ADAMAS UNIVERSITY

PURSUE EXCELLENCE

KOLKATA

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY

M.Tech. Environmntal Engineering

Course Structure& Syllabus

Academic Year 2019-20

SEMESTER I								
Sl.	**Type**	**Course code**	**Title of the Course**	**L**	**T**	**P**	**Contact Hours/Week**	**Credits**
1	Theory	ECE61101	Physico-Chemical Processes in Environmental Engineering.	3	1	0	4	4
2	Theory		Elective - I	3	0	0	3	3
3	Theory	ECE61107	Air and Noise Pollution	3	1	0	4	4
4	Theory	ECE61109	Process Chemistry for Water and Wastewater Treatment	3	1	0	4	4
5	Practical	ECE61201	Water and Waste Water Quality Lab	0	0	3	3	2
6	Practical	ECE61203	Air and Noise Pollution Lab	0	0	3	3	2
7	Sessional	ECE61301	Colloquium-I	0	0	3	3	2
8	Sessional	ECE61303	Civil-Technical Report Writing	0	0	3	2	2
			Total	**14**	**3**	**9**	**26**	**23**

SEMESTER II								
Sl.	**Type**	**CourseCode**	**Title of the Course**	**L**	**T**	**P**	**Contact Hours/Week**	**Credits**
1	Theory	ECE61102	Biological Process for Environmental Engineering	3	1	0	4	4
2	Theory	ECE61104	Solid and Hazardous Waste Management	3	1	0	4	4
3	Theory		Elective-II	3	0	0	3	3
4	Theory		Elective-III	3	0	0	3	3
5	Practical	ECE61202	Design of Environmental Engineering Systems	0	0	3	3	2
6	Sessional	ECE61302	Colloquium-II	0	0	3	3	2
			Total	**12**	**2**	**6**	**20**	**18**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

SEMESTER III								
Sl. No.	**Type**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**Contact Hours/ Week**	**Credits**
1	Thesis	ECE62401	EE-Pre-Dissertation	0	0	0	24	**18**
2	Viva	ECE62501	EE-Pre-submission Defense of Dissertation	0	0	0	0	**4**
			Total				24	**22**

SEMESTER IV								
Sl. No.	**Type**	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**Contact Hours/ Week**	**Credits**
1	Thesis	ECE62402	EE-Dissertation	0	0	0	24	**18**
2	Viva	ECE62502	EE-Defense of Dissertation	0	0	0	**0**	**6**
			Total					**24**

TOTAL CREDITS = 87

Environmental Engineering Electives and code

Elective-I

i. ECE61103 Environmental System Engineering
ii. ECE61105 Advanced Soil and Foundation Engineering

Elective-II

i. ECE61106 - Industrial Wastewater Pollution Control

ii. ECE61108 – Environmental Impact Assessment

Elective-III

i. ECE61110–Numerical Methods
ii. ECE61112– Optimization Methods

ADAMAS UNIVERSITY
M.TECH IN ENVIRONMENTAL ENGINEERING
SEMESTER – I

PROCESS CHEMISTRY FOR WATER AND WASTEWATER TREATMENT	**ECE61109**	**3-1-0**	**4 Credits**
Module 1: Basic Concepts from Equilibrium Chemistry, Chemical equilibrium and kinetics fundamentals; Acids and Bases; Buffers; Buffer index; Titrations; Solution to equilibrium problems; pC-pH diagram; Complex formation; Solubility of salts; Oxidation-reduction reaction; pE-pH diagram		**[12]**	
Module 2: Water and Wastewater Analysis , Basic concepts from quantitative chemistry: Gravimetric analysis; Volumetric analysis; Colorimetry; Optical methods		**[18]**	

of analysis; Chromatographic methods of analysis; Standard solutions. Acidity; Alkalinity; Chemical coagulation and water softening, hardness; Chemistry of chlorination, disinfection and breakpoint chlorination; Biological oxygen demand; Chemical oxygen demand	
Module 3: Role of Chemical Unit Processes in Wastewater Treatment , Application of chemical unit processes; Fundamentals of chemical coagulation; nature of particles in wastewater; Development and measurement of surface charge; Particle-particle interaction; Particle destabilization with potential determining ions and electrolytes; Particle	**[12]**
Module4: Chemical precipitation for improved plant performance: Chemical reactions in wastewater; Enhanced removal of suspended solids in primary sedimentation; Chemical precipitation for phosphorus removal; Chemical precipitation for removal of heavy metals and dissolved inorganic substances.	**[12]**

Text Books:	
1	Sawyer, C.N., McCarty, P.L. and Parkin, G.F. Chemistry for Environmental Engineering

	and Science, 5th Edition, McGraw-Hill, Inc., New York, 2003.
2	Manahan, S.E. Fundamentals of Environmental Chemistry, Lewis Publishers, Inc., Boca Raton, 1993.
3	Stumm, W and Morgan, J.J. Aquatic Chemistry: An Introduction emphasizing chemical equilibrium in natural waters, 2nd Edition, Wiley Intersciences, New York.
Reference Books:	
1	Metcalf and Eddy, Inc. Wastewater Engineering: Treatment and Reuse, 4th Edition, McGraw-Hill, Inc., New York, 2002

ADAMAS UNIVERSITY
M.TECH IN ENVIRONMENTAL ENGINEERING
SEMESTER – I

PHYSIO-CHEMICAL PROCESSES IN ENVIORNMENTAL ENGINEERING	**ECE61101**	**3-1-0**	**4 Credits**
Module 1: Water and solid waste pollution, Introduction, Domestic water pollution, Industrial water pollution, Agricultural water pollution, Solid waste pollution, Sources and classification of solid waste pollution. Water Demands - Various types of water demand , Total requirement of water for a town or a city , The per capita demand (q) , Factors affecting per capita demand , Population data and population growth , Population forecasting methods			**[18]**
Module 2: Quality control of municipal and industrial water supplies			**[12]**

Introduction , Characteristics of water , Purification of water supplies , Introduction , Methods of purification of water Screening-course and fine screens , Plain sedimentation , Sedimentation aided with coagulation , Filtration , Disinfection or sterilization , Water softening , Miscellaneous treatments	
Module 3: Distribution system - Introduction, Requirement of a good distribution system, Arrangement of distribution pipes and other accessories, Layout of distribution networks, Methods of distribution, Pressure in the distribution system, Systems of supply. Distribution reservoir - Wastage of water in the distribution system , Design of distribution networks , Quality and Characteristics of sewage - Introduction , Physical characteristics of sewage and their testing , Chemical characteristics of sewage and their testing , Total solids, suspended solids and settleable solids , pH value , Chloride content , Nitrogen content , Dissolved solids , Chemical oxygen demand ,Bio-chemical Oxygen Demand , Population equivalent , Relative stability.	**[10]**
Module 4: Disposing of the sewage effluents - Disposal by dilution, Conditions favoring disposal by dilution, Standards of dilution for discharge of wastewater into rivers , Dilution in rivers and self-purification of natural streams , Disposal of wastewaters in lakes and management of lake waters , Disposal of waste water vin sea waters , Disposal on land , Sewage sickness , Dilution method Vs. land disposal method for disposal of sewage. Treatment of sewage- Classification of treatment processes , Preliminary treatment	**[20]**

Primary treatment , Secondary treatment , Complete final treatment type sedimentation tanks- constructional details of sedimentation tanks , Sedimentation aided with coagulation Secondary treatment through biological filtration of sewage , Intermittent sand filters for biological filtration of sewage , Trickling filters for biological filtration of sewage , Recirculation of treated sewage and its use in high rate trickling filters , Digestion and disposal of primary and secondary sludge, Sludge digestion process , Stages in sludge digestion process , Factors affecting sludge digestion and their control , Sludge digestion tank or digesters , Disposal of digested sewage , Secondary treatment through activated sludge process , Primary treatment units of an activated sludge plant , Aeration tank of an activated sludge plant , Secondary sedimentation tank of an activated sludge plant , Design considerations involved in an activated sludge plant	

Text Books:	
1	Santosh Kumar Garg , Sewage Disposal and Air Pollution Engineering, Environmental Engineering (Vol.II), Khanna Publishers,2013
2	S.V.S. Rana, Essentials of Ecology and Environmental Science ,Fourth Edition , 2010
Reference books:	
1	Santosh Kumar Garg , Water Supply Engineering, Environmental Engineering (Vol.I), Khanna Publishers, 2014

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

ENVIRONMENTAL SYSTEM ENGINEERING	**ECE61103**	**3-0-0**	**3 Credits**
Module 1: Earth and lithosphere Zonal structure of earth,Composition of crust ,Composition of mantle,Hydrologic cycle,Techtonic cycle ,Sources of water and Hydrological concepts ,Surface source and sub-surface source or underground source ,Factors governing the selection of site for a particular source of water ,Aquifers and their types ,Unconfined aquifers or non-artesian aquifers ,Confined aquifers or artesian aquifers ,Infiltration galleries,Infiltration wells ,Springs,Wells including tubewells		**[12]**	
Module 2: Intakes for collecting surface water ,Definition and general introduction , Factors governing the location of intake,Types of intakes,Intake towers,Pumps for lifting water General introduction,Types of pumps ,Roto-dynamic Pumps ,Displacement pumps Factors affecting the selection of a particular of pump Head, power and efficiency of pumps		**[10]**	
Module 3: Water supply plumbing systems in building and houses - Introduction , The house water connection, Stop cocks,Water taps and bib cocks,Pipe fittings,Storage of water in buildings,General requirement of domestic water storage,Water piping systems in building ,Hydraulic		**[10]**	

design of sewers and S.W. drain sections-Introduction ,Hydraulic formulas for determining flow velocities in sewers and drains **,** Maximum and minimum velocities to be generated in sewers,, Hydraulic characteristics of circular sewer sections running full or partially full	
Module4: Sewers, their construction, maintenance, and required appurtenances , Introduction , Forces acting on sewer pipes , Laying and testing of sewer pipes, Sewer appurtenances, Maintenance, cleaning and ventilation of sewers Sewage collection from houses and buildings, General introduction, General principles governing the design of a sanitary plumbing system, Function and types of traps being used in sanitary plumbing systems, Systems of plumbing, Choice of a particular system of plumbing, Sewerage plans of buildings and design of sewer pipes, Testing of house sewers, Sanitary fittings and other accessories, Antisiphonage pipes Wastewater recycling in buildings	**[13]**

Text Books:	
1	Santosh Kumar Garg , Sewage Disposal and Air Pollution Engineering, Environmental Engineering (Vol.II), Khanna Publishers,2013
2	Santosh Kumar Garg , Water Supply Engineering, Environmental Engineering (Vol.I), Khanna Publishers, 2014
Reference Books:	
1	S.V.S. Rana, Essentials of Ecology and Environmental Science ,Fourth Edition , 2010
2	S.V.S. Rana, Essentials of Ecology and Environmental Science ,Fourth Edition , 2012

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

ADVANCED SOIL AND FOUNDATION ENGINEERING	**ECE61105**	**3-0-0**	**3 Credits**

Module I:	**15 Lecture Hours**
An introduction: General considerations: Functions of foundations. Requisites of satisfactory foundations. Different types of foundations. Definition of shallow and deep foundation. Selection of type of foundation. Advantages and limitations of various types of foundations. Design considerations. Footings subjected to eccentric loading. Conventional procedure for proportioning footings for equal settlements. Open excavation: Open foundation excavations with unsupported slopes. Supports for shallow and deep excavations. Stress distribution in sheeting and bracing of shallow and deep excavations. Stability of bottom of excavations.	
Unit II:	**10Lecture Hours**
Shallow Foundations: Shallow Foundations: Definitions, Bearing Capacity of Footings; Terzaghi, Mayerhoffand Skempton's analysis. Effect of Rising and Lowering of Water Table on Bearing Capacity; Settlement: Permissible, Total and Differential Settlements as per IS Code. Plate Load test, Standard Penetration and Cone Penetration Tests for Determining Allowable Bearing Pressure	
Raft foundations: Bearing capacity equations. Design considerations. Conventional design procedure for rigid mat. Uplift pressures. Methods of resisting uplift. Floating foundations.	
Unit III:	**10 Lecture Hours**
Pile foundations: Uses of piles. Classification of piles based on purpose and material. Determination of type and length of piles. Determination of bearing capacity of axially loaded. Single vertical pile.Static and dynamic formulae. Determination of bearing capacity by penetration tests and pile load tests (IS methods). Negative skin friction.Group action and pile spacing.Analysis of pile groups.Load distribution by Culmann's method. Caissons and piers: Open (well) caissons. Box (floating) caissons.Pneumatic caissons. Construction details and design considerations of well foundations. Drilled piers and their constructiondetails.	
Unit IV:	**10 Lecture Hours**
Machine foundations: Machine Foundation: Design Criteria, Free and Forced Vibrations for Single Degree of Freedom systems, Undamped and Damped Case, Types of Machine Foundations.	

Reference Books

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

1. Dr.Punmia. B. C., Jain. A. K., Jain. A. K., Soil Mechanics and Foundation Engineering, 16th Edition, Laxmi Publications Pvt. Ltd.
2. B.M. Das, Principles of Geotechnical Engineering, Thomson.
3. VNS Moorthy, Principles of soil Mechanics & Foundation Engineering, UBS Publication.
4. J.E. Bowels, Foundation Analysis & Design, McGraw Hill.

GopalRanjan& A.S.R. Rao, Basic & Applied Soil Mechanics, Wiley Eastern Ltd

AIR AND NOISE POLLUTION	**ECE61107**	**3-1-0**	**4 Credits**
Module 1: Environment. Pollution, Pollution control. Concept of unpolluted air, Gaseous and vapour pollutants in atmosphere, Scales of air pollution, Primary and secondary pollutants, Ambient Air Quality, Monitoring for pollutants (SO2, NO2, O3, PAN, Particulates, Hydrocarbons, PAH's) and their health effects.			**[12]**
Module 2: Self-cleansing properties of the environment; Dilution method; Engineered Control of Air Pollutants: Control of the particulates, Control of Gaseous Pollutants, Control of Air pollution from Automobiles.			**[15]**
Module 3: Noise Pollution: Definition; Sound Pressure, Power and Intensity; Noise Measurement: Relationships among Pressure, Power and Intensity, Levels, Frequency Band, Decibel Addition, Measures of community Noise i.e. LN, Leq, Ldn,, LNP; Sources, ; Effects; Control. Stack monitoring for thermal power plant, Oil refinery industry, Fertilizer industry, Non ferrous metal industry. Recent techniques			**[18]**

of online stack monitoring, Emission inventory. Trends of AAQ in Urban, Rural and Industrial areas.		

Text Books:	
1	Santosh Kumar Garg , Sewage Disposal and Air Pollution Engineering, Environmental Engineering (Vol.II), Khanna Publishers,2013
2	S.V.S. Rana, Essentials of Ecology and Environmental Science ,Fourth Edition , 2010
Reference books:	
1	Santosh Kumar Garg , Water Supply Engineering, Environmental Engineering (Vol.I), Khanna Publishers, 2014

PROCESS CHEMISTRY FOR WATER & WASTEWATER TREATMENT	**ECE61109**	**3-1-0**	**4 Credits**
Course Content			
Module 1 **Lecture Hr. 10 + Tutorial Hr. 4**			
Basic Concepts from Equilibrium Chemistry, Chemical equilibrium and kinetics fundamentals; Acids and Bases; Buffers; Buffer index; Titrations; Solution to equilibrium problems; pC-pH diagram; Complex formation; Solubility of salts; Oxidation-reduction reaction; pE-pH diagram.			

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Module 2 **Lecture Hr. 10 + Tutorial Hr. 4**
Water and Wastewater Analysis, Basic concepts from quantitative chemistry: Gravimetric analysis; Volumetric analysis; Colorimetry; Optical methods of analysis; Chromatographic methods of analysis; Standard solutions.
Acidity; Alkalinity; Chemical coagulation and water softening, hardness; Chemistry ofchlorination, disinfection and breakpoint chlorination; Biological oxygen demand; Chemical oxygen demand.
Module 3 **Lecture Hr. 12 + Tutorial Hr. 4**
Role of Chemical Unit Processes in Wastewater Treatment ,Application of chemical unit processes; Fundamentals of chemical coagulation; nature of particles in wastewater; Development and measurement of surface charge; Particle-particle interaction; Particle destabilization with potential determining ions and electrolytes; Particle.
Module4 **Lecture Hr. 13 + Tutorial Hr. 3**
Chemical precipitation for improved plant performance: Chemical reactions in wastewater; Enhanced removal of suspended solids in primary sedimentation;

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Chemical precipitation for phosphorus removal; Chemical precipitation for removal of heavy metals and dissolved inorganic substances.	
Text Books:	
1	Sawyer, C.N., McCarty, P.L. and Parkin, G.F. Chemistry for Environmental Engineering and Science, 5th Edition, McGraw-Hill, Inc., New York, 2003.
2	Manahan, S.E. Fundamentals of Environmental Chemistry, Lewis Publishers, Inc., Boca Raton, 1993.
3	Stumm, W and Morgan, J.J. Aquatic Chemistry: An Introduction emphasizing chemical equilibrium in natural waters, 2nd Edition, Wiley Intersciences, New York.
Reference Books:	
1	Metcalf and Eddy, Inc. Wastewater Engineering:

	Treatment and Reuse, 4th Edition, McGraw-Hill, Inc., New York, 2002

Course Content

Experiment No.1: Determination of pH of the waste water sample
Experiment No.2: Determination of TS, TDS and TSS of the waste water sample
Experiment No.3: Determination of alkanity of the waste water sample
Experiment No.4: Determination of iron concentration of the waste water sample
Experiment No.5: Determination of hardness of the waste water sample
Experiment No.6: Determination of chloride concentration of the waste water sample
Experiment No.7: Determination of fluoride concentration of the waste water sample
Experiment No.8: Determination of BOD_3& BOD_5 of the waste water sample
Experiment No.9: Determination of DO of the waste water sample
Experiment No.10: Determination of COD of the waste water sample
Experiment No.11: Wastewater analysis (TKN, Oil & Grease, Surfactant and Heavy metals).

Text Books:	
1	APHA, "Standard Methods for the Examination of Water and Wastewater", 21st Ed. Washington, 2005.
2	"Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist, H. – Second Edition, VCH, Germany, 1992.
Reference books:	
1	Lab Manuals.

AIR AND NOISE POLLUTION LAB	**ECE61203**	**0-0-3**	**2 Credits**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Course Content

Experiment No.1: Demonstration of air pollution monitoring instruments.
Experiment No.2: Determination of SPM; PM10; SO2; ammonia and NOx in ambient air.
Experiment No.3: Respirable dust monitoring by RDS and FPM.
Experiment No.4: Demonstration of stack monitoring kits.
Experiment No.5: Demonstration of Indoor air quality CO, VOC and aerosol monitors.
Experiment No.6: Determination of atmospheric stability class using portable anemometers.
Experiment No.7: Development of wind rose diagram.
Experiment No.8: Demonstration of noise pollution monitoring equipment; namely modular precision sound level meter, noise dose meter, human vibration monitoring instrument, audiometer, etc.
Experiment No.9: Noise survey in a multiple noise sources situation in order to develop noise contour diagram for the entire locality.
Experiment No.10: Noise monitoring at residential localities.
Experiment No.11: Traffic noise situation monitoring; human vibration monitoring (whole body as well as hand-arm vibration).

Text Books:	
1	Henry C. Perkins,"Air Pollution & Control", Mc Graw Hill Pvt. Ltd., New Delhi, 1974.
2	Stern A. C., "Air Pollution" (Vol-I), "Air Pollution & it effects" (Vol-II), "Analysis, Moniturin& Surveying" (Vol-III), "Sources of Air Pollution & their Control" Academic Press, New York, 1968.
3	Environmental Noise Pollution - PE Cunniff, McGraw Hill, New York, 1987.
4	Handbook of Noise Measurement - APG Peterson & EE Gross, General Radio Co., West Concord, Mass, 1967.
5	Air Pollution Control Equipment – H Brauer and YBG Verma, Berlin Heidelberg, New York, latest edition, 1981.

COLLOQUIUM-I	**ECE61301**	**0-0-3**	**2 Credits**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Each student will present a seminar on an assigned problem in the First Semester. The problem will be given to the student at the beginning of the Semester and the work will be continued throughout the Semester. The student will be required to give a write up and present a seminar in the First Semester.

CIVIL-TECHNICAL REPORT WRITING	**ECE61303**	**0-0-3**	**2 Credits**

Technical report is a vital tool for engineers to communicate their ideas. This course introduces technical report writing and teaches the techniques that need to construct well-written engineering reports.

Each week, it will look at a key section of a technical report and the skills needed to write it. It will cover areas such as referencing and citations; presenting equations; diagrams and data; and using language and tenses correctly.

It will also talk to practicing engineers, as well as students and educators who write and mark technical reports, who'll give their hands-on advice.

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ADAMAS UNIVERSITY
M.TECH IN ENVIRONMENTAL ENGINEERING
SEMESTER – II

BIOLOGICAL PROCESSES FOR ENVIRONMENTAL ENGINEERING	**ECE61102**	**3-1-0**	**4 Credits**
Module 1: Microbiological concepts**:** Cells, classification and characteristics of living organisms, reproductions, metabolisms - basic metabolic models, microbial growth kinetics.		**[24]**	

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Chemistry of carbohydrates- carbohydrates , proteins, fats , lipids Theory and design of biological unit operation, aerobic suspended growth systems – activated sludge processes , its modifications, ponds and lagoons	
Module 2: Aerobic attached growth systems , Aerobic attached growth systems , anaerobic suspended and attached systems . Biological nutrient removal, Sequential Batch Reactors. Sludge- Theory and design of sludge treatment, Wastewater disposal systems.	**[21]**

Text Books:	
1	Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, TMH publication, 4th Edition, 2003. .
2	Heritage, J., Evans, E. G. V. and Killington, R. A., Introductory Microbiology, Cambridge Univ. Press, 1996.
Reference Books:	
1	Benefield, L. D. and Randall, C. W., Biological Principles in Wastewater Treatment, Prentice- Hall, 1980.

2	Grady, C. P. L., Daigger, G. T. and Lim, H. C., Biological Wastewater Treatment, Marcel Dekker, Inc., New York, 2nd Edition, 1999.

ADAMAS UNIVERSITY
M.TECH IN ENVIRONMENTAL ENGINEERING
SEMESTER – II

SOLID HAZARDOUS AND WASTE WATER MANAGEMENT.	**ECE61104**	**3-1-0**	**4 Credits**
Module 1: Introduction Waste Generation and Management in a Technological Society , Issues in Solid Waste Management , Integrated Waste Management , Implementing Integrated Waste Management Strategies, Typical Costs for Major Waste Management Option. Federal Role in Municipal Solid Waste Management Resource Conservation and Recovery Act, Clean Air Act, Clean Water Act, Federal Aviation Administration Guidelines , Flow Control Implications.		**[12]**	
Module 2: Solid Waste State Legislation –		**[16]**	

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Introduction ,Trends in Municipal Waste Generation and Management ,The Waste Reduction Legislation Movement ,The Effect of Legislation ,State Municipal Solid Waste Legislation ,State Planning Provisions ,Permitting and Regulation Requirements ,Waste Reduction Legislation , Establishing Waste Reduction Goals Legislating Local Government Responsibility. Solid Waste Stream flow and its Characteristics- Municipal Solid Waste Defined , Methods of Characterizing Municipal Solid Waste Materials in Municipal Solid Waste by Weight , Products in Municipal Solid Waste by Weight , Municipal Solid Waste Management , Discards of Municipal Solid Waste by Volume	
Module 3: Planning for Municipal Solid Waste Management Programs State Solid Waste Management Planning, Local and Regional Solid Waste Management Planning. Source Reduction: Quantity and Toxicity- Introduction ,Effects of Source Reduction Involvement by Government ,Developing a Source Reduction Plan ,Strategies for, Source Reduction, The Toxicity of Trash ,Waste Management Policy , Product Management Policy	**[10]**
Module4: Collection of Solid Waste and Recycling The Logistics of Solid Waste Collection. Types of Waste Collection Services. Types of Collection	**[7]**

Systems, Equipment, and Personnel Requirements *Collection* Routes. Management of Collection Systems. Overview of Recycling. Recovery of Recyclable Materials from Solid Waste 8.3 Development and Implementation of Materials Recovery Facilities. Unit Operations and Equipment for Processing of Recyclables ,Environmental and Public Health and Safety Issues	

Text Books:	
1	Santosh Kumar Garg , Sewage Disposal and Air Pollution Engineering, Environmental Engineering (Vol.II), Khanna Publishers,2013
2	Santosh Kumar Garg , Water Supply Engineering, Environmental Engineering (Vol.I), Khanna Publishers, 2014
Reference Books:	
1	S.V.S. Rana, Essentials of Ecology and Environmental Science ,Fourth Edition , 2010
2	S.V.S. Rana, Essentials of Ecology and Environmental Science ,Fourth Edition , 2012

ADAMAS UNIVERSITY
M.TECH IN ENVIRONMENTAL ENGINEERING
SEMESTER – II
ELECTIVE-II

INDUSTRIAL WASTEWATER POLLUTION CONTROL	**ECE61106**	**3-0-0**	**3 Credits**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Module 1: Industrial wastewater- Types, amount and effects Introduction , Types of industrial wastewater, Inorganic industrial wastewater, Organic industrial wastewater, Amount of industrial wastewater, Effect of industrial wastewater, Effect of inorganic pollutants from industrial wastewater, Effect of organic pollutants from industrial wastewater, Other factors related to the effect of industrial wastewater Industrial pollution prevention and waste minimization Prevention and control of industrial pollution- Benefits and barriers, Waste management hierarchy , Source reduction techniques, Periodic waste minimization assessment, Evaluation of pollution prevention options, Cost benefit analysis- payback period, Implementing and promoting pollution prevention programs in industries	**[12]**
Module 2: Industrial wastewater treatment - Flow and load equalization, Solid separation-removal of fats, oil and grease Neutralization-removal of inorganic constituents-precipitation , Heavy metal removal, Nitrogen and phosphorus removal , Ion exchange, Adsorption-membrane filtration, Electro dialysis and evaporation- Removal of organic constituents, Biological treatment processes, Chemical oxidation processes, Advanced oxidation processes.	**[18]**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Wastewater reuse and residual management- Individual and common effluent treatment plants, Joint treatment of industrial and domestic wastewater, Zero effluent discharge system, Quality requirement for wastewater reuse, Industrial reuse, Present status and issues, Disposal on water and land, Residuals of industrial wastewater treatment, Quantification and characteristics of sludge, Thickening, digestion, conditioning, dewatering and disposal of sludge, Management of RO rejects	
Module 3: Case studies - Industrial manufacturing process description, Wastewater characteristics, Source reduction option and waste treatment flow sheets for textiles-Tanneries-pulp and paper, Metal finishing-oil refining-pharmaceuticals-sugar and distilleries	**[15]**

Text Books:	
1	Eckenfelder, W. W., Industrial Water Pollution Control, McGraw-Hill, 2000..
2	Nemerow, N. L and Dasgupta, A., Industrial and Hazardous Waste Treatment, Van Nostarnd Reinhold (New York), 1988.
Reference Books:	
1	Nemerow, N. L., Zero Pollution for Industry: Waste Minimization through Industrial Complexes, John Wiley & Sons, 1995. 9
2	Clesceri, L. S., Greenberg, A. E. and Eaton, A. D., Standard Methods for the Examination of Water and Wastewater, Washington, D.C., 20 th Ed., 1998.

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

ENVIRONMENTAL IMPACT ASSESSMENT	**ECE61108**	**3-0-0**	**3 Credits**

Course Content
Module 1 **Lecture Hr. 10**
Definition of Terms: Conventions and protocols; Policy; law; acts and rules; Administrative and legal interpretations; Codes and specifications.
Overview of Environmental Legislation: Overview of Indian environmental law; Pollution control boards – Powers; functions and Procedures.
Module 2 **Lecture Hr. 11**
Provisions of: Water Act; Water-cess Act; Air Act; Environmental Protection Act;
Public Liability Insurance Act as Applicable to Industry: Provisions relating to Environmental clearance; Environmental sampling, analysis and reporting of results; Environmental standards; Overview of other key environmental regulations- Municipal solid waste rules; Biomedical waste rules; Hazardous waste, microorganisms, and chemicals rules.
Module 3 **Lecture Hr. 12**
Legal Aspects of EIA: EIA notification; Environmental clearance process - Screening; scoping; public consultation and appraisal; Objectives and scope of EIA; EIA process flow chart.
Module 4 **Lecture Hr. 12**
EMP (Environmental Management Plan) and EIA Documentation: Principles and Elements of approach; identification and mitigation of environmental impacts: types and structure of EIA documents.

Reference books:	
1	CPCB, Pollution Control Law Series - PCL/2/2001; Central Pollution Control Board (http://envfor.nic.in/cpcb/cpcb.html).
2	Jain R and Clark A, Environmental Technology Assessment and Policy; Ellis Harwood (1989)
3	EIA notification, Gazette Notification: SO 1533 dated 14-09-2006; MOEF. GOI (2006).

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering
Elective -III

NUMERICAL METHODS	**ECE61110**	**3-0-0**	**3 Credits**
Module 1: 1. Error Approximation 1.1 Approximation of errors 1.2 Round of errors 1.3 Truncation errors 1.4 Taylor Series 2. Root determination 2.1 Determination of roots of polynomials 2.2 Determination of roots of transcendental equations 2.3 Newton-Raphson method 2.4 Secant method 2.5 Bairstow's method			**[10]**
Module 2: **1. Curve fitting** **1.1** Linear regression analysis.			**[11]**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

1.2 Nonlinear regression analysis **2. Difference relations** 2.1 Backward difference relations, 2.2 Forward difference relations 2.3 Central difference relations and their uses Uses of difference relations.	
Module 3: **1. Numerical Differentiation** 1.1 Introduction 1.2 Unequally Spaced Data 1.3 Taylor Series Approach. 1.4 Difference Formulas 1.5 Error Estimation 1.6 Extrapolation. **2. Numerical Integration** 6.1 Introduction 6.2. Direct Fit Polynomials 6.3. Newton-Cotes Formulas 6.4 Extrapolation and Romberg Integration 6.5. Adaptive Integration 6.6. Gaussian Quadrature 6.7. Multiple Integrals	**[12]**
Module 4: 1. Ordinary differential equation 1.1 Introduction 1.2 General Features of Ordinary Differential Equations 1.3 Classification of Ordinary Differential Equations 1.4 Classification of Physical Problems 1.5 Initial-Value Ordinary Differential Equations	**[12]**

1.6 Boundary-Value Ordinary Differential Equations 2. Partial differential equation 2.1 Introduction 2.2 General Features of Partial Differential Equations 2.3 Classification of Partial Differential Equations 2.4 Classification of Physical Problems 2.5 Elliptic Partial Differential Equations 2.6 Parabolic Partial Differential Equations	

Text Books:	
1	Joe D. Hoffman, Numerical methods for Engineers and Scientists, Revised Second Edition
2	J. B. Scarborough, Numerical mathematical analysis, Oxford & IBH Publishing CO Pvt
Reference books:	
1	K. K. Jain, S. R. K Iyengar and R. K. Jain Numerical methods-problem and solutions, Wiley eastern limited.
2	R.W. Hamming, Numerical methods for scientist and engineers, McGraw Hill.

ADAMAS UNIVERSITY
M.TECH IN ENVIRONMENTAL ENGINEERING
Elective -III

OPTIMIZATIONME	**ECE61112**	**3-0-0**	**3 Credits**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

THODS		
Module 1: Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers. Linear Programming Problem, Simplex method, Concept of Duality		**[12]**
Module 2: Single Variable Optimization Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method. Application to Root finding		**[10]**
Module 3: Multivariable Optimization Algorithms Optimality Criteria, Unidirectional Search. Direct Search Methods: Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method. Gradient Based Methods: Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method		**[10]**
Module 4: Further Topics in Optimization Techniques Quadratics Programming, sequential Department of Mathematics, quadratic programming, Integer Programming, Penalty Function Method, Branch and Bound Method, Geometric Programming, Dynamic programming; Genetic algorithm.		**[13]**

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering

Text Books:	
1	S. S. Rao: Engineering Optimization, New Age International.
2	E. J. Haug and J.S. Arora, Applied Optimal Design, Wiley, New York.
Reference books:	
1	Kalyanmoy Deb, Optimization for Engineering Design, Prentice Hall of India.
2	A. Ravindran and K.M. Rogsdeth, Optimization G.V. Reklaites, Wiley, New York**.**

DESIGN OF ENVIRONMENTAL ENGINEERING SYSTEMS	**ECE61202**	**0-0-3**	**2 Credits**

Course Content:

Experiment 1: Development and Evolution of ecosystems- Principles and concepts.

Experiment 2: Energy flow and material cycling-productivity- classification of eco-technology-ecological engineering.

Experiment 3: Classification of systems-Structural and functional interactions of environmental systems-Mechanisms of steady-state maintenance in open and closed systems.

Experiment 4: Modeling and eco-technology- Classification of ecological models-Applications-Ecological economics-Self –organizing design and processes-Multi seeded microcosms.

Experiment 5: Interface coupling in the ecological systems- concepts or energy-determination of sustainable loading of ecosystems.

Experiment 6: Eco-Sanitation- soil infiltration systems-Wetlands and ponds-Source Separation systems-Aqua cultural systems-Agro ecosystems-Detritus based Treatment for solid wastes –marine systems.

Experiment 7: Case Study 1.

Experiment 8: Case Study 2.

Text Books:	
1	Ecological Engineering: Principlesand Practice, Kangas, P.C and Kangas, P., Lewis Publishers, New York (2003).
2	Ecological Engineering for Wastewater Treatment, Etnier, C. and Guterstam, B., Lewis Publishers, New York (1996).
Reference books:	
1	Basic Ecology, E .P. Odum, H.S Publication (1983).
2	Energy and Ecological Modelling,W.J Mitch, R. W. Bosserman and KlopatekJN,Elsevier Publication (1981).

COLLOQUIUM-II	**ECE61302**	**0-0-3**	**2 Credits**

Each student will present a seminar on an assigned problem in the second Semester. The problem will be given to the student at the beginning of the Semester and the work will be continued throughout the Semester. The student will be required to give a write up and present a seminar in the second Semester.

ECE62401, ECE62501, ECE62402, ECE62502:

Dissertation is a document submitted in support of candidature for an academic degree or professional qualification presenting the author's research and findings. In M.Tech , each student has to submit their final copy of research in Hard Binding form.

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING & TECHNOLOGY
M.Tech in Environmental Engineering