UNIVERSITY OF CALICUT
(Abstract)

Faculty of Engineering – Regulations, scheme & Syllabi of M.Tech Courses – implemented with effect from 2010 admn onwards - Orders Issued.

GENERAL AND ACADEMIC BRANCH - IV 'E' Section

GAIV/E1/AC / 03.07.2010 Dated, Calicut University.P.O., 27-08-2010.

Read:- 1) U.O. No. GAI/D4/4085/2003 dated, 21.11.2009.
2) Minutes of the meeting of the BOS in Engineering (PG) held on 10.12.2009 and 28.01.2010.
3) Minutes of the meeting of the faculty of Engineering held on 28.01.2010.
4) Minutes of the meeting of the Academic Council held on 03.07.2010.

ORDER

As per paper read 1st, Provisional affiliation was granted to start a new course in M.Tech Machine Design in Nehru College of Engineering & Research Centre, Pampady.

As per the paper read 2nd, the Board of Studies in Engineering (PG) framed, formulated and approved the syllabi of M.Tech in Machine design for 2010-2011. The Board of Studies also framed the revised M.Tech regulations, scheme and Syllabi of the following M.Tech Courses for the year 2010-2011.

1) Environmental Engineering
2) Production Engineering
3) Thermal Systems
4) Power Systems
5) Chemical Process Control
6) Embedded Systems

As per the paper read 3rd, the meeting of the faculty of Engineering approved the decision of the Board of Studies held on 10.12.2009 and 28.01.2010 and approved the revised M.Tech regulations and scheme and syllabi of the above M.Tech Courses.

The faculty also recommended the following in the revised regulations of M.Tech in the case of self financing colleges that there should be sufficient qualified faculty members and sufficient infrastructure in self financing colleges as recommended by All India Council for Technical Education.

As per paper read 4th, the meeting of the Academic Council held on 03.07.2010, approved the decisions of the Board of Studies held on 10.12.2009 and 28.01.2010 and the minutes of the faculty of Engineering held on 28.01.2010 for implementing the regulations and scheme and syllabi of the above M.Tech courses with effect from 2010 admission.

Contd…..2

Sanction has therefore been accorded for implementing the revised M.Tech regulations and Scheme & Syllabi of the following M.Tech Courses with effect from 2010 admission onwards.

1) Environmental Engineering
2) Production Engineering
3) Thermal Systems
4) Power Systems
5) Chemical Process Control
6) Embedded Systems
7) Machine design

Orders are issued accordingly, (regulations, scheme & Syllabi appended)

Sd/-
DEPUTY REGISTRAR (G & A-IV)
For REGISTRAR

To

The Principals of all affiliated
Engineering Colleges where M.Tech. courses are offered

Copy to:

PS toVC / PA to Reg./
PA to CE/ DR ; AR - B.Tech Branch /
PRO/GAI A Sn./ SF / FC.

Forwarded / By Order

Sd/-
SECTION OFFICER

UNIVERSITY OF CALICUT

M.Tech. DEGREE COURSE
ENVIORNMENTAL ENGINEERING-2010

Curricula, Scheme of Examinations and Syllabi
(With effect from 2010 admissions)

Scheme of M.Tech Programme in Environmental Engineering

SEMESTER 1

Sl no	Course code	Subject	Hours/week			ICA	ESE	Total
			L	T	P			
1	CEE10 101	Applied Statistics	3	1	0	100	100	200
2	CEE10 102	Environmental Chemistry	3	1	0	100	100	200
3	CEE10 103	Environmental Microbiology	3	1	0	100	100	200
4	CEE10 104	Physicochemical methods in Environmental Engineering	3	1	0	100	100	200
5	CEE10 105	Elective	3	1	0	100	100	200
6	CEE10 106(P)	Seminar	0	0	2	100		100
7	CEE10 107(P)	Advanced Environmental Engineering Lab-I	0	0	2	100		100
Total			15	5	4	700	500	1200

ELECTIVES

CEE10 105A Industrial Water Pollution Control
Solid and Hazardous Waste
CEE10 105B Management
CEE10 105C Instrumental Methods in Environmental Engineering

Note: Remaining 6 hours / week is meant for departmental assistance by students

L-Lecture T-Tutorial P-Practical ESE-End Semester Examination

SEMESTER 2

Course code	Subject	Hours / week			ICA	ESE	Total	Credits
		L	T	P				
CEE10 201	Biological methods in Environmental Engineering	3	1	0	100	100	200	4
CEE10 202	Air Quality Management and Meteorology	3	1	0	100	100	200	4
CEE10 203	Environmental Impact Assessment	3	1	0	100	100	200	4
CEE10 204	Elective I	3	1	0	100	100	200	4
CEE10 205	Elective II	3	1	0	100	100	200	4
CEE10 206(P)	Seminar	0	0	2	100		100	2
CEE10 207(P)	Advanced Environmental Engineering Lab-II	0	0	2	100		100	2
	TOTAL	15	5	4	700	500	1200	24

Elective I

CEE10 204A Water Pollution Control and Stream Sanitation
CEE10 204B Environmental Health and Hygiene
Environmental Systems
CEE10 204C Analysis

Elective II

CEE10 205A Advanced Hydrology and water resources engineering
CEE10 205B Groundwater Contamination and Pollution Transport
CEE10 205C Environmental Geology
Note: Remaining 6 hours / week is meant for departmental assistance by students

SEMESTER 3

Sl no	Course code	Subject	Hours/Week			ICA	ESE	Total	C
			L	T	P				
1	CEE10 301	Elective I	3	1	0	100	100	200	
2	CEE10 302	Elective II	3	1	0	100	100	200	
3	CEE10 303(P)	Industrial Training	0	0		0	50	50	
4	CEE10 304(P)	Master Research Project Phase-I	0	0	22	300		300	
	TOTAL		6	2	22	500	250	750	

ELECTIVE I
CEE10 301A Research Methodology

	GIS and Remote
CEE10 301B	Sensing
CEE10 301C	Numerical Methods

ELECTIVE II

	Planning and Design of Environmental
CEE10 302A	Facilities
	Environmental
CEE10 302B	Legislation
CEE10 302C	Bioremediation Principles and Applications
CEE10 302D	Envirionmental Biotechnology

Note: Remaining 6 hours / week is meant for departmental assistance by students

SEMESTER 4

Sl no	Course code	Subject	Hours/ Week			Internal Evaluation		ESE		Total	Credits
			L	T	P	Guide	Evaluation committee	External Examiner	Viva Voce		
1	CEE10 401(P)	Master Research Project Phase-II	0	0	30	150	150	150	150	600	12

* The student has to undertake the departmental work assigned by Head of the Department

	Credits	Marks
Grand Total	**75**	**3750**

SEMESTER 1

CEE10 101: APPLIED STATISTICS

Credits: 4

Hours per week: Lecture-3 and Tutorial-1

Objective: ***To enable the students apply statistics in various areas of environmental engineering like sampling and analysis, stochastic modeling etc.***

MODULE 1

Probability Distributions: Probability mass functions and probability density function, mean and variance. Binomial, Poisson, Exponential, Gamma, Lognormal and normal distribution: Fitting of the distributions.

MODULE 2

Sampling techniques: Simple random sampling, stratified sampling, systematic sampling, sample size determination- application in Environmental Engineering

Regression and correlation: Linear Regression and correlation, multiple correlation coefficient, standard error of estimate, curvilinear regression- Applications.

MODULE 3

Statistical inference: Intervals estimation, Confidence interval for mean, variances and regression coefficients. Sampling Distribution, Test of significance of (i) Means (ii) Mean of two samples (iii) Proportions (iv) Variance (v) Two variances (vi) Two observed correlation coefficients (Fishers' z-transformation), (vii) Paired T-test (viii) Regression coefficients (ix) Chi-square test of goodness of fit, Skewness and Kurtosis tests.

MODULE 4

Applications: Analysis of variance (i) Completely randomized designs (ii) Randomized block designs. Latin squares. Grecco Latin square design. Factorial experiments. Graphical presentation techniques.

Time Series Models: Components of time series-smoothing- Measuring forecasting accuracy-Testing of ARIMA Models.

References:

1. Gupta.S.C. and Kapoor.V.K, Fudamentals of Mathematical Statistics, Sultan Chand and Sons, 1978.
2. Benjamin, Jack.R and Comell.C, Allin, Probability, Statistics and Decision for Civil Engineers, Mc-Graw Hill.
3. Kadiyali.L.R, Traffic Engineering and Transport Planning, Khanna Publishers.
4. Wohl, Martin and Martin, Brian.V, Traffic Systems analysis for Engineers and Planners, Mc-Graw Hill.
5. Richard.A. Johnson: Miller and Freunds, Probability and Statistics for Engineers (6^{th} edition)
   Pearson.
6. Elhance: fundamentals of Statistics.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suit best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 102: ENVIRONMENTAL CHEMISTRY

Credits: 4

Hours per week: Lecture-3 and Tutorial-1

Objective: ***To bring into focus those aspects of chemistry that are particularly valuable for solving environmental problems like water and wastewater analysis***

MODULE 1

Physical Chemistry- Introduction-solutions-normal, molar and molal solutions - vapour pressure, Henry's law, Graham's law, Rault's law- Law of mass action - chemical equilibrium, LeChatelier's principle – basic concept of chemical kinetics – Osmosis – Principle of solvent extraction – distribution coefficient, adsorption – Type of adsorptions – Theory of ionization, pH and buffers – Henderson Hasselbalch's equation – Colloids and their classification, Properties and their stability – Colloidal dispersions – Zeta potential – destruction of colloids – basic method of coagulation, different colloidal dispersions.

MODULE 2

Radioactivity – Atomic structure and radio active isotopes – isotopes and isobars – energetics of radiations – units of radio activity – nuclear reactions associated with atomic change – nuclear fusion and fission – use of radioactive materials as tracers – radioactive waste management – assessment and control of environmental hazards from radioactive substances – disposal methods of radioactive waste

Chemistry of water and waste water – water pollution – pollutants in water – determination of water quality parameters like pH, alkanility, BOD, COD, hardness, lethal doses of pollutants – sulphides, chlorides, Ca, Mg, and analysis of minerals Fe, Mn, Ca, Mg in water.

MODULE 3

Organic chemistry – Chemistry of various carcinogenic organic compounds like poly aromatic hydrocarbons, pesticides like DDT, BHC, aflatoxins, food dyes, anticarcinogens – phenolic antioxidants, flavones, indoles, retinoids, vitamin C surfactants – Cationic, anionic and non ionic detergents, modified detergents.

Pesticides: Classification, degradation, pollution due to chlorinated pesticides.

MODULE 4

Chromatography – thin layer and paper – gas – adsorption – partition – ion exchange – exclusion – electro chromatography – ion chromatography and HPLC.

Chemical toxicity – identification through chromatography – spectro analytical methods – IR, UV and visible – atomic absorption, atomic emission and mass spectroscopy (instrumentation details and analysis)

References:

1. Clair N.Sawyer, Pery L.McCarty - Chemistry for Environmental Engineering (Mc Graw Hill)
2. APHA – Standard methods for the examination of water and waste water.
3. P.K.Ray – Pollution and health (Wiley Eastern Ltd)
4. S.K.Banerjee – Environmental Chemistry.
5. Chatwal and Anand – Instrumental methods of analysis (Dhanpat Rai)

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 103: ENVIRONMENTAL MICROBIOLOGY

Credits: 4

Hours per week: Lecture-3 and Tutorial-1

Objective: ***To understand the fundamentals of biological treatment process in environmental engineering***

MODULE1

Introduction to microbiology - microorganism and their characteristics- classification and application in sanitary engineering. General characteristics of the bacteria, algae, fungi, protozoa, viruses, rickettsiae, chlamydiae.

Principles and use of light microscopes-dark field, bright field, phase contrast and fluorescent. Electron microscopes- Scanning and Transmission type.

MODULE 2

Characteristics of bacteria -observation of wet and stained preparation - Grams stain.

Growth of bacteria, growth curve factors influencing growth aerobic and anarobic growth-role of enzymes, mechanism of action and factors influencing enzyme action-basic concepts of metabolism.

Culture media, composition, classification.

MODULE 3

Microbiology of water, wastewater, soil and air - water borne diseases and their causative organisms, bacteriological analysis of water and sewage, test for coliforms, their significance, bacteriological standards, MPN and membrane filter technique.

Importance of sterilization, factors influencing sterilization, principles and methods

MODULE 4

Microbial production of industrial products, principles of bio technology applied to waste treatment, waste utilization, bio-energy conversion, biogeochemical cycling, diary microbiology-diseases transmitted through milk

References

1. Rose E Mckanney. Microbiology for sanitary engineers-
2. Gamey and Lord. Microbiology for waste water and sewage
3. Pelczhar and Reid. Test book of microbiology.
4. Standard methods . APHA.
5. Roger T Stainer and Michael Dandroff. General Microbiology.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suit best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 104: PHYSICOCHEMICAL METHODS IN ENVIRONMENTAL ENGINEERING

Credits: 4

Hours per week: Lecture-3 and Tutorial-1

Objective: ***To make the students understand the principles of physico-chemical treatment methods in Environmental Engineering.***

MODULE1

Process dynamics-Reactions and Reactors- Mechanics of mass transport-reactions and energetics-kinetics and reaction rates-reactor engg. and process design.

Screenings-types of screens-head loss in screens

Equalization process-types of equalization process-volume of equalization basins

MODULE 2

Sedimentation-sedimentation processes- types of settlings- tube settlers-design of sedimentation tanks

Coagulation and flocculation- coagulation processes-stability of colloids-destabilisation of colloids in water and wastewater treatment-transport of colloidal particles

Floatation and aerosol separation-methods of floatation-gas particle contact-dissolved air floatation.

Filtration-filtration processes-filter media- types of filters-mechanisms of filtration-hydraulics of filtration-filter problems -effluent quality-design of filters

MODULE 3

Disinfection-processes-methods of disinfection-factors influencing-nonchemical methods-details of chlorination-other disinfectants.

Adsorption-adsorption process-adsorption isotherm-adsorption kinetics-factors influencing-design of adsorption units

Ion exchange- process-materials-exchange reactions-application in water and wastewater treatment-design of units

Membrane process-Reverse osmosis-electrodialysis-ultra filtration-membrane properties-process design

Chemical oxidation-principles and theories-generation and application of chemical methods

MODULE 4

Sludge treatment-characteristics of sludge-dewatering methods-conversion process-anaerobic and aerobic digestion-combustion-disposal, of sludge.

References

1. Weber W. J. Physico-chemical processes for water quality control (Wiley Inter-science,1972)
2. Rich L. G. Unit operations of sanity engineers (Wiley Topan)
3. Fair G. M Etal- Water and wastewater engg
4. Stermm,W & Morgan J. J.-Aquatic chemistry
5. Halfferic F.- Ion Exchange

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

emester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module I

Question 1 : 20 marks

Question 2 : 20 marks

Module II

Question 3 : 20 marks

Question 4: 20 marks

Module III

Question 5 : 20 marks

Question 6: 20 marks

Module IV

Question 7 : 20 marks

Question 8: 20 marks

CEE10 105: ELECTIVE

CEE10 105A INDUSTRIAL WATER POLLUTION CONTROL

Credits: 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To provide information regarding different elements of water pollution and methods of treatment. Also to expose students to the various industrial processes and the origin, characteristics and treatment of waste water generated.

MODULE 1

Damages caused by industrial pollution- Effects of industrial waste on stream- Effects of industrial waste on sewage treatment plants- Study of some typical problem caused by industrial pollution in India – Need for environment impact assessment for major industries.

MODULE 2

Volume reduction of industrial waste- strength reduction of industrial waste- neutralization- equalization and proportioning

Joint treatment of raw industrial waste with domestic sewage- Joint treatment of partially treated industrial waste with domestic sewage – Discharge of treated waste to municipal sewers- Stream protection measures.

MODULE 3

Industrial manufacturing process of the following industries-Textile mills, Dairy plant, Canneries, Distilleries, Fishing industry, Sugar mills , Pulp and paper mills, Rubber industry, Metal plating industry, Oil refineries, Petrochemicals, Fertilizer plant, steam power plant-origin of radioactive wastes.

MODULE 4

Characteristics of waste, waste management and treatment methods in the following industries-Textile mills, Dairy plant, Canneries, Distilleries, Fishing industry, Sugar mills , Pulp and paper mills, Rubber industry, Metal plating industry, Oil refineries, Petrochemicals , Fertilizer plant, steam power plant-management and disposal of radioactive wastes.

References

1. N.L. Nemerrow –Theories and practices of Industrial Waste Engineering.
2. C.G. Gurnham –Principles of Industrial Waste Engineering.
3. M.N. Rao and Dutta – Industrial Waste.
4. Berne F. – Industrial Waste Treatment

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 105B SOLID AND HAZARDOUS WASTE MANAGEMENT

Credits: 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To provide information regarding different elements of land pollution, various hazardous wastes, their origin, characteristics and treatment.

MODULE 1

Legal and Organizational foundation: Definition of solid waste-waste generation in a technological society- major legislation, monitoring responsibilities, sources and types of solid waste- sampling and characterization- Determination of composition of MSW- storage and handling of solid waste- Future changes in waste composition.

Collection and transport of solid waste: Collection of Solid waste: type of waste collection systems, analysis of collection system- alternative techniques for collection system.

MODULE 2

Separation and Processing and Transformation of Solid Waste: unit operations used for separation and processing, Materials Recovery facilities, Waste transformation through combustion and anaerobic composting, anaerobic methods for materials recovery and treatment- Recycling of pastic materials and metals. Energy recovery – Incinerators. Transfer and Transport: need for transfer operation, transport means and methods, transfer station types and design requirements. Landfills: Site selection, design and operation, drainage and leachate collection systems – requirements and technical solutions, designated waste landfill remediation – Integrated waste management facilities.

MODULE 3

Hazardous waste management: Definition and identification of hazardous wastes- sources and characteristics- hazardous wastes in Municipal Waste- Hazardous waste regulations – minimization of Hazardous Waste – compatibility, handling and storage of hazardous waste- collection and transport.

MODULE 4

Hazardous waste treatment and design: Hazardous waste treatment technologies – Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Biomedical waste disposal.Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation – remediation of hazardous waste disposal sites.

References

Technobanoglous et al –Integrated Solid Waste Management, McGraw- Hill
Charles A. Wentz – Hazardous Waste Management, McGraw- Hill

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 105C INSTRUMENTAL METHODS IN ENVIRONMENTAL ENGINEERING

Credits: 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To provide information regarding principles and details of quantitative analysis of different parameters present in water and air.

MODULE 1

Instrumental methods in environmental engineering, analytical methods, chemical, instrumental and biological methods. Analytical instruments and process instruments, sensors, body of the instrument, read out, accuracy, precision, sensibility, range, resolution. Transducers, measurement of nonelectrical quantities like pressure, temperature, displacement, velocity, acceleration etc. strain gauge and its applications, use of microprocessors in instrumentation.

MODULE 2

Potentiometer: pH meter, ion selective electrodes, redox potential. Polarographic analysis, photometry, DO meter, conductivty, coulometry and its applications.

Optical methods of analysis: absorption and emission methods, visible spectrum photometer, U.V. Spectrometer, infrared spectrometer, flame photometer, atomic absorption spectrophotometer. X-ray diffraction method, mass spectrometer, methods using microscopy, refractrometric method.

MODULE 3

Dispersion and scattering: turbidimetry and nephelometry, fluorimetry. Thermal conductivity method , radioactivity methods, sound absorption method.

MODULE 4

Chromatography: general principles and specific techniques-thin layer, column, liquid, high performance, ion etc. Air and water pollution control instrumentation, computer aided analysis, process instrumentation and control in lab and pilot experiments. Process Control Instrumentation: basic design concepts for air ,water and waste water treatment process instrumentation

References:

Sawyer and McCarty-Chemistry for environmental engineering,McGraw Hill
Kemmer-The NALCO Water Handbook,McGraw Hill

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 106(P): SEMINAR

Credits:2

Hours per week 2

Objective: To assess the debating capability of the student to present a technical topic. Also to impart training to students to face audience and present their ideas and thus creating in them self esteem and courage that are essential for engineers.

Individual students are required to choose a topic of their interest from Environmental Engineering related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Environmental Engineering) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Internal continuous assessment: 100 marks

CEE10 107(P): ADVANCED ENVIRONMENTAL ENGINEERING LAB - I

Credits: 2

Hours per week: 2

Objective ***To analyse the characteristics of water/wastewater samples***

Sampling - Taking Grab and composite samples.

Physical characteristics of water/wastewater – Turbidity, electrical conductivity, solids

Chemical analysis of water – determination of ions by colorimetric, volumetric analysis, preparation of standards BOD, COD

Analysis of soil for organic content, chloride, sulphate, pH, conductivity

References

1. Standard methods for the examination of water and waste water, American public health association 1996, NewYork.

2. F.W. Fifield and P.J. Haives Blackie, Environmental Analytical Chemistry, Academic and professional glasgow.

Internal continuous assessment: 100 marks

SEMESTER 2

CEE10 201: BIOLOGICAL METHODS IN ENVIRONMENTAL ENGINEERING

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective*: *To familiarize the students with collection and characterization of wastewater samples, their treatment and disposal and advanced wastewater treatment process and their applications

MODULE 1

Objectives of biological treatment – Role of microorganisms in waste water treatment – Types of biological processes for waste water treatment – Different microbial metabolisms – Bacterial growth patterns – Microbiological treatment kinetics and flow regimes – Michaelis-Menten and Monod models – Rate of biomass growth with soluble substrates – Kinetic coefficients – Effect of temperature – Oxygen requirements – Biomass yield – Observed yield – Kinetic constants evaluation of biological treatment.

MODULE 2

Aerobic biological treatment – Attached growth and suspended growth treatment systems – Modeling suspended growth treatment process – Activated sludge process – Description – Various types – Methods of aeration – Microbiology – Process analysis – Process design considerations – Operational difficulties – Modifications.

Sequencing Batch Reactor – Process description and operation.

Trickling filter – Filter classifications – Microbiology – Process design considerations – Design of physical facilities – Recirculation – NRC Equation – Operational difficulties.

MODULE 3

Aerated lagoons – Types – Process design considerations.

Stabilisation ponds – Classification – Design considerations.

Sludge treatment and disposal – Characteristics of sludge – Sludge processing – Preliminary operations – Thickening – Stabilizatio - Aerobic digestion - Anaerobic digestion – Composting – Conditioning – Dewatering - Heat drying - Incineration- Wet air oxidation – Land application

MODULE 4

Advanced biological treatment processes – Nitrogen removal – Nitrification and Denitrification -Stoichiometry – Process analysis – Operational and environmental variables.

Economics of biological treatment – Constructional cost, capital cost, operational cost – Total cost.

References

7. Metcalf and Eddy Inc. - Waste Water Engineering: Treatment, disposal and reuse, Tata McGraw Hill
8. Benefield and Randall- Biological treatment Process – Design for waste water treatment,
   Prentice Hall of India, New Delhi.
9. Hammer- Water and Waste Water Technology, John Wiley and Sons
10. Quano- Principles of Waste Water Treatment, Vol. I, Oxford and IBH
11. Eckenfelder and Conner – Biological waste Treatment

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 202: AIR QUALITY MANAGEMENT AND METEOROLGY

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective*: *To familiarize the students with collection and characterization of ambient and stack air samples, their treatment and control. Importance of mathematical models and meteorology in air pollutant dispersion and its concentration.

MODULE 1

Air pollution – sources and effects – Definition and concentrations, classification and properties of air pollutants, emission sources, major emissions from global sources, importance of Anthropogenic sources, behaviour and fate of air pollutants. Photochemical smog, Effects of air pollution on health, vegetation and materials damages.

Meteorological aspects of air pollutant dispersion – Temperature lapse rates and stability, wind velocity and turbulence, plume behaviour, dispersion of air pollutants, solutions to the atmospheric dispersion equation, The Gaussian plume model.

MODULE 2

Air pollution sampling and measurement – Types of pollutant sampling and measurement, ambient air sampling, collection of gaseous air pollutants, collection of particulate pollutants, stack sampling, analysis of air pollutants – sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and ozone, hydrocarbons, particulate matter.

MODULE 3

Air pollution control methods and equipment – Control methods, source correction methods, cleaning of gaseous effluents, particulate emission control – gravitational settling chambers, cyclone separators, fabric filters, electrostatic precipitators, wet scrubbers, selection of a particulate collector, control of gaseous emissions, absorption by liquids, adsorption by solids, combustion, biological methods

MODULE 4

Control of specific gaseous pollutants – Control of sulphur dioxide emission, desulphurisation of flue gases, Dry methods, wet scrubbing methods, control of nitrogen oxides, Modification of operating conditions, modification of design conditions, effluent gas treatment methods, Carbon monoxide control, control of hydrocarbons, mobile sources.
Air pollution laws and standards.

References:-

1. C.S.Rao. Environmental Pollution Control Engineering, Wiley Eastern Ltd, Delhi
2. Stern A. Air pollution Control vols 1, 2, 3. Academic press, Newyork
3. Magill. P. L. Air pollution hand book McGraw -Hill.
4. De Nevers Air Pollution Control Engineering McGraw-Hill.
5. Chhatwal G.R. Encyclopedia of Environmental Pollution and Control. Vol 1,2,3 Anmol Publications

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 203: ENVIRONMENTAL IMPACT ASSESSMENT

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To make the students aware about the ecological and social costs of unrestrained technological progress and the importance of protection of environment through environmental impact assessment.

MODULE 1

Concept of environmental impact analysis –Legislations, laws and Acts relevant to Environmental protection in India – Factors for consideration in assessing environmental impacts- Measurement of environmental impacts – Short term and long term effects.

Socioeconomic impact analysis- Types of socioeconomic impacts – Outline of the basic steps in performing socioeconomic impact assessment.

MODULE 2

Air quality impact analysis - Air pollutants-sources - Atmospheric interaction- Environmental impact assessment methodology

Noise impact analysis- typical considerations- Environmental impacts and effects of noise on people- control of noise pollution.

MODULE3

Water quality impact analysis – water quality criteria and standards –Environmental setting-modelling - water quality impacts by projects like highways, power plants, mining, agriculture and irrigation, forest management.

Energy impact analysis- Energy impact considerations, organization and methodology.

MODULE4

Vegetation and wildlife impact analysis **–** Environment assessment – assessment methodologies

Summarization of Environmental Impact –Checklist method, Matrix method, Network method.

References:-

1. John G. Rau and David C. Wooten –Environmental Impact Analysis Handbook.
2. Canter –Environmental Impact Assessment.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 204: ELECTIVE 1

CEE10 204 A: WATER POLLUTION CONTROL AND STREAM SANITATION

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To make the students aware about the sources of surface water pollution, their control and stream quality standards

MODULE 1

Introduction-importance of water sources-socio-economic importance-sources of pollution-types of waste-waste products of man's activities-sources of stream pollution-types of waste products-location and management of waste loads-projecting waste loadings

Water quality and stream quality standards

MODULE 2

Eutrophication-organic pollution-oil pollution-radioactive pollution-marine pollution-thermal pollution-pesticide pollution-heavy metal pollution

Organic self purification-quantitative definition-reoxygenation-oxygen balance and stream dissolved oxygen profile-oxygen sag curve-Streeter Phelp's equation-Critical deficit-problems

Microbial self purification-pathogenic microorganisms of sewage origin-indices of contamination-enumeration-percapita contribution-seasonal variations-death rate survival in the stream environment

MODULE 3

Classification of streams-natural self purification process-disposal of wastewater-

Rational stream sanitation practices-dual objectives of stream sanitation practices-the science and art of applied stream sanitation-stream survey-types of stream survey-execution of stream surveys

Purification in estuaries-evaluation of self purification in estuaries-tides and currents-distribution of waste loads by tidal translation-sea water intrusion-waste assimilation capacity of estuaries-bacterial contamination-stable wastes

MODULE 4

Impacts of river developments on waste assimilation capacity-detrimental and beneficial effects-hydroelectric power-navigation works-flood control works-irrigation and other diversions

References:-

1. Phelps E. Stream Sanitation
2. Viez Applied stream sanitation

3. P. K. Goel Water pollution, causes, effects and control
4. Todd G. K. Applied Groundwater hydrology

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 204 B: ENVIRONMENTAL HEALTH AND HYGIENE

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To make the students aware about environmental issues like adverse effect of pollutants on health and control methods for mitigating the effects

MODULE 1

Dimensions of environmental health, causative agents of diseases, social factors, urban problems, housing and health, economy and health, climate and other atmospheric elements, violence, crime and mental health, family health practice, health care planning and delivery, chronic and communicable disease, worldwide nutrition and population control.

MODULE 2

Industrial and agricultural pollutants, occupational health, epidemiological data, occupational health hazards, environmental exposure and diseases, industrial toxicants, hazardous wastes, preventing exposure to unhealthy and unsafe working conditions ,vector control.

MODULE 3

Disease control, disease prevention, morbidity and mortality, diseases and progressive deterioration, controlling diseases and disability. Foodborne and waterborne diseases outbreaks, controlling stress of life, epidemiology

MODULE 4

Nuclear energy and environmental health, concerns and uncertainties about nuclear power, nuclear power plants, safety.

Environmental health planning, need for planning, the planning process. Environmental health services, various agencies, International efforts, role of industry, voluntary health agencies, Law and human welfare, constitutional right to healthy environment, environmental education.

References:-

Willgoose-Environmental Health
Morgan-Environmental Health
Cairncross and Feachem-Environmental Health engineering in tropics
The world bank-Appropriate technology for water supply and sanitation

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 204 C: ENVIRONMENTAL SYSTEMS ANALYSIS

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To introduce modern tools like expert systems, neural networks, genetic algorithm etc. in environmental systems design .

MODULE 1

Significance of Systems Engineering: Systems Analysis, Systems Design and system synthesis.

Scope of applications to environmental engineering Systems addressing to specific environmental problems. Water pollution and transport and atmospheric processes.

MODULE 2

Role of optimization models: Deterministic models/Linear programming, Dynamic programming, separable and nonlinear programming models.

MODULE 3

Formulation of objective functions and constraints for environmental engineering planning and design. Applications to environmental systems analysis.

MODULE4

Introduction to modern tools: Expert systems, Neural networks, Genetic Algorithm

References:

1. Douglas A Haith Environmental systems optimization, John Wiley &Sons, Newyork
2. B.S.Goel, S.K.Mittal Operation research, Pragathy prakasham
3. Singiresu.S.Rao Engineering Optimization, New Age international(P) Ltd.
4. James A. Anderson An introduction to neural networks Prentice Hall of India, New Delhi

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 205: ELECTIVE 2

CEE10 205A ADVANCED HYDROLOGY AND WATER RESOURCES ENGINEERING

Credits 4

Hours per week: Lecture-3 and Tutorial-1

***Objective:* To make the knowledge base of the student in Hydrology stronger and broader so**

that they can handle the design and analysis of the environmental systems with confidence.

MODULE 1_

Fundamental hydrology-Hydrological cycle-components of hydrologic cycle –

Rainfall- atmospheric circulation –types and forms of precipitation-Rainfall data and its processing- frequency analysis-probability distribution and its application hydrology.-IDF Curves and DAD curves and its derivation and uses.

Water losses-Infiltration-Hortans' and Green Ampt model runoff-Indices.

Hydrograph-components- base flow separation- unit hydrograph- S and synthetic hydrograph.

MODULE 2_

Ground water flow and well hydraulics-Aquifer parameters-land subsidence due to over pumping- steady radial flow in to a well-well in uniform flow-steady flow with uniform charge-and steady flow in to a well confined, unconfined and leaky aquifers-well near aquifer boundaries-multiple well systems-partially penetrating wells –-pumping tests. Non equilibrium for pumping test-Theis method.-Jacob's method-Chow's method.

Salt water intrusion, ground water basin development, and Artificial recharge.

MODULE 3_

Open wells – Design of open well –yield test.- Methods of construction-dug wells.

Tube wells –design-screened wells-gravel packed wells- -selection of screen size-yield of a well

Well loss- determination of well loss by step pumping method.

Test holes-well logs - shallow tube wells -deep wells - -drilling in rocks-screen installation-well completion- well development-testing wells for yield-failure of tube wells.

Collector of radial wells. cavity wells and Infiltration galleries

MODULE 4_

Yield estimation: flow duration curve and mass curve –reservoir capacity and design. Hydrologic equation and water balance studies- flood routing studies.

Floods-estimation: Empirical -Rational formula- hydrograph method- flood frequency analysis- Gumbel's and Log-pearson type III.

Regression – Linear and non-linear - correlation- Methods of assessing error in hydrologic data and hydrologic computation.

Modelling – Classification of models based various criteria – Physically based models – Classification of PDEs- Methods for solution – FDM –Explicit and Implicit equation -solution procedure for Laplace and Unsteady ground water flow equation- and FEM (Basic concepts only)

References:

Singh, V.P. *Elementary Hydrology.* Prentice Hall of India, New Delhi, 1994.

Chow , V.T., D.R. Maidment and L.W. Mays, *Applied Hydrology*, McGraw Hill Book company, Singapore, 1988.

McCuen, R. H. *Hydrologic analysis and design*, Prentice Hall, Eaglewood Cliffs, New Jersey, 1989.

Subramanya, K. Engineering Hydrology, Tata Mcgraw Hill, Newdelhi,1994

Raghunath H.M..-Hydrology H.M Wiley Eastern Ltd Newdelhi,1985

Raghunath H.M..- Groundwater , New Age International, 2007

Ciriani T.A -Mathematical models for surface water hydrology

Tood D. K.-Ground water hydrology, Wiley Eastern

Viessman,L and Knapp.-Introduction to hydrology

Duggal and Soni, Elements of Water Resources Engineering, New Age International, 1996

Garg S.P, Ground water and tube wells, Oxford &IBH Newdelhi, 1982.

Chapra, S.C and Canale, R .P. Numerical methods for Engineers, Mcgraw hill Int.1990.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 205B GROUND WATER CONTAMINATION AND POLLUTION TRANSPORT

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To learn the principles of pollution transport, and estimation of extent of contamination by modelling

MODULE 1

Ground water and the hydrologic cycles-Ground water as a resource-Ground water contamination-Ground water as a geotechnical problem-Ground water and geologic processes. Physical properties and principles-Darcy's law-Hydraulic head and fluid potential-piezometers and nests. Hydraulic conductivity and permeability-homogenicity and anisotropy-porosity and voids ratio-Unsaturated flow and the water table-steady state flow and transient flow-compressibility and effective stress-transmissivity and storativity-Equations of ground water flow -Limitations of Darcian Approach-hydro dynamic dispersion.

MODULE 2

Resource evaluation: development of ground water resources-Exploration of Aquifers-the response of ideal aquifers to pumping-Measurement of parameters-Laboratory tests-Numerical simulation for aquifer yield prediction-Artificial recharge and induced infiltration-land subsidence - sea water intrusion

MODULE 3

Chemical properties and principles: constituents -chemical equilibrium-association and dissociation of dissolved species-effects of concentration gradients-mineral dissolution and solubility-Oxidation and reduction process-Ion exchange and adsorption-environmental isotopes-field measurement of index parameters. Chemical evolution: ground water in carbonate terrain-ground water in crystalline rocks-ground water in complex sedimentary systems -geotechnical interpretation of 14C dates-process rates and molecular diffusion.

MODULE 4

Solute transport: water quality standards-transport process-non reactive constituents in homogeneous media-transport in fracture media-hydrochemical behaviour of contaminants-trace metals-nitrogen-trace non metals-organic substances-measurement of parameters – velocity-dispersivity-chemical partitioning- sources of contamination-land disposal of solid waste-sewage disposal on land.

USGS-Moc model: modelling principles-MOC modelling.

References

Randall J. Charbeneau-Ground water Hydraulics and Pollutant Transport

Allen Freeze R. and John A. Cherry -Ground water. Prentice Hall.Inc

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 205C ENVIRONMENTAL GEOLOGY

Credits 4

Hours per week: Lecture-3 and Tutorial-1

Objective: To learn the fundamentals of geology in environmental planning and analysis of systems

MODULE 1

Fundamental concepts of environmental geology-concepts of ecology-flood and impact on environment-Nydel projects and environment-depositional environments-resources and silting-lakes-lagoons and estuarine environments-coastal erosion and impact on beach environment-Aeolian deposits and their environmental consequences-wind erosion and related environmental problems

MODULE 2

Geology and urban planning-problems of urbanization. Environmental analysis in planning of rural and urban areas. Environmental consequences of natural calamities like volcanic activity, earth quakes and landslides. Disposal of waste from nuclear and thermal stations and factories. Impact of waste disposal in the quality of ground water. Vulnerability of ground water to pollutants. Ecologist's role in management of waste disposal.

MODULE 3

Natural resources utilization and the environment. Green house effect and global warming. Chlorofluorocarbons and holes in the ozone layer. Problems in mining environment. Environmental legislation in India. Marine pollution-marine base sources-oil spills-processes of oil water interface-effects of ecosystems.

MODULE 4

Definition and scope of medical geology-environmental and health. Heavy metal pollutants (Cd,Hg,Pb,Re,Ra,As).Problems relating health and geology. Man-environment relationship. Trace elements in human biology. Goiter and iodine, fluorosis, fluorite, multiple sclerosis and Pb, As poisoning, Cesium and heart disease, radiation hazards.

References:

1.Strahler A.N and Strahler A.H.-Environmental geosciences. Wiley International
2.Pacyna J.M. and Ohar B. -Control and fate of atmospheric trace metals.
3.Raiz Akhtar - Environment and health
4.Park J.E. and Park K.-Textbook of preventive and social medicine.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE 206(P): SEMINAR

Credits: 2

Hours per week: 2

Objective:To assess the debating capability of the student to present a technical topic. Also to impart training to students to face audience and present their ideas and thus creating in them self esteem and courage that are essential for engineers.

Individual students are required to choose a topic of their interest from Environmental Engineering related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Environmental Engineering) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the

departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.
Internal continuous assessment : 100 marks

SEMESTER 3

ELECTIVE 1

CEE10 301A RESEARCH METHODOLOGY

Credits:4

Hours per week: Lecture-3 and Tutorial-1

***Objective: To impart knowledge about various methodologies followed in engineering research, formulation of research problems and to apply the same in project work. To make students aware of the problems faced by Indian researchers*.**

MODULE 1

Research Concepts – concepts – meaning – objectives – motivation. Types of research – descriptive research – conceptual research – theoretical research – applied research – experimental research. Research process – Criteria for good research – Problems encountered by Indian researchers.

MODULE 2

Formulation of Research Task – Literature Review – Importance & Methods – Sources – Quantification of Cause Effect Relations – Discussions – Field Study – Critical Analysis of Generated Facts – Hypothetical proposals for future development and testing, selection of Research task

MODULE 3

Mathematical modelling and simulation – Concepts of modelling – Classification of mathematical models – Modelling with – Ordinary differential equations – Difference equations – Partial differential equations – Graphs – Simulation – Process of formulation of model based on simulation.

MODULE 4

Interpretation and report writing – Techniques of interpretation – Precautions in interpretation – Significance of report writing – Different steps in report writing – Layout of research report – Mechanics of writing research report – Layout and format – Style of writing – Typing – References – Tables – Figures – Conclusion – Appendices.

References:

1. J.W. Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York
2. Schank Fr., Theories of Engineering Experiments, Tata Mc Graw Hill Publication.
3. C. R. Kothari, Research Methodology, New Age Publishers.
4. Willktnsion K. L, Bhandarkar P. L, Formulation of Hypothesis, Himalaya Publication.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 301B GIS AND REMOTE SENSING

Credits:4

Hours per week: Lecture-3 and Tutorial-1

Objective: To make the students understand the basics of emerging fields -remote sensing principles and Geographic Information System- so that they can utilize it for environmental system modeling

MODULE 1

Introduction to remote sensing – Electro magnetic spectrum – Physics of remote sensing – Effects of atmosphere – Atmospheric windows – Interaction of earth surface features with EMR – Spectral characteristics of vegetation, water, soil, etc. –
Various types of platforms– Airborne and space based platforms - Different types of aircraft – Manned and unmanned spacecraft used for data acquistion – Characteristics of different types of platforms – Characteristics of Remote Sensors –Multi spectral sensors – Multi Spectral Scanners – Microwave remote sensing- Factors affecting Microwave measurement-Radar wave bands- SLAR and SAR.

MODULE 2

Sensors- Satellite system parameters- sensor parameters-spatial, spectral and radiometric resolution – False colour composite (FCC) – Multi spectral photographs – Thermal and microwave imaging system-Earth Resources satellite and Meteorological satellites

Different types of data products and their characteristics – Image Interpretation - Basic principles of visual interpretation – Elements of image interpretation - Equipment for visual interpretation – Activities of image interpretation – Ground truth - Basic principles of digital image processing – filtering

MODULE 3
Geographic Information system – History and development of GIS – GIS definitions and Terminology -Architecture– System concepts – Coordinate systems – Standard GIS packages
Type of data – Spatial and non- spatial data – Data structure – Points – Lines – Polygon – Vector and raster – Files and data formats – Spatial data modeling –Raster GIS model and Vector GIS models.-GIS data file management and Database models

MODULE 4

Data input and data editing-Input methods –GPS as data capture-data editing.
Spatial analysis – Data retrieval – Query – Simple analysis – Record – Buffering and Overlay – Vector data analysis – Raster data analysis – Modelling in GIS – Digital elevation model – DTM – Modelling Networks
Integration of RS and GIS – Need and Facilities for integration. Application of these to water resources and environmental engg- Cadestral records and LIS

References:

1. **Lillesand T.M. and Kiefer R.W., Remote sensing and Image Interpretation, Second Edition, John Wiley and Sons, 1987.**
2. **AnjiReddy, M. Remote Sensing and Geographical Information System, BSP Publications., 2001.**
3. **Chang, K (2005). Introduction to Geographic Information Systems, *Tata Mc Graw Hills Edition, NewDelhi*.**
4. **Manual of Remote Sensing, American Society of Photogrammetry and Remote Sensing, 1993.**
5. **Paul Curran P.J., Principles of Remote Sensing , ELBS, 1983.**
6. **Sabins F.F. Jr., Remote Sensing Principles and Interpretation, W.II. Freeman and Company, 1978.**
7. **Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992.**
8. **Burrough P.A., Principles of GIS for Land Resources Assessment, Oxford Publication, 1980.**
9. **Jeffrey Star and John Estes, Geographical Information System – An Introduction, Prentice – Hall Inc., 1990.**
10. **Marble D.F., Galkhs H.W. and Pequest, Basic Readings in Geographic Information System, Sped System Ltd., New York, 1984.**
11. **Clarke, K.C. Parks B.O., and Crane M.P. (2006) Geographic Information systems and environmental modeling- PHI of India , New Delhi.**

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 301C NUMERICAL METHODS

Credits:4

Hours per week: Lecture-3 and Tutorial-1

Objective: To use mathematical knowledge in solving problems like optimization, correlation of data etc. and for modelling

MODULE 1

Solution of algebraic and transcendental equations- Review and comparison of various iterative methods, convergence- Generalized Newton- Raphson method for multiple roots-
Higher order methods- Newton's method for non-linear systems.

MODULE 2

Solution of simultaneous equations-Direct & indirect methods-Gauss elimination and Gauss Jordan methods- ill conditioning- pivoting – Jacobi, Gauss-Seidel and relaxation methods- convergence-Eigen value problems-Vector iteration method
Interpolation- Newton's Divided difference, Lagrange, Aitken, Hermite and Spline techniques – Inverse interpolation –Error estimates-Double interpolation-Trigonometric interpolation.

MODULE 3

Numerical differential-Numerical integration-Newton–Cote's integration formula-Gauss quadrature –Error estimates-Double integration.

Curve fitting-method of least squares – nn-linear relationships – Correlation and Regression – Linear Correlation – Measure of correlation – Standard error of estimate – Coefficient of correlation – Multiple linear regression.

MODULE 4

Solution of ordinary differential equations-Single step & multi step methods-stability of solution – simultaneous first order differential equations - higher order different equations. Numerical solution of integral equations.

Partial differential equations – classification – Laplace equation, ID wave equation, ID heat equation – Finite difference method – Relaxation methods. Stability and convergence of solution.

References:

1. **Jain M.K.,** ***Numerical methods for Scientific and Engineering Computation***
2. **Conte and Carl DeBoor,** ***Elementary Numerical Analysis***
3. **Gupta A and Bose S C,** ***Introduction to Numerical Analysis***
4. **Hilderbrand FB,** ***Introduction to Numerical Analysis***
5. **Fjorberg C E,** ***Introduction to Numerical Analysis***
6. **Kendall E Atkinson,** ***An Introduction to Numerical Analysis***
7. **Murrey R Spiegel,** ***Statistics***
8. **James B. Scarborough,** ***Numerical Mathematical Analysis***
9. **C F Gerald & P O Wheatley,** ***Applied Numerical Analysis***
10. **E V Krishnamurthy & S K Sen ,** ***Numerical algorithms***

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 302: ELECTIVE 2

CEE10 302A PLANNING AND DESIGN OF ENVIRONMENTAL FACILITIES

Credits:4

Hours per week: Lecture-3 and Tutorial-1

Objective: Students are expected to know in detail the various water and wastewater treatment systems and their layout and design.

MODULE 1

Environmental Engineering hydraulic design: Water distribution systems- Design of distribution systems- Hydraulic analysis – Distribution system components – Storage tanks -Analysis – Hardy Cross method – Equivalent Pipe method – Computer Programmes Pumps – Design of water and waste water pumping system.

MODULE 2

Types of sewerage system – Hydraulics of sewers –Design of various sewer appurtenances - Design of sanitary and storm water sewers – Structural requirement of sewer under various conditions – Design of surface and subsurface drainage – Roadways and Airport drainage

MODULE 3

Design of water treatment units – Design of sedimentation tanks, Mixing basins, Flash Mixer, Clariflocculator, Slow sand filter, Rapid sand filter, Spray and Cascade aerator, Chlorinator

MODULE 4

Design of waste water treatment units – Design of screens, Grit chamber, Sedimentation tank, Activated sludge process, Trickling filter, Aerated lagoons, Stabilization ponds, Oxidation ditch, Septic tank, Imhoff tank, Sequencing batch reactor, Sludge digestion tank.

References:

1. **Metcalf and Eddy Inc. - Waste water Engineering: Treatment, disposal & reuse, Tata McGraw Hill**
2. **Peavy- Environmental Engineering, McGraw Hill**
3. **Rodger Walker- Water supply Treatment and distribution**
4. **Sinero- Environmental Engineering: A Design Approach, Prentice Hall of India, Delhi**
5. **Wilson- Design calculations in waste water treatment, McGraw Hill Kogakusha**

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 302B ENVIRONMENTAL LEGISLATION

Credits:4

Hours per week: Lecture-3 and Tutorial-1

Objective: Students are expected to know the various legal acts formulated to control and protect the environment.

MODULE 1

The water (prevention and control of pollution) Act-Definitions, Constitution of central and state boards, Constitution and composition of joint boards, functions, prevention and control of water pollution, Penalties, Central and state water laboratory, power of supersession, power to make rules. The water (P&CP) rules - power and duties of the chairman and member- secretary, Temporary association of persons with central board, Consulting engineer, Annual report, Report of central board analyst, central water lab, powers and function of the central boar in U.T

MODULE 2

The Air (prevention and control of pollution) Act- Definition, powers and functions of boards, prevention and control of pollution, Penalties and procedure, Miscellaneous. The Air (P&CP) Rules- procedure of transaction of business of the board and its committees, Temporary Association of the board and its committees, Temporary association of the persons with the Central board, Annual Report of Central Board, persons with central boards.

MODULE 3

The Environmental (Protection) Act- Definition, General powers of the Central Govt., Prevention, Control and abatement of environmental pollution, miscellaneous. The E(P) Rules- recipient system, standards for emission or discharge of environmental pollutants, Prohibition and restriction on location of industries, Procedure for taking samples, notice and submission for analysis, functions of Env. Lab., furnishing information to authorities and agencies, prohibition and restriction on handling hazardous substances.

MODULE 4

Hazardous Wastes (Management and handling) Rules- Definition, esp, hazardous wastes, hazardous waste site. Transboundary movement, Responsibility of the occupier, grant of authorization, power to respond or cancel, packaging, labeling, transport, disposal or import, Accident reporting, appeal. Manufacture, storage and important of hazardous chemicals rules- Definitions- Mitigation of the major accident, safety reports.

Preparation of on- site & off -site emergency plans, Information to vulnerable public, collection and dissemination of information like MSDS.

The Bio-medical waste (Management and handling) rules. The ozone depleting substances (Regulations & Control) rules. The recycled plastics manufacture and usage rules. Noise pollution rules.

References:

The water (P& CP) Act and Rules.
The Air (P & CP) Rules.
The Env(Protection)Act and various rules.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 302C BIOREMEDIATION PRINCIPLES AND APPLICATIONS

Credits:4

Hours per week: Lecture-3 and Tutorial-1

Objective: Students are expected to know the principles of bioremediation and in situ treatment practices.

MODULE 1

Current bioremediation practices and applications, Microbial systems of bioremediation, Factors influencing bioremediation (Environmental, physical and chemical factors).

MODULE 2

Genetic response of microorganisms to the presence of pollutants (plasmid coded inducible degradative enzymes, Applications of genetically engineered microorganisms for hazardous waste management, microbial transformation reactions (aerobic and anaerobic biotransformations).

MODULE 3

Microbial detoxification of specialty chemicals (insecticides, herbicides, fungicides, polychlorinated biphenyls, heavy metals), Bioremediation systems and processes (solid, liquid and slurry phase remediation)

MODULE 4

Microbial cleaning of gases (biofiltration and bioscrubbing), in situ bioremediation, laboratory scale biotreatability studies for bioremediation, management of bioremediation project

References:

1. Rose E Mckanney. Microbiology for sanitary engineers
2. Gamey and Lord. Microbiology for waste water and sewage
3. Pelczhar and Reid. Test book of microbiology.
4. Roger T Stainer and Michael Dandroff. General Microbiology.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 302D ENVIRONMENTAL BIOTECHNOLOGY

Credits:4

Hours per week: Lecture-3 and Tutorial-1

Objective: Students are expected to know the principles of biotechnology and its application in environmental engineering

MODULE 1

Introduction to microbial genetics; mutation, genetic code, protein synthesis, regulation of gene expression- operon concept, reverse transcription, DNA repair.Introduction to DNA technology- cloning, vectors, restriction enzymes, plasmids, recombination in prokaryotes. Genetic engineering and gene therapy.

MODULE 2

Bioengineering of microorganisms for industrial purposes.Techniques used in molecular biology- PCR, DNA fingerprtinting, DNA sequencing. Industrially important microbial products. Immobilization of microbial cells and enzymes- immobilized cells and enzymes for waste water treatment.

MODULE 3

Microbial aggregation, idealized biofilm, the concept of completely mixed boifilm reactor. Nitrification and denitrification; biochemistry and physiology, activated sludge nitrification, biofilm nitrification, denitrification process.
Anaerobic treatment- process chemistry and microbiology, upflow and down flow reactors, upflow anaerobic sludge blanket reactor. Microbiology of various waste water treatment processes.

MODULE 4

Waste treatment and reuse; bio energy conversion, methanogenisis, biotechnology of composting, vermicomposting.
Microbes and organic pollutants; Relationship between contaminant structures, toxicity and biodegradability, environmental factors affecting biodegradation, biodegradation of organic pollutants.

References:

12. **Bruce. E. Rittmann & Perry.L.McCarty Environmental Biotechnology Principles and applications, published by Mc Graw Hills International edition**
13. **S.S.Purohit Biotechnology - published by Agrobios (India), Agro House, Chopasani Road, Jodhpur**
14. **Albert L. Lehninger Principles of Biochemistry - CBS publishers & disributors,485 Jain Bhavan, Delhi-32**
15. **Prescott & Dunn's Industrial microbiology- CBS publishers & disributors 4596/1 A 11 Darya Ganj, New Delhi- 110 002**
16. **Raina M. Maier, Ian Lpepper & Charles P. Environmental Microbiology published by Elsevier India pvt ltd, 17-A/1, Main Ring Eoad, Lajpat Nagar- IV, New Dehi- 24**

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced to students' right at the beginning of the semester by the teacher.

End semester Examination:100 marks

Question pattern

Answer any 5 questions by choosing at least one question from each module.

Module 1

Question 1 : 20 marks

Question 2 : 20 marks

Module 2

Question 3 : 20 marks

Question 4: 20 marks

Module 3

Question 5 : 20 marks

Question 6: 20 marks

Module 4

Question 7 : 20 marks

Question 8: 20 marks

CEE10 303(P): INDUSTRIAL TRAINING

Credits: 1

Hours per week -30 (during the period of training)

The students have to arrange and undergo an industrial training of minimum two weeks in an industry during the semester break after semester 2 and complete within 15 calendar days from the start of semester 3.The students are requested to submit a report of the training undergone and present the contents of the report before the evaluation committee. Evaluation committee will award the marks of end semester examination based on training quality, contents of the report and presentation.

End semester examination : Marks 50

SEMESTER 4

CEE 401(P): MASTERS RESEARCH PROJECT PHASE 2

Credits: 12

Hours per week: 30

Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Master Research project phase 2 is a continuation of project phase 1 started in the third semester. Towards the end of the semester there would be a pre submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conference. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external.

Internal Continuous assessment:

	Guide	**Evaluation committee**
First review	**50**	**50**
Second review	**100**	**100**

End Semester Examination:

Project Evaluation by external examiner: 150 marks
Viva Voce by external / internal examiner: 150 marks(75 each)
Total: 600 marks