POLLUTANTS
Subject Code QEN 303 A
Designed by Department of Civil Engineering
Prerequisite None
L –T –P –C Credits : 3 Contact Hour : 45 hrs
3- 0 – 0- 3

COURSE CONTENT

- UNIT I INTRODUCTION 9**
Instrumental Methods, Selection of method, Precision and Accuracy, Errors in measuring signals, Noise/signal ratio, base line drift, Indicator tubes.
- UNIT II SPECTROSCOPIC METHODS 9**
Electromagnetic radiation, matter radiation interactions; Colorimetry and spectrophotometry, fluorimetry, nephelometry and turbidimetry, flame photometry Atomic Absorption Spectrometry (AAS), Atomic Emission Spectrometry (AES) – Inductively coupled plasma (ICP) and Direct Current Plasma (DCP) spectrometry. ICP – MS (Mass spectrometry).
- UNIT III CHROMATOGRAPHIC METHODS 9**
Classical methods, Column, Paper and thin layer chromatography (TLC), Gas Chromatography (GC), GC-MS, High performance liquid chromatography (HPLC) and Ion chromatography (IC).
- UNIT IV ELECTRO AND RADIO ANALYTICAL METHODS 9**
Conductometry, potentiometry, coulometry, amperometry polarography, Neutron Activation Analysis (NAA), X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) methods.
- UNIT V CONTINUOUS MONITORING INSTRUMENTS 9**
Non – dispersive infra-red (NDIR) analyzer for CO, chemiluminescent analyzer for NO_x, Fluorescent analyzer for SO₂, Auto analyzer for water quality using flow injection analysis; permeation devices.

TEXT BOOKS

1. Willard. H., Merritt, L., Dean, D.A. and Settle. F.A. 'Instrumental methods of analysis, 7th Edn. Words Worth, New York, 2004.
2. Eckman D.P. "Industrial Instrumentation", Wiley Eastern Ltd., 1989.
3. Considine D M and Considine G D "Process Instruments Controls" Handbook 3rd Edition , McGraw – Hill Book Co., NY, 1990.
4. Scborg D E, Edgar T.F and Mellichamp D.A, "Process Dynamics and Control" John Wiley 1989.

REFERENCES

1. Fribance, "Industrial Instrumentation Fundamentals" ,Mc Graw Hill Co. Inc. New York 1985
2. Ewing 'Instrumental Methods of Chemical Analysis, 5th Edn., McGraw-Hill, New York, 1995.
3. Ernest Doebelin, Measurement systems, McGraw – Hill Book, Co., NY, 1975.
4. Astrom K.J., Bjon wittenmark, Computer controlled systems, Prentice-Hall of India, New Delhi 1994.
5. Cartis Johnson, Process Control Instrumentation Technology, Prentice-Hall of India, New Delhi 1993.

Semester II
Subject Name Groundwater Contamination and Transport Modeling
Subject Code QEN 303 B
Designed by Department of Civil Engineering
Prerequisite Transport of Water and Waste Water
 L –T –P –C Credits : 3 Contact Hour : 45 hrs.
 3- 0 – 0- 3

COURSE CONTENT

- UNIT I INTRODUCTION TO TRANSPORT PHENOMENA 9**
 Transport phenomenon, diffusion, dispersion, advection, adsorption, conservative and non-conservative pollutants, sources and sinks- point and nonpoint.
- UNIT II FLOW AND TRANSPORT EQUATIONS 9**
 Governing Equations for flow and transport in surface and subsurface waters, chemical and biological process models, simplified models for lakes, streams, and estuaries.
- UNIT III MODEL COMPLEXITY 9**
 Selection and development, model resolution, coupled and uncoupled models, Linear and nonlinear models, solution techniques, data requirements for calibration, application and evaluation of environmental control.
- UNIT IV NUMERICAL MODELS 9**
 FDM, FEM and Finite volume techniques, explicit vs. implicit methods, numerical errors, and stability, High resolution techniques.
- UNIT V SOFTWARE MODELLING 9**
 Stream quality modeling and Groundwater transport modeling using software.

Text books

1. Alexander H.-d Cheng, Jacob Bear, "Modeling Groundwater Flow and Contaminant Transport", springer 02, 2011.
2. PascualHoracio Benito," Approaches to Modeling Contaminant Transport in Porous Media: Pore-Scale to Regional Scale Investigations,"Proquest, Umi Dissertation Publishing, 09-2011.
3. Mark Goltz, Junqi Huang," Analytical Modeling of Solute Transport in Groundwater: Using Models to Understand the Effect of Natural Processes on Contaminant Fate and Transport I",John Wiley & Sons, Aug 2010.

References

1. Rafael Antonio PrietoPiedrahita," Treatment of Contaminated Sediments Using Reactive Cap Technology: Characterization and Modeling of Geotechnical, Hydraulic and Contaminant Transport",Proquest, Umi Dissertation Publishing, Sep 2011.
2. ChunmiaoZheng, Gordon D. Bennett," Applied Contaminant Transport Modeling", Wiley-Interscience, February 2002.
3. ShaharShlomi,"Combining Geostatistical Analysis and Flow-And-Transport Models to Improve Groundwater Contaminant Plume Estimation,"Proquest, Umi Dissertation Publishing,2011.

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries.

TEXT BOOKS:

1. Eckenfelder, W.W., 'Industrial Water Pollution Control', Mc-Graw Hill, 2000.
2. Nelson Leonard Nemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007
3. Paul L. Bishop, 'Pollution Prevention: - Fundamentals and Practice', Mc-Graw Hill International, Boston, 2000.

REFERENCES

1. Nemerow, N.I, Butterworth-Heinemann,"Theories of practice of Industrial Waste Treatment", 2006.
2. Gurnham, C.F., "Principles of Industrial Waste Treatment "CRC Press, 1999.
3. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 2001

Semester II
Subject Name REMOTE SENSING AND GIS
Subject Code QEN 403 A
Designed by Department of Civil Engineering
Prerequisite None
L –T –P –C Credits : 3 Contact Hour : 45 hrs
3- 0 – 0- 3

COURSE CONTENT

- UNIT I FUNDAMENTALS OF REMOTE SENSING 9**
Definition, Physics of Remote Sensing, Electromagnetic Radiation and its interactions with atmosphere, Spectral reflectance of earth materials and vegetation
- UNIT II PLATFORMS AND SENSORS 9**
Aerial Photographs, Active and passive sensors, Data products, Various satellite in orbit and their sensors.
- UNIT III DATA PROCESSING 9**
Data analysis - Visual Interpretation and Digital Image Processing – classification
- UNIT IV GIS 9**
Introduction to GIS, concepts and Data base structure, various GIS software.
- UNIT V REMOTE SENSING AND GIS APPLICATIONS 9**
Management and monitoring of land, air, water and pollution studies, conservation of resources, Identification of site for waste disposal – optimization of Route for collection of MSW

Text books

1. Anji Reddy.M,” Textbook of Remote Sensing and GIS”, BPB Publications,2006
2. T. M. Lillesand and R.W.Kiefer,” Remote Sensing and Image Interpretation “,Wiley,2011
3. E. T. Engman and R. J. Curney,” Remote Sensing in Hydrology,”Chapman&Hall,1990

References

1. Lillies and T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation ", John Wiley and Sons, 1994.
2. Burrough, P.A. and McDonnell, R.A., "Principles of Geographical Information Systems ", Oxford University Press, 1998. 3. Lintz, J. and Simonet, " Remote Sensing of Environment ", Addison Wesley Publishing Company, 1994.
3. David Martin," Geographic Information Systems", Routledge,1995.

Semester II
Subject Name ENVIRONMENTAL BIOTECHNOLOGY
Subject Code QEN 403 B
Designed by Department of Civil Engineering
Prerequisite None

L –T –P –C Credits : 3 Contact Hour : 45 hrs
3 - 0 – 0- 3

COURSE CONTENT

- UNIT I INTRODUCTION 5**
Principles and concepts of environmental biotechnology—usefulness to mankind, current status.
- UNIT II DETOXIFICATION OF ENVIRONMENTAL POLLUTANTS 8**
Degradation of high concentrated toxic pollutants—halogenated, non-halogenated, petroleum hydrocarbons, metals. Mechanisms of detoxification—oxidation, dehalogenation, biotransformation of metals, biodegradation of solid wastes.
- UNIT III MICROBIAL TECHNOLOGY FOR WASTE TREATMENT 12**
Biotechnological remedies for environmental pollution—decontamination of groundwater systems, subsurface environment—reclamation concepts—bioremediation. Production of proteins – biofertilizers. Physical, chemical and microbiological factors of composting – health risk – pathogens – odour management – Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology and applications in agriculture – role of extracellular polymers. Biogas technology – case studies.
- UNIT IV RECOMBINANT DNA TECHNOLOGY AND GENETIC APPLICATION 10**
Concept of rDNA technology – expression vectors – cloning of DNA – mutation – construction of microbial strains, radioactive probes, protoplast fusion technology – applications.
- UNIT V ETHICAL AND REGULATORY ISSUES 10**
Environmental effects and ethics of microbial technology – safety of genetically engineered organisms – microbial containment – Risk assessment, IPR – patents.

TEXT BOOKS

1. Chaudhury, G.R. 'Biological degradation and Bioremediation of toxic chemicals', Dioscorides Press, Oregon, 1994.
2. Martin.A.M, 'Biological degradation of wastes', Elsevier Applied Science, London, 1991.
3. Sayler, Gray S. Robert Fox and James W. Blackburn Environmental Biotechnology for Waste Treatment, Plenum Press, New York, 1991.
4. Blaine Metting.F (Jr.) Soil Microbiology Ecology, Marcel Dekker Inc., 1993.

REFERENCES

1. Wainwright, M, An Introduction to Environmental Biotechnology, 1999.
2. Old, R.W., and Primrose, S.B., Principles of Gene Manipulation 3rd Ed. Blackwell Sci. Publ., Cambridge, 1985.
3. Bruce E. Rittmann, Eric Seagren, Brian A.Wrenn and Albert J. Valocchi, Chittaranjan Ray, Lutgarde Raskin, Insitu Bioremediation (2nd Edition) Naves Publication, U.S.A, 1991

Semester II
Subject Name ENVIRONMENTAL LEGISLATION AND POLLUTION CONTROL
MANAGEMENT
Subject Code QEN 403 C
Designed by Department of Civil Engineering
Prerequisite None
L –T –P –C Credits : 3 Contact Hour : 45 hrs
3- 0 – 0- 3

COURSE CONTENT

- UNIT I INTRODUCTION 8**
Basics of jurisprudence – Environmental law relation with other disciplines - Criminal law – Common Law – Relevant sections of the Code of Civil Procedure, Criminal Procedure Code – Indian Penal Code.
- UNIT II INDIAN CONSTITUTION AND ENVIRONMENT 10**
Introduction – Fundamental Rights – Directive Principles of State Policy – Article 48 (A) and 51-A(g) Judicial enforceability – Constitution and Resources management and pollution control – Indian Forest Policy (1990) – Indian Environmental Policy (1992).
- UNIT III ADMINISTRATIVE REGIME & LEGAL REGIME 9**
Administrative regulations – constitution of Pollution Control Boards Powers, functions, Accounts, Audit etc. – Formal Justice Delivery mechanism Higher and Lower of judiciary – Constitutional remedies writ jurisdiction Article 32, 226 136 special reference to Mandamus and Certiorari for pollution abatement – Equitable remedies for pollution control
- UNIT IV POLLUTION CONTROL LAWS 9**
Administrative regulation under recent legislations in water pollution control. Water (prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Water (prevention and control of pollution) Rules 1975 Water (prevention & control or Pollution) cess Act. 1977 as amended by Amendment Act 1987 and relevant notifications.
- UNIT V ENVIRONMENTAL (PROTECTION) ACT 1986 9**
Relevant notifications in connection with Hazardous Wastes (management and handling) Biomedical wastes (management and handling), Noise pollution, Eco-labeling, and E.I.A.

TEXT BOOKS

1. Constitution of India Eastern Book Company Lucknow 12th Edn. 1997.
2. Constitutional Law of India – J.N. Pandey 1997 (31st Edn.) Central Law Agency Allahabad.
3. Administrative Law U.P.D. Kesari 1998. Universal Book Trade Delhi.
4. Environmental Law H.N. Tiwari, Allahabad Law. Agency 1997.

REFERENCES

1. Environmental, A., Divan and Noble M. Environmental Law and Policy in India (cases, Materials and Statutes) 1991 Tripathi Bombay.
2. Environmental Policy. Forest Policy. Bare Acts – Government Gazette Notification.