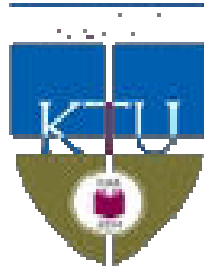


**APJ ABDUL KALAM KERALA TECHNOLOGICAL UNIVERSITY**



**(KOLAM CLUSTER - 02)**

**SCHEME AND SYLLABI**

**of**

**M. TECH.**

**in**

**ENVIRONMENTAL ENGINEERING &  
MANAGEMENT**

OFFERING DEPARTMENT

**CIVIL ENGINEERING**

## CLUSTER LEVEL GRADUATE PROGRAM COMMITTEE

NO	MEMBER
1	Dr. S. Mohan, Professor, IIT Madras, Chennai
2	Principal, TKM College of Engineering, Kollam
3	Principal, Baselios Mathews II College of Engineering, Sasthamcotta, Kollam
4	Principal, College of Engineering, Karunagapally, Kollam
5	Principal, College of Engineering, Perumon, Kollam
6	Principal, Pinnacle School of Engineering and Technology, Anchal, Kollam
7	Principal, Shahul Hameed Memorial Engineering College, Kadakkal, Kollam
8	Principal, TKM Institute of Technology, Ezhukone, Kollam
9	Principal, Travancore Engineering College, Parippally, Kollam
10	Principal, Younus College of Engineering and Technology, Pallimukku, Kollam

## CERTIFICATE

This is to certify that

1. The scheme and syllabi are prepared in accordance with the regulations and guidelines issued by the KTU from time to time and also as per the decisions made in the CGPC meetings.
2. The suggestions/modifications suggested while presenting the scheme and syllabi before CGPC on 8.6.2015 have been incorporated.
3. There is no discrepancy among the soft copy in MS word format, PDF and hard copy of the syllabi submitted to the CGPC.
4. The document has been verified by all the constituent colleges

Coordinator in charge of syllabus revision of the programme

Ms.Deepthi V.

Head of the Department

UKF College of Engineering & Technology

Parippally, Kollam

Dr.E.Gopalakrishna Sarma

Principal

UKF College of Engineering & Technology, Parippally, Kollam

Date:

Place:

Dr S. Mohan,

Professor, IIT, Madras

Chairman

## **Programme Educational Objective**

PEO1: Graduates of the programme will have in depth knowledge to identify and formulate challenging Environmental Engineering problems, apply appropriate research methodologies, use modern engineering tools and provide technically sound, economically feasible sustainable solutions

PEO2: Graduates of the programme will possess sound analytical and lateral thinking ability to engage in lifelong learning for professional advancement to cope up with the increasingly multi-disciplinary and rapidly evolving environmental engineering profession

PEO3: Graduates of the programme will become socially responsible and will demonstrate abilities to communicate and work effectively in an ethical way and ready to play leadership roles in their profession, public services and community

## **Programme outcome**

After successful completion of the programme the student should be able to

PO1: Acquire in-depth knowledge in environmental engineering discipline, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge

PO2: Analyse complex environmental engineering problems critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context

PO3: Think laterally and originally, conceptualize and solve environmental engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors

PO4: Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in environmental engineering domain

PO5: Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex environmental engineering activities with an understanding of the limitations

PO6: Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and

rational analysis in order to achieve common goals and further the learning of themselves as well as others

PO7: Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in environmental engineering discipline and multi-disciplinary environments after consideration of economical and financial factors

PO8: Communicate with the engineering community, and with society at large, regarding complex environmental engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions

PO9: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously

PO10: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society

PO11: Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback

### PEO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PEO1											
PEO2											
PEO3											

# Scheme of M. Tech Programme in Environmental Engineering & Management

## SEMESTER 1 (Credits 21)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	02CE6311	Applied Statistics	3-0-0	40	60	3	3
B	02CE6321	Environmental Chemistry	3-0-0	40	60	3	3
C	02CE6331	Environmental Microbiology	3-0-0	40	60	3	3
D	02CE6341	Physicochemical Methods in Environmental Engineering	4-0-0	40	60	3	4
E	02CE6351	Elective I	3-0-0	40	60	3	3
	02CA6001	Research Methodology	1-1-0	100	0	0	2
	02CE6361	Seminar		100	0	0	2
	02CE6371	Environmental Monitoring Laboratory –I	0-0-2	100	0	0	1

L-Lecture    T-Tutorial    P-Practical

### **ELECTIVE I**

02CE6351.1 Industrial Waste Management

02CE6351.2 Communicable Diseases and Environmental Control

02CE6351.3 Waste Recycling and Reuse

# Scheme of M. Tech Programme in Environmental Engineering & Management

## SEMESTER 2 (Credits 19)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	02 CE6312	Biological and Advanced wastewater treatment	4-0-0	40	60	3	4
B	02CE6322	Solid and hazardous waste management	3-0-0	40	60	3	3
C	02CE6332	Environmental Impact Assessment	3-0-0	40	60	3	3
D	02CE6342	Elective II	3-0-0	40	60	3	3
E	02CE6352	Elective III	3-0-0	40	60	3	3
	02CE6362	Mini Project	0-0-4	100	0	0	2
	02CE6372	Environmental Monitoring Laboratory -II	0-0-2	100	0	0	1

L-Lecture    T-Tutorial    P-Practical

### **ELECTIVE II**

02CE6342.1 Environmental Systems Analysis

02CE6342.2 Environmental Biochemistry and Toxicology

02CE6342.3 Water quality Modelling

### **Elective III**

02CE6352.1 Air Quality Management

02CE6352.2 Water Pollution Control and Stream Sanitation

02CE6352.3 Environmental Legislation

# Scheme of M. Tech Programme in Environmental Engineering & Management

## SEMESTER 3 (Credits 14)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	02CE7311	Elective IV	3-0-0	40	60	3	3
B	027CE7321	Elective V	3-0-0	40	60	3	3
	02CE7331	Seminar	0-0-2	100	0	0	2
	02CE7341	Project (Phase I)	0-0-12	50	0	0	6

L-Lecture    T-Tutorial    P-Practical

### Elective IV

02CE7311.1 Environmental Management and Audit  
02CE7311.2 Environmental Biotechnology

### Elective V

02CE7321.1 Bioremediation Principle and its Application  
02CE7321.2 Planning and Design of Environmental Facilities



# Scheme of M. Tech Programme in Environmental Engineering & Management

## Semester 4 (Credits: 12)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
	02CE7312	Project (Phase II)	0-0-21	70	30	0	12

L-Lecture    T-Tutorial    P-Practical

**Total credits for all semesters: 66**

## SEMESTER 1

Course No.	Course Name	L-T-P-Credits	Year of Introduction
<b>02CE6311</b>	<b>APPLIED STATISTICS</b>	<b>3-0-0-3</b>	<b>2015</b>
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>• To enable the students apply statistics in various areas of environmental engineering</li> <li>• To familiarize in the field of sampling and analysis, stochastic modelling etc.</li> </ul>			
<b>Syllabus</b> Probability Distributions; Sampling techniques; Statistical inference; Sampling Distribution; Analysis of variance ; Time Series Models: Components of time series; Regression and correlation: Applications.			
<b>Course Outcome</b> Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts statistics; Sampling distribution; Time series models; various application of regression and correlation			
<b>Text Books</b> <ol style="list-style-type: none"> <li>1. Gupta.S.C. and Kapoor.V.K, “<i>Fundamentals’ of Mathematical Statistics</i>”, Sultan Chand and Son</li> <li>2. Benjamin, Jack.R and Comell.C, Allin, “<i>Probability, Statistics and Decision for Civil Engineers</i>”, Mc-Graw Hill.</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>1. Kadiyali.L.R, “<i>Traffic Engineering and Transport Planning</i>”, Khanna Publishers.</li> <li>2. Wohl, Martin and Martin, Brian.V, “<i>Traffic Systems analysis for Engineers and Planners</i>”, Mc-Graw Hill.</li> <li>3. Richard.A. Johnson: Miller and Freunds, “<i>Probability and Statistics for Engineers</i>” (edition) Pearson.</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ; %
<b>I</b>	<b>Probability Distributions</b> Probability mass functions and probability density function, mean and variance. Binomial, Poisson, Exponential, Gamma, Lognormal and normal distribution: Fitting of the distributions.	<b>7</b>	<b>15</b>

<b>II</b>	<b>Sampling techniques</b> Simple random sampling, stratified sampling, systematic sampling, sample size determination-application in Environmental Engineering	<b>6</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	<b>Statistical inference</b> 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.	<b>8</b>	<b>15</b>
<b>IV</b>	<b>Applications</b> Analysis of variance (i) Completely randomized designs (ii) Randomized block designs. Latin squares. Grecco Latin square design. Factorial experiments. Graphical presentation techniques.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	<b>Time Series Models</b> Components of time series-smoothing- Measuring forecasting accuracy-Testing of ARIMA Models.	<b>7</b>	<b>20</b>
<b>VI</b>	<b>Regression and Correlation</b> Linear Regression and correlation, multiple correlation coefficient, standard error of estimate, curvilinear regression- Applications.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAM</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6321	ENVIRONMENTAL CHEMISTRY	3-0-0-3	2015
<b>Course Objectives</b>			
To bring into focus those aspects of chemistry Particularly valuable for solving environmental problems like water and wastewater analysis			
<b>Syllabus</b>			
Physical Chemistry; Colloids and their classification; Radioactivity; Organic chemistry; Pesticides; Chromatography; Chemical toxicity-instrumentation details and analysis; Chemistry of water and waste water – water pollution.			
<b>Course Outcome</b>			
Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts environmental chemistry; Various phenomenon behind toxicity and pollution.			
<b>Text Books</b>			
1. Clair N. Sawyer, Pery L. McCarty – “ <i>Chemistry for Environmental Engineering</i> ” (McGraw Hill)			
<b>References:</b>			
1. APHA – Standard methods for the examination of water and wastewater. 2. S. K. Banerjee – Environmental Chemistry.			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	<b>Physical Chemistry</b> 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.	8	15

<b>II</b>	<p><b>Radioactivity</b> Atomic structure and radioactive 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.</p>	<b>7</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	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.	<b>7</b>	<b>15</b>
<b>IV</b>	Pesticides: Classification, degradation, pollution due to chlorinated pesticides. Chromatography – thin layer and paper – gas – adsorption – partition – ion exchange – exclusion – electro chromatography – ion chromatography and HPLC.	<b>6</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	<p><b>Chemical toxicity</b> Identification through chromatography–spectro analytical methods – IR, UV and visible – atomic absorption, atomic emission and mass spectroscopy (instrumentation details and analysis)</p>	<b>7</b>	<b>20</b>
<b>VI</b>	<p><b>Chemistry of water and wastewater</b> – water pollution – pollutants in water – determination of water quality parameters like pH, acidity, alkalinity, BOD, COD, hardness, lethal doses of pollutants – sulphides, chlorides, Ca, Mg, and analysis of minerals Fe, Mn, Ca, Mg in water.</p>	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6331	ENVIRONMENTAL MICROBIOLOGY	3-0-0-3	2015
<b>Course Objectives</b>			
To understand the fundamentals of microbiology Microbiological aspects of biological treatment process in environmental engineering			
<b>Syllabus</b>			
Introduction to microbiology; General characteristics of the bacteria, algae, fungi, protozoa; Growth of bacteria, growth curve factors influencing growth aerobic and anaerobic growth- role of enzymes; Microbiology of water, wastewater, soil and air; Microbial production of industrial products; principles of bio technology applied to waste treatment; Principles and use of light microscopes; MPN and membrane filter technique.			
<b>Course Outcome</b>			
Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts environmental microbiology; Various mechanism behind waste treatment.			
<b>Text Books</b>			
1. Michael J. Pelczhar, E. C. S. Chan & Noel R. Krieg, “ <i>Microbiology</i> ”, Tata McGraw-Hill, 5 <sup>th</sup> Edition			
2. P. D. Sharma, “ <i>Microbiology</i> ”			
<b>References:</b>			
1. Rose E Mckanney. “ <i>Microbiology for Sanitary Engineers</i> ”.			
2. Gamey and Lord. “ <i>Microbiology for Wastewater and Sewage</i> ”			
3. Roger T Stainer and Michael Dandroff, “ <i>General Microbiology</i> ”			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	<b>Introduction to microbiology</b> - microorganism and their characteristics- classification and application in sanitary engineering. General characteristics of the bacteria, algae, fungi, protozoa, viruses, rickettsiae, chlamydiae.	7	15
II	<b>Characteristics of bacteria</b> -observation of wet and stained preparation - Grams stain. Growth of bacteria, growth curve factors influencing growth aerobic and anaerobic growth- role of enzymes, mechanism of action and factors influencing enzyme action-basic concepts of metabolism. Culture media, composition, classification.	7	15
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	<b>Principles and use of light microscopes</b> -dark field, bright field, phase contrast and fluorescent. Electron microscopes- Scanning and Transmission type.	<b>7</b>	<b>15</b>
<b>IV</b>	<b>MPN and membrane filter technique.</b> Importance of sterilization, factors influencing sterilization, principles and methods.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	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.	<b>7</b>	<b>20</b>
<b>VI</b>	Microbial production of industrial products, principles of bio technology applied to waste treatment, waste utilization, bio-energy conversion, biogeochemical cycling, and dairy microbiology-diseases transmitted through milk.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6341	PHYSICO CHEMICAL METHODS IN ENVIRONMENTAL ENGINEERING	4-0-0-4	2015
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>To understand various physico-chemical methods in environmental engineering</li> <li>To familiarize the students with the treatment processes</li> <li>Various processes behind sludge treatment</li> <li>Effectiveness of treatment process in waste management</li> </ul>			
<b>Syllabus</b> Process dynamics; Screenings; Equalization process; Sedimentation; Coagulation and flocculation; Disinfection-processes-methods of disinfection; Adsorption; Ion exchange; Sludge treatment; Filtration.			
<b>Course Outcome</b> Students who successfully complete this course will have an ability to understand the fundamental concepts of various physic-chemical processes in environmental engineering; Various mechanism behind waste treatment.			
<b>Text Books</b>  Weber W. J. “ <i>Physicochemical Processes for Water Quality Control</i> ”.			
<b>References:</b> Metcalf and Eddy Inc., “ <i>Wastewater Engineering Treatment Disposal Reuse</i> ”, Tata McGraw Hill Publishing Company, 4 <sup>th</sup> Edition.			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	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	10	15
II	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.	10	15
FIRST INTERNAL EXAM			



<b>III</b>	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	<b>9</b>	<b>15</b>
<b>IV</b>	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	<b>9</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Filtration-filtration processes-filter media- types of filters-mechanisms of filtration-hydraulics of filtration-filter problems -effluent quality-design of filters. Chemical oxidation-principles and theories-generation and application of chemical methods.	<b>9</b>	<b>20</b>
<b>VI</b>	Sludge treatment-characteristics of sludge-dewatering methods-conversion process-anaerobic and aerobic digestion-combustion-disposal, of sludge.	<b>9</b>	<b>20</b>
<b>ENDE SEMESTR EXAMINATION</b>			

## ELECTIVES FOR SEMESTER I

Course No.	Course Name	L-T-P-Credits	Year of Introduction
<b>02CE6351.1</b>	<b>INDUSTRIAL WASTE MANAGEMENT</b>	<b>3-0-0-3</b>	<b>2015</b>
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>• To make the students understand the principles of industrial waste management in Environmental Engineering.</li> <li>• To familiarize the students with the treatment processes adopted in industries</li> </ul>			
<b>Syllabus</b>			
Industrial water, sources and characteristics; reuse, recycle, recovery, source reduction, raw material substitution; Application of membrane processes; Waste treatment methodologies for specific industries; Control and removal of specific pollutants in industrial wastewater.			
<b>Course Outcome</b>			
Students who successfully complete this course will have an ability to understand the fundamental concepts of various treatment process adopted in industries. Proper management of wastes in industrial area.			
<b>Text Books</b>			
1. N. L. Nemerow, “ <i>Liquid waste of Industry- Theory, Practice &amp; Treatment</i> ”			
<b>References:</b>			
1. Ronald L. Droste, “ <i>Theory and Practice of Water and Wastewater Treatment</i> ”, John Willy and sons (ASIA) Pvt Ltd			
2. Mark J Hammer, Mark J Hammer Jr, “ <i>Water and Wastewater Technology</i> ” Prentice Hall of India Pvt. Ltd.			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ; %
<b>I</b>	Industrial water, sources and characteristics, quantity and quality of industrial waste and their impact on streams and treatment plants; Stream quality criteria for water supply and aquatic life; Stream sanitation, de oxygenation and self-purification in streams; Industrial waste survey.	<b>7</b>	<b>15</b>
<b>II</b>	Tools for clean processes, reuse, recycle, recovery, source reduction, raw material substitution, process modifications.	<b>7</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Industrial wastewater treatment processes, waste volume reduction, waste strength reduction, neutralization, equalization and proportioning of wastes.	<b>7</b>	<b>15</b>
<b>IV</b>	Application of membrane processes, Ion exchange processes, materials and reactions, Reverse osmosis Ultra filtration, Electro dialysis.Environmental audit, definitions and concepts.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Waste treatment methodologies for specific industries eg: Tannery wastes, pulp and paper industry, food processing industry, iron and steel industry, thermal power plant.	<b>7</b>	<b>20</b>
<b>VI</b>	Control and removal of specific pollutants in industrial wastewater, eg: cyanide, fluoride, heavy metals etc., removal of Suspended, colloidal and dissolved solids.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6351.2	COMMUNICABLE DISEASES AND ENVIRONMENTAL CONTROL	3-0-0-3	2015
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>To make the students aware about the various communicable diseases occurring due to improper waste management</li> <li>Their control in the environment</li> </ul>			
<b>Syllabus</b>			
Fundamental aspects; General Preventive and control measures; Communicable diseases and control; Parasites and vectors; Administrations and Voluntary organizations: Public health administration in India role of voluntary organizations in controlling spread of communicable diseases; ecological and environmental control.			
<b>Course Outcome</b>			
Students who successfully complete this course will have an ability to understand the various communicable diseases caused due to ineffective waste management processes. Also their control in the environment.			
<b>Text Books</b>			
<ol style="list-style-type: none"> <li>Joseph &amp; Salvato Jr, NCE, PE, “<i>Environmental sanitation</i>”</li> <li>Maxey. K.F, “<i>Preventive Medicine and Hygiene</i>”</li> </ol>			
<b>References:</b>			
<ol style="list-style-type: none"> <li>Bedi Y.P, “<i>Hygiene and Public Health</i>”.</li> <li>Park J E and Park K. “<i>Text Book of Preventive and Social Medicine</i>”.</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Fundamental aspects: Definition of health, epidemiological items, infection source etc. General Preventive and control measures. Quarantine, isolation and notification, immunity, its classification and mechanism in the human body.	7	15
II	Communicable diseases and control : Detailed description of communicable diseases like history, symptoms, mode of transmission, immune responses in humans, prevention and control of Malaria, Gambia fever, Dengue, Relapsing fever, Plague, Enteric Fever including Typhoid and Paratyphoid, Cholera, Chicken pox, Measles, Mumps, Tuberculosis, Rabies, AIDS-Source and mode of transmission,	7	15
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Disinfection: Classification with examples, various disinfectants and their uses, standardization of disinfectants.	<b>6</b>	<b>15</b>
<b>IV</b>	Vectors, mosquitoes, sand flies, house flies, ticks mites. Fleas, Lice, bugs, Snails, life history, ecological and environmental control.	<b>6</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Parasites and vectors : Common worm infections in man, its transmission through water, life cycle of parasitic worms with special reference to round worm, hook worm Guinea	<b>8</b>	<b>20</b>
<b>VI</b>	Administrations and Voluntary organizations: Public health administration in India role of voluntary organizations in controlling spread of communicable diseases, health and vital statistics, basic principles.	<b>8</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6351.3	<b>WATER RECYCLING AND REUSE</b>	<b>3-0-0-3</b>	<b>2015</b>
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>To make the students understand the process of waste recycling and reuse.</li> <li>And also in the areas of bye-product recovery and public health consideration in recycling.</li> </ul>			
<b>Syllabus</b> Typical waste composition and its uses; Need for recycling and factor affecting; Waste water recycle and reuse; Byproducts recovery from solid wastes; Public health consideration in recycling; Basic concepts in solid waste recycling, estimation of solid waste products rates; Solid waste recycling; Testing and evaluation of materials recovery.			
<b>Course Outcome</b> Students who successfully complete this course will have an ability to understand different phenomena involved in waste recycling and reuse, material recovery process in the waste management field.			
<b>Text Books</b> <ol style="list-style-type: none"> <li>Skiff. J., “<i>Waste Disposal Management and Practice</i>”</li> <li>Harvey Alter- “<i>Materials Recovery from Municipal Waste</i>”.</li> </ol> <b>References:</b> <ol style="list-style-type: none"> <li>David Kut and Gerard Hare, “<i>Waste recycling for Energy Conservation</i>”</li> <li>David Gordon Wilson, “<i>Hand Book of Solid Waste Management</i>”</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
<b>I</b>	Typical waste composition and its uses: Need for recycling and factor affecting it, general considerations, environmental impact of waste generation, disposal versus recycling and final disposal, resources position, water resources potential, waste water reuse potential, recourses in solid residuals, quantity and quality role of recycling in resources utilization, waste water renovation, practically of use, technical and institutional factors affecting reuse, consumer attitude towards renovated waste water.	<b>8</b>	<b>15</b>
<b>II</b>	Waste water recycle and reuse: Waste water reuse for irrigation, aquaculture alga harvesting, fertilization, potentials for waste reuse in industries, quality requirements in industrial reuse for waste water, treatment requirements.	<b>6</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Physico-chemical, biological and advanced treatment techniques. Solid waste recycling: Testing and evaluation of materials recovery.	<b>7</b>	<b>15</b>
<b>IV</b>	Public health consideration in recycling: Bacterial, viral problems associated with recycling, prevention and control, health status of workers in waste recycling operation, aspects of recycling operations.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Byproducts recovery from solid wastes: Materials recovery from solid wastes, recycling paper, quality of recycled paper, recycling versus energy recovery from incineration, recycling of metal, separation into ferrous and non-ferrous metals and aluminum salvaging recycling of glass and plastics.	<b>7</b>	<b>20</b>
<b>VI</b>	Basic concepts in solid waste recycling, estimation of solid waste products rates; consumption and analysis of solid wastes, salvageable materials, potential for recycling, separation techniques.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CA6001	RESEARCH METHODOLOGY	1-1-0-2	2015

#### Course Objectives

The objective of this course is to help the student to understand the fundamental ideas and logic of research. This course will also to help students to plan design, execute, evaluate and report research within the specified time.

#### Syllabus

Typical waste composition and its uses; Need for recycling and factor affecting; Waste water recycle and reuse; Byproducts recovery from solid wastes; Public health consideration in recycling; Basic concepts in solid waste recycling, estimation of solid waste products rates; Solid waste recycling; Testing and evaluation of materials recovery.

#### Course Outcome

At the end of this course, the students should be able to

1. Understand the basic concepts of research and its methodologies.
2. Identify appropriate research topics.
3. Select and define an appropriate research problem.
4. Organize and conduct scientific research.
5. Prepare and defend a research thesis.

#### Text Books:

1. C. R. Kothari, 2004, "*Research Methodology Methods and Techniques*", 2<sup>nd</sup> Edn., New Age International.
2. Donad H. McBurney and Theresa L White, 2009, "*Research Methods*", 8<sup>th</sup> Edn., Wadsworth Cengage Learning Inc.
3. Donald R. Cooper, Pamela S. Schindler, 2013, "*Business Research Methods*", 12<sup>th</sup> Edn., Tata McGraw-Hill.
4. J.W Barnes, 1994, "*Statistical Analysis for Engineers and Scientists: A Computer based Approach*", McGraw Hill.
5. Panneerselvam, 2012, "*Research Methodology*", Prentice Hall of India.
6. Leedy, P.D. and Ormirod, J.E., 2012, "*Practical Research: Planning and Design*", 10<sup>th</sup> Edn., Prentice Hall.
7. Stuart Melville and Wayne Goddard, 1996, "*Research Methodology: An Introduction for Science & Engineering Students*", Juta and Company Ltd.
8. Turabian, K.L Revised by Grossman, J. and Bennert, A., 1996, "*A Manual for writers of term papers, theses and Dissertation*", 6<sup>th</sup> Edn., University of Chicago Press.



<b>COURSE PLAN</b>			
<b>Module</b>	<b>Contents</b>	<b>Contact Hours</b>	<b>Sem.Exam Marks ;%</b>
<b>I</b>	<b>Introduction to Research</b> Meaning and definition of research-Motivation and objectives of research-Types of research-Fundamental-Applied – Descriptive – Analytical – Qualitative – Quantitative – Conceptual – Empirical – Research and Scientific methods– Research process-Criteria for good research	<b>5</b>	<b>15</b>
<b>II</b>	<b>Research Problem</b> Sources of research problems-Characteristics of a research problem-Problem defining techniques-Sources of literature-Review of literature-Issues and gap areas identification-Purpose of study-Exploratory and descriptive-Qualities of good hypothesis-Null and alternative hypothesis-Importance of hypothesis testing	<b>5</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	<b>Research Design</b> Features of good design-Different research designs-Laboratory and field experiments-Measurement concepts-Scales and levels-Measurement of variables-Factors affecting validation-Internal and external validation-Reliability-Stability methods-Development of experimental and sample designs	<b>4</b>	<b>15</b>
<b>IV</b>	<b>Data Collection and Analysis</b> Methods of data collection-Data sources-Surveys and questionnaires-Methods of data collection and their utility-Concepts of statistical population-Sampling techniques-Probabilistic and non probabilistic samples-Sample size determination issues-Primary and secondary data analysis-Use of computers, internet and library-Data analysis with statistical packages-Preparation of data for analysis	<b>5</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	<b>Research Reporting</b> Purpose of written reports-Concept of audience-Types of reports-Structure and components of reports-Technical reports and thesis-Features of a good thesis-Layout and language of reports-Illustrations-Tables-Referencing-Footnotes-Intellectual contents of the thesis-Making oral presentations-Effective communications-Publishing research findings-Defending the thesis	<b>5</b>	<b>20</b>

<b>VI</b>	<b>Research Application and Ethics</b> Application of results of research outcome-Environmental impacts-Professional ethics-Ethical issues and committees-Copyright-Royalty-Intellectual property rights-Patent laws and Patenting-Reproduction of published material-Plagiarism-Citation and acknowledgement-Reproducibility and accountability-Developing research proposals	<b>4</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

<b>Course No.</b>	<b>Course Name</b>	<b>Credits</b>	<b>Year of Introduction</b>
<b>02CE 6361</b>	<b>SEMINAR</b>	<b>2</b>	<b>2015</b>

**Course Objectives**

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.

**Syllabus**

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.

**Course Outcome**

Students who successfully complete this course will have demonstrated an ability to convey their ideas properly. It also helps the students to improve their personality in the field of teaching.

Course No.	Course Name	L-T-P Credits	Year of Introduction
02CE 6371	ENVIRONMENTAL MONITORING LABORATORY-I	0-0-2-1	2015
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>To analyze the characteristics of water/wastewater samples</li> </ul>			
<b>Syllabus</b>			
Sampling - Taking Grab and composite samples; Physical characteristics of water/wastewater – Turbidity, conductivity, solids; Chemical analysis of water – determination of ions by colorimetric, volumetric analysis, preparation of standards BOD, COD.			
<b>Course Outcome</b>			
Students who successfully complete this course will have an ability to do practical examination of water samples to determine their physic-chemical characteristics.			
<b>Text Books:</b>			
1. “ <i>Standard Methods for the Examination of Water and Wastewater</i> ”, American public health association, New York.			
<b>References:</b>			
1. F.W. Fifield and P.J. Haives Blackie, “ <i>Environmental Analytical Chemistry</i> ”, Academic and professional glasgow.			

## SEMESTER 2

Course No.	Course Name	L-T-P-Credits	Year of Introduction
<b>02CE6312</b>	<b>BIOLOGICAL AND ADVANCED WASTEWATER TREATMENT</b>	<b>4-0-0-4</b>	<b>2015</b>
<p><b>Course Objectives</b></p> <ul style="list-style-type: none"> <li>• To make the students understand the principles of biological and advanced treatment methods in Environmental Engineering.</li> <li>• To familiarize the students with the treatment processes</li> <li>• Various advanced processes behind sludge treatment</li> </ul>			
<p><b>Syllabus</b></p> <p>Theory and design of biological unit operations; Aerobic and anaerobic sludge digestion, Biological unit operations for nitrogen and phosphorus removal; Recarbonation; Filtration; Activated carbon adsorption and regeneration; Anaerobic operations.</p>			
<p><b>Course Outcome</b></p> <p>After successful completion of the course, the students will be able to:</p> <ul style="list-style-type: none"> <li>• Analyze and understand main issues related to waste water and its management</li> <li>• Explain, evaluate and design various units of a typical water treatment plant</li> <li>• Outline the various anaerobic processes, membrane processes and its application in day-to-day life</li> <li>• Develop an understanding on the advanced water treatment techniques</li> </ul>			
<p><b>Text Books</b></p> <ol style="list-style-type: none"> <li>1. Metcalf and Eddy Inc., “Wastewater Engineering Treatment Disposal Reuse” Tata McGraw Hill Publishing Company.</li> <li>2. Russell. L. Culp and Gorden. L. Culp, “Handbook of Advanced Wastewater treatment” Van Nostr and Reinhold c, New York.</li> </ol> <p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Ronald L. Droste, “Theory and practice of water and wastewater treatment”, John Willy and sons (ASIA) Pvt Ltd.</li> <li>2. Mark J Hammer, Mark J Hammer Jr, “Water and wastewater technology”, Prentice Hall of India Pvt Ltd.</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
<b>I</b>	Theory and design of biological unit operations; Aerobic and anaerobic processes; Aerobic unit operations such as activated sludge, trickling filter oxidation ponds, aerated lagoons.	<b>9</b>	<b>15</b>

<b>II</b>	Aerobic and anaerobic sludge digestion, Biological unit operations for nitrogen and phosphorus removal.Limitations of conventional wastewater treatment methods, Purpose and benefits of advanced wastewater treatment.Chemical clarification, coagulation, flocculation, sedimentation.	<b>10</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Recarbonation -sources of carbon dioxide quantities of carbon dioxide required;Filtration, theory and performance of in-depth filters filter problems and their solutions types of in-depth filters, surface filters.	<b>9</b>	<b>15</b>
<b>IV</b>	Disinfection, chlorination, system requirements for disinfection. Nitrogen removal, Ammonia stripping, biological nitrogen removal. Demineralization, ion exchange, Electro dialysis, reverse osmosis, Brine disposal.	<b>10</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Activated carbon adsorption and regeneration, manufacture of activated carbon characteristics of carbon used in wastewater treatment, carbon regeneration.	<b>9</b>	<b>20</b>
<b>VI</b>	Anaerobic operations such as up flow anaerobic sludge blanket reactors Anaerobic filters, Expanded/fluidized bed reactors.	<b>9</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6322	<b>SOLID AND HAZARDOUS WASTE MANAGEMENT</b>	3-0-0-3	2015
<p><b>Course Objectives</b></p> <ul style="list-style-type: none"> <li>• Solid and hazardous waste are defined. Technology, health, and policy issues associated with solid waste and hazardous materials are examined.</li> <li>• Methods of managing solid and hazardous waste are introduced and regulations presented where appropriate.</li> <li>• The characteristics of hazardous and solid waste materials, health frameworks, and the distribution of contaminants in the environment are reviewed.</li> </ul>			
<p><b>Syllabus</b></p> <p>Introduction-Evolution of solid waste management; Transfer and transport; Processing techniques and equipments; Recovery of resources; Disposal of solid waste and residual matter; incinerators- type of incinerator Legal and institutional frame work-Current management practices; Typical cost data and cost – estimating procedure; Solid waste collection.</p>			
<p><b>Course Outcome</b></p> <p>After successful completion of the course, the students will be able to:</p> <ol style="list-style-type: none"> <li>1. A comprehensive and historical overview of hazardous waste management, and prepare our students to be well-qualified and competitive in the responsibility of engineering design and permitting in the field of hazardous waste management.</li> <li>2. Provide comprehensive and historical overviews of hazardous wastes management from both scientific and engineering principles;</li> <li>3. Define and characterize solid and hazardous wastes from technical and regulatory points of view;</li> <li>4. Identify current statutory and regulatory cradle to grave framework related to hazardous waste management.</li> </ol>			
<p><b>Text Books</b></p> <ol style="list-style-type: none"> <li>1. George Tchobanoglous et al. “<i>Solid Waste Engineering Principles and Management Issues</i>”, McGraw Hill Books Co New York.</li> <li>2. David GordinWilson, “<i>Handbook of solid waste management</i>” - (Van Nostrand Reinhold Co., New York).</li> </ol>			
<p><b>References:</b></p> <ul style="list-style-type: none"> <li>• D. Joseph Hagerty. Joseph L Pavoni, “<i>Solid waste management</i>”(Van Nostrand, Reinhold Co., New York)</li> </ul>			

<b>COURSE PLAN</b>			
<b>Module</b>	<b>Contents</b>	<b>Contact Hours</b>	<b>Sem.Exam Marks ;%</b>
<b>I</b>	Introduction-Evolution of solid waste management – objective- Functional elements –Generation and characteristics: -Sources and Types, Composition, Analysis of solid waste Onsite handling:- storage and processing.	<b>7</b>	<b>15</b>
<b>II</b>	Transfer and transport; Processing techniques and equipments: -purpose-mechanical volume reduction – chemical volume reduction- mechanical size reduction-component separation- drying and dewatering. Recovery of resources: -Recovery of chemical, biological conversion	<b>7</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Typical cost data and cost – estimating procedure for equipment used in solid waste management systems.	<b>7</b>	<b>15</b>
<b>IV</b>	Solid waste collection: -Collection Services, collection system, analysis of collection system collection routes, advanced technique of analysis-waste allocation problem.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Disposal of solid waste and residual matter: - Sanitary landfill – type of landfill method- environmental; factors leachate and pollution consideration- incinerators- type of incinerator –incinerators maintenance and operational problems- composting – types- design consideration for aerobic composting process.	<b>7</b>	<b>20</b>
<b>VI</b>	Legal and institutional frame work-Current management practices-Action plan for municipal solid waste management- case studies. Hazardous waste – identification – classification, regulations, storage, collection- process and disposal.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			



Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6332	ENVIRONMENTAL IMPACT ASSESSMENT	3-0-0-3	2015
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>To make the students aware about the ecological and social costs of unrestrained technological progress</li> <li>And the importance of protection of environment through environmental impact assessment.</li> </ul>			
<b>Syllabus</b> Concept of environmental impact analysis –Legislations; Air quality impact analysis; Noise impact analysis; Water quality impact analysis; Vegetation and wildlife impact analysis; Energy impact analysis; Socioeconomic impact analysis.			
<b>Course Outcome</b> After successful completion of the course, the students will be able to: <ol style="list-style-type: none"> <li>A comprehensive overview of impact assessment in various regions of environment.</li> <li>Identify current statutory and regulatory cradle to grave framework related impact assessment.</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>John G. Rau and David C. Wooten –“<i>Environmental Impact Analysis Handbook</i>”</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>Larry W Canter, “<i>Environmental Impact Assessment</i>”, McGraw Hill Book Company, 1997.</li> </ol>			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	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.	7	15
II	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.	6	15
FIRST INTERNAL EXAM			

<b>III</b>	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.	<b>8</b>	<b>15</b>
<b>IV</b>	Vegetation and wildlife impact analysis – Environment assessment – assessment methodologies Summarization of Environmental Impact –Checklist method, Matrix method, Network method.	<b>8</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Energy impact analysis- Energy impact considerations, organization and methodology.	<b>6</b>	<b>20</b>
<b>VI</b>	Socioeconomic impact analysis- Types of socioeconomic impacts – Outline of the basic steps in performing socioeconomic impact assessment.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

## ELECTIVES FOR SEMESTER 2

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6342.1	<b>ENVIRONMENTAL SYSTEMS ANALYSIS</b>	<b>3-0-0-3</b>	<b>2015</b>
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>• Describe the development of environmental systems analysis</li> <li>• Describe and apply a selection of environmental systems analysis tools and use these in different decision situations</li> <li>• Describe and analyse different mitigation measures for avoiding or minimising environmental impact and thereby contribute to a sustainable development.</li> </ul>			
<b>Syllabus</b> Significance of Systems Engineering: Systems Analysis; Role of optimization models: Deterministic models/Linear programming; Introduction to modern tools: Expert systems; Scope of applications to environmental engineering; Systems addressing to specific environmental problems.			
<b>Course Outcome</b> After completing the course, the student should be able to: <ol style="list-style-type: none"> <li>1. Identify basic concepts within environmental systems analysis</li> <li>2. Explain basic theory of environmental systems analysis</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>1. Douglas A Haith, “<i>Environmental Systems Optimization</i>”, John Wiley &amp; Sons, New York</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>1. Singiresu S. Rao “<i>Engineering Optimization</i>”, New Age International (P) Ltd.</li> <li>2. James A. Anderson “<i>An Introduction to Neural Networks</i>” Prentice Hall of India, New Delhi.</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ; %
<b>I</b>	Significance of Systems Engineering: Systems Analysis, Systems Design and system synthesis.	<b>7</b>	<b>15</b>
<b>II</b>	Role of optimization models: Deterministic models/Linear programming, Dynamic programming, separable and nonlinear programming models.	<b>6</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Formulation of objective functions and constraints for environmental engineering planning and design. Applications to environmental systems analysis.	<b>8</b>	<b>15</b>

<b>IV</b>	Introduction to modern tools: Expert systems, Neural networks, Genetic Algorithm.	<b>8</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Scope of applications to environmental engineering; Systems addressing to specific environmental problems.	<b>6</b>	<b>20</b>
<b>VI</b>	Water pollution and transport and atmospheric processes.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6342.2	ENVIRONMENTAL BIOCHEMISTRY AND TOXICOLOGY	3-0-0-3	2015
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>Introduces students to the basic principles of toxicology and the application of toxicology to the environment, food, forensics and occupational settings.</li> <li>Biochemical interactions of industrial, agricultural and household chemicals with elements of soils, plants, animals and humans.</li> </ul>			
<b>Syllabus</b>			
Bio molecules- carbohydrates, proteins, lipids, Nucleic acids, vitamins; Environmental toxicology- definition, classification ,experimental methods of measuring toxins; Biotransformation, bioaccumulation and biomagnifications of toxicants ; Ecological risk assessment process ; Mutagenesis, teratogenesis, carcinogens, hallucinogens.			
<b>Course Outcome</b>			
By the end of this course a student should:			
<ol style="list-style-type: none"> <li>Understand the basic concepts of toxicology.</li> <li>Understand the relationship between exposure, hazards and development of disease.</li> <li>Be able to calculate risk factors associated with exposure to toxic chemicals.</li> </ol>			
<b>Text Books</b>			
<ol style="list-style-type: none"> <li>Conn E.E and Stumpf P.K, “<i>Outlines of Biochemistry</i>”.</li> <li>David .A. Wright and Pamela Welcone “<i>Basic Environmental Toxicology</i>”.</li> </ol>			
<b>References:</b>			
<ol style="list-style-type: none"> <li>Albert. L. Lehninger, “<i>Biochemistry</i>”, Kalyani publishers, New Delhi</li> <li>James A. Anderson “<i>An Introduction to Neural Networks</i>” Prentice Hall of India, New Delhi.</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Bio molecules- carbohydrates, proteins, lipids, Nucleic acids, vitamins; Enzymes, factors influencing enzymatic activity, inhibitors and regulation, biodegradability, QSAR.	7	15
II	Environmental toxicology- definition, classification, origin and nature of toxicants in the environment.	7	15
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Photosynthesis, light and dark reactions, biofuels, protein biosynthesis, nitrogen metabolism	<b>7</b>	<b>15</b>
<b>IV</b>	Mutagenesis, teratogenesis, carcinogens, hallucinogens, phytotoxins, animal toxins, animal toxins	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Experimental methods of measuring toxins, methods of assessing the impacts of chemicals on the ecosystem. Biotransformation, bioaccumulation and biomagnifications of toxicants	<b>7</b>	<b>20</b>
<b>VI</b>	Ecological risk assessment process and evaluation of human exposure, case studies related to accidental discharge of pollutants and their impact on ecology and inhabitants in the surrounding areas.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6342.3	WATER QUALITY MODELING	3-0-0-3	2015
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>• Understand the idea, methodology and basic tools of water quality modelling</li> <li>• Understand the different modelling approaches, their scope and limitations</li> <li>• Understand the fate and transport of pollutants in different water bodies</li> <li>• Become mindful of a wide range of applications of modelling in water resources management &amp; decision making</li> </ul>			
<b>Syllabus</b> Introduction to models-System; Zeroth Order, First order and Second order reactions; D.O. Model for streams Determination of Deoxygenation and Reoxygenation Coefficients; Mass Balance-Conservation of mass, Decay rate.			
<b>Course Outcome</b> By the end of this course a student should: <ul style="list-style-type: none"> <li>• Identifying appropriate system boundaries and problem definition</li> <li>• Identifying and evaluating connections between real-world engineering solutions and the environment, society (including cultural, governance and ethical issues), and economy, in both global and domestic area</li> </ul>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>1. Gilbert M Masters, “An Introduction to Environmental Engineering and Science” Prentice hall of India (P) Ltd.</li> <li>2. Davis M.L and Cornwell, “Environmental Engineering”</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>1. Peavy, Rowu and Tchobanoglous, “Environmental Engineering”, McGraw Hill Publishing Company.</li> </ol>			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Introduction to models-System, Models-Type and Components, Modelling.	7	15
II	Order of a reaction-Zeroth Order, First order and Second order only.	7	15
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Mass Balance-Conservation of mass, Decay rate, Accumulation rate.	<b>7</b>	<b>15</b>
<b>IV</b>	Steady, Unsteady and transient states, Conservation and Non – Conservative substances.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	D.O. Model for streams, B.O.D and C.O.D, Determination Thomas Method to determine B.O.D constants, Streeter Phelps Model.	<b>7</b>	<b>20</b>
<b>VI</b>	Determination of Deoxygenation and Reoxygenation Coefficients, Models for lake, Thermal Stratification.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			



Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6352.1	AIR QUALITY MANAGEMENT	3-0-0-3	2015
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>• Students would get an insight into the dispersion of air pollution in the atmosphere.</li> <li>• This life cycle of air pollution will enable the student to first identify the pollutants and their sources and then the transport mechanisms of the pollutants followed by the affected population and there control mechanisms.</li> </ul>			
<b>Syllabus</b> Air pollution – sources and effects – Definition and concentrations, classification and properties of air pollutants, emission sources, major emissions from global sources; Air pollution sampling and measurement – Types of pollutant sampling and measurement, ambient air sampling, collection of gaseous air pollutants; Air pollution control methods and equipment; particulate emission control; Control of specific gaseous pollutants; Meteorological aspects of air pollutant dispersion; Modification of operating conditions, modification of design conditions.			
<b>Course Outcome</b> By the end of this course a student should: <ol style="list-style-type: none"> <li>1. After attending the course the students shall have acquired knowledge and understanding to evaluate air quality management and analyze the causes and effects of air pollution.</li> <li>2. Students would be able to understand the type and nature of air pollutants, the behavior of plumes and relevant meteorological determinants influencing the dispersion of air pollutants.</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>1. C.S.Rao. “<i>Environmental Pollution Control Engineering</i>”, Wiley Eastern Ltd, Delhi .</li> <li>2. Stern A. “<i>Air pollution Control</i>” Vols 1, 2, 3. Academic press, Newyork..</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>1. Chhatwal G.R. “<i>Encyclopedia of Environmental Pollution and Control</i>”. Vol 1,2,3 Anmol Publications</li> </ol>			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	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.	7	15
II	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.	7	15
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	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	<b>7</b>	<b>15</b>
<b>IV</b>	Modification of operating conditions, modification of design conditions, effluent gas treatment methods, Carbon monoxide control, control of hydrocarbons, mobile sources.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Control of specific gaseous pollutants – Control of sulphur dioxide emission, desulphurisation of flue gases, Dry methods, wet scrubbing methods, control of nitrogen oxides, Air pollution laws and standards.	<b>7</b>	<b>20</b>
<b>VI</b>	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.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6352.2	<b>WATER POLLUTION CONTROL AND STREAM SANITATION</b>	<b>3-0-0-3</b>	<b>2015</b>
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>• Students would get an idea about water pollution and its control</li> <li>• Stream sanitation criteria would be implemented for proper pollution control</li> </ul>			
<b>Syllabus</b>			
Introduction-importance of water sources-socio-economic importance-sources of pollution; Eutrophication-organic pollution-oil pollution-radioactive pollution-marine pollution-thermal pollution-pesticide pollution-heavy metal pollution; Purification in estuaries-evaluation of self purification in estuaries-tides and currents; Impacts of river developments on waste assimilation capacity; Water quality and stream quality standards; Rational stream sanitation practices-dual objectives of stream sanitation practices.			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>1. After attending the course the students shall have acquired knowledge and understanding stream quality criteria for waste disposal</li> <li>2. Students would be able to understand various water pollution controlling measures.</li> </ol>			
<b>Text Books</b>			
<ol style="list-style-type: none"> <li>1. Phelps E. “<i>Stream Sanitation</i>”.</li> <li>2. P. K. Goel “<i>Water Pollution, Causes, Effects and Control</i>”.</li> </ol>			
<b>References:</b>			
<ol style="list-style-type: none"> <li>3. Vierz “<i>Applied Stream Sanitation</i>”</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
<b>I</b>	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.	<b>6</b>	<b>15</b>
<b>II</b>	Eutrophication-organic pollution-oil pollution-radioactive pollution-marine pollution-thermal pollution-pesticide pollution-heavy metal pollution. Organicself purification-quantitative definition-reoxygenation-oxygen balance and stream dissolved oxygen profile-oxygen sag curve-Streeter Phelp’s equation-Critical deficit-problems.	<b>8</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Classification of streams-natural self purification process-disposal of wastewater-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.	<b>8</b>	<b>15</b>
<b>IV</b>	Impacts of river developments on waste assimilation capacity-detrimental and beneficial effects-hydroelectric power-navigation works-flood control works-irrigation and other diversions.	<b>6</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Water quality and stream quality standards; Microbial self purification-pathogenic microorganisms of sewage origin-indices of contamination-enumeration-per capita contribution-seasonal variations-death rate survival in the stream environment.	<b>7</b>	<b>20</b>
<b>VI</b>	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.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE6352.3	ENVIRONMENTAL LEGISLATION	3-0-0-3	2015
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>Students are expected to know the various legal acts formulated to control and protect the environment.</li> <li>Students should get a legal awareness about the pollution impact in the environment.</li> </ul>			
<b>Syllabus</b> The water ( prevention and control of pollution) Act-Definitions, Constitution of central and state boards; The Air (prevention and control of pollution) Act- Definition, powers and functions of boards, prevention and control of pollution, Penalties and procedure, Miscellaneous; The Environmental (Protection) Act- Definition, General powers of the Central Govt., Prevention, Control and abatement of environmental pollution, miscellaneous Hazardous Wastes (Management and handling) Rules-Definition, esp, hazardous wastes, hazardous waste site; The water (P&CP) rules; Preparation of on-site & off -site emergency plans.			
<b>Course Outcome</b> <ol style="list-style-type: none"> <li>After attending the course the students shall have acquired knowledge and understanding about the environmental legislation.</li> <li>Students would be able to understand acts which would be implemented to safeguard the environment.</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>The Environmental (Protection) Act and various rules</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>The water (P&amp; CP) Act and Rules.</li> <li>The Air (P &amp; CP) Rules.</li> </ol>			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	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.	6	15
II	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.	8	15

<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	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.	<b>8</b>	<b>15</b>
<b>IV</b>	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.	<b>6</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	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.	<b>7</b>	<b>20</b>
<b>VI</b>	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.	<b>7</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

<b>Course No.</b>	<b>Course Name</b>	<b>Credits</b>	<b>Year of Introduction</b>
<b>02CE 6362</b>	<b>MINI PROJECT</b>	<b>2</b>	<b>2015</b>

**Course Objectives**

- To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes.
- 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.

**Syllabus**

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. It aims as a basic work for the students before the main project work. It also evaluates the report drafting and a well executed project which should be completed in the allotted time period

**Course Outcome**

Students who successfully complete this course will have demonstrated an ability to do projects, convey their ideas properly. It also helps the students to improve their personality in the field of teaching.

<b>Course No.</b>	<b>Course Name</b>	<b>Credits</b>	<b>Year of Introduction</b>
<b>02CE 6372</b>	<b>ENVIRONMENTAL MONITORING LABORATORY -II</b>	<b>2</b>	<b>2015</b>
<b>Course Objectives</b>			
<ul style="list-style-type: none"> <li>• To analyze the microbiological characteristics of samples</li> </ul>			
<b>Syllabus</b>			
<ul style="list-style-type: none"> <li>➤ Culture media preparation-solid and liquid media; Preparation,distribution and sterilization.</li> <li>➤ Inoculation, streaking, colony observation; Colony counting technique for bacteria.</li> <li>➤ Determination of total bacterial population by standard plate count technique</li> <li>➤ Preparation of bacterial smear, staining of bacteria.</li> <li>➤ Hanging drop technique for observation of motility of bacteria.</li> <li>➤ Isolation of microbes from soil, water, and air.</li> <li>➤ Bacteriological examination of water. Multiple tube fermentation tests -MPN technique for coliforms in water and sewage.</li> </ul>			
<b>Course Outcome</b>			
Students who successfully complete this course will have an ability to do practical examination of water samples to determine their microbiological characteristics.			
<b>Text Books:</b>			
<ul style="list-style-type: none"> <li>• P. D. Sharma. "Microbiology"</li> </ul>			



## SEMESTER 3

Course No.	Course Name	L-T-P-Credits	Year of Introduction
<b>02CE7311.1</b>	<b>ENVIRONMENTAL MANAGEMENT AND AUDIT</b>	<b>3-0-0-3</b>	<b>2015</b>
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>To make the students understand the concepts of environmental management and audit processes in the field of environmental engineering</li> </ul>			
<b>Syllabus</b> Introduction and scope, environmental ethics, waste minimization and pollution strategies; Introduction to environmental policies; Life cycle design and analysis; Environmental management system standards: environmental management systems (EMS); Environmental economics; Environmental Auditing; Environmental management techniques.			
<b>Course Outcome</b> By the end of this course a student should: <ol style="list-style-type: none"> <li>Identifying appropriate problems in the field of environment.</li> <li>Identifying and evaluating connections between real-world engineering solutions and the environment, society (including cultural, governance and ethical issues), and economy, in both global and domestic arenas.</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>Dr. Suresh K. Dhameja, “<i>Environmental Engineering and Management</i>”</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>Vijay Kulkarni and T.V. Ramachandra, “<i>Environmental Management</i>”, Capital Publishing Company, New Delhi.</li> </ol>			
<b>COURSE PLAN</b>			
<b>Module</b>	<b>Contents</b>	<b>Contact Hours</b>	<b>Sem.Exam Marks ;%</b>
<b>I</b>	Introduction and scope, environmental ethics, waste minimization and pollution strategies, waste management hierarchy, tools of corporate environment management. Policy and legal aspects of environment management.	<b>7</b>	<b>15</b>
<b>II</b>	Introduction to environmental policies, industries and environmental policies, agriculture and environment policies, environmental policy instruments, environment policies and programme in India, environmental laws and legislations.	<b>8</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			

<b>III</b>	Life cycle design and analysis;Environmental management system standards: environmental management systems (EMS), core elements of EMS, benefits of EMS, documentation for EMS, EMS standards.	<b>7</b>	<b>15</b>
<b>IV</b>	Environmental economics: environmental costs and benefits, environmental taxes, environmental accounting, environmental valuation, economics of natural resources.	<b>6</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Environmental Auditing (EA): types, basic structure of EA EA steps, elements of audit process, waste audits and pollution prevention assessments, EA in industrial projects.	<b>8</b>	<b>20</b>
<b>VI</b>	Environmental management techniques: environmental monitoring, environmental modelling, application of remote sensing and GIS in environmental management, environmental risk assessment, eco mapping, industrial symbiosis and eco parks.	<b>6</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE7311.2	ENVIRONMENTAL BIOTECHNOLOGY	3-0-0-3	2015
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>To make the students understand the concepts of biotechnology in the field of environmental engineering</li> </ul>			
<b>Syllabus</b> Introduction to microbial genetics; Genetic engineering and gene therapy; Bioengineering of microorganisms for industrial purposes; Techniques used in molecular biology-PCR, DNA fingerprinting, DNA sequencing; Microbiology of various wastewater treatment processes; vermicomposting; Bioremediation; Environmental applications; Relationship between contaminant structures, toxicity and biodegradability.			
<b>Course Outcome</b> By the end of this course a student should: <ol style="list-style-type: none"> <li>Identifying appropriate problems in the field of environmental biotechnology.</li> <li>Evaluating novel trends in biotechnology which would enhance various deterministic procedures in the field of environmental engineering</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>Raina.M.Maier, Ian.Lpepper &amp; Charles.P. :”Environmental Microbiology”; published by Elsevier Indiapvt ltd.</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>Bruce. E. Rittmann&amp;Perry.L.McCarty, “<i>Environmental Biotechnology Principles and applications</i>”, published by McGraw Hills International edition</li> <li>S.S.Purohit: “<i>Biotechnology</i>”- published by Agrobios (India), AgroHouse, Chopasani Road, Jodhpur</li> </ol>			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	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.	8	15
II	Bioengineering of microorganisms for industrial purpose Techniques used in molecular biology-PCR, DN fingerprinting, DNA sequencing. Industrially important microbial products. Immobilisation of microbial cells and enzymes-immobilized cells and enzymes for waste water treatment.Microbial aggregation, idealized biofilm., the concept of completely mixed bio film reactor.	8	15
FIRST INTERNAL EXAM			

<b>III</b>	Environmental applications-Biomass energy, mushroom production, single cell proteins, yeast technology.	<b>5</b>	<b>15</b>
<b>IV</b>	Bioremediation:-engineering strategies for bioremediation like site characterization, in situ bioremediation, phytoremediation, evaluating bioremediation.	<b>5</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Relationship between contaminant structures, toxicity and biodegradability, environmental factors affecting biodegradation, biodegradation of organic pollutants.	<b>8</b>	<b>20</b>
<b>VI</b>	Microbiology of various wastewater treatment processes.Waste treatment and reuse; bio energy conversion, methanogenesis, biotechnology of composting,vermicomposting.Microbes and organic pollutants.	<b>8</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE7321.1	<b>BIOREMEDIATION PRINCIPLES AND APPLICATIONS</b>	<b>3-0-0-3</b>	<b>2015</b>
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>• Students are expected to know the principles of bioremediation and in situ treatment practices.</li> <li>• Current bioremediation principles and practices which enhances waste management</li> </ul>			
<b>Syllabus</b> Current bioremediation practices and applications; Genetic response of microorganisms to the presence of pollutants; Microbial detoxification of specialty chemicals; in situ bioremediation; Applications of genetically engineered microorganisms for hazardous waste management.			
<b>Course Outcome</b> By the end of this course a student should: <ol style="list-style-type: none"> <li>1. Identifying recent techniques in the field of bioremediation</li> <li>2. Commercialization of various process in the field of environmental engineering</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>1. Michael J. Pelczhar, E. C. S. Chan &amp; Noel R. Krieg, “<i>Microbiology</i>”, Tata McGraw-Hill, 5<sup>th</sup> Edition</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>1. Rose E Mckanney. “Microbiology for Sanitary Engineers”</li> <li>2. S.S.Purohit, “Biotechnology”- published by Agrobios (India), Agro House, Chopasani Road, Jodhpur</li> </ol>			
<b>COURSE PLAN</b>			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
<b>I</b>	Current bioremediation practices and applications, Microbial systems of bioremediation, Factors influencing bioremediation (Environmental, physical and chemical factors).	<b>8</b>	<b>15</b>
<b>II</b>	Genetic response of microorganisms to the presence of pollutants (plasmid coded inducible degradative enzymes,	<b>8</b>	<b>15</b>
<b>FIRST INTERNAL EXAM</b>			
<b>III</b>	Bioremediation systems and processes ( solid, liquid and slurry phase remediation)	<b>5</b>	<b>15</b>
<b>IV</b>	Bioremediation-:engineering strategies for bioremediation like site characterization, in situ bioremediation, phytoremediation, evaluating bioremediation.	<b>5</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			

V	Microbial cleaning of gases (biofiltration and bioscrubbing), in situ bioremediation, laboratory scale biotreatability studies for bioremediation, management of bioremediation project.	8	20
VI	Applications of genetically engineered microorganisms for hazardous waste management, microbial transformation reactions (aerobic and anaerobic biotransformations).	8	20
<b>END SEMESTER EXAMINATION</b>			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
02CE7321.2	PLANNING AND DESIGN OF ENVIRONMENTAL FACILITIES	3-0-0-3	2015
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>Students are expected to know in detail the various water and wastewater treatment systems and their layout and design.</li> </ul>			
<b>Syllabus</b> Environmental Engineering hydraulic design: Water distribution systems- Design of distribution systems; Types of sewerage system – Hydraulics of sewers –Design of various sewer appurtenances; Design of water treatment units; Design of waste water treatment units; Analysis – Hardy Cross method – Equivalent Pipe method; Design of-Stabilization ponds, Oxidation ditch, Septic tank, Imhoff tank, Sequencing batch reactor, Sludge digestion tank.			
<b>Course Outcome</b> By the end of this course a student should: <ol style="list-style-type: none"> <li>Aware about the design of various treatment facilities which would be further considered for an efficient treatment option in the field of environmental engineering</li> </ol>			
<b>Text Books</b> <ol style="list-style-type: none"> <li>Metcalf and Eddy Inc., “Wastewater Engineering Treatment Disposal Reuse”, Tata McGraw Hill Publishing Company, 4<sup>th</sup> Edition.</li> <li>Sinero- Environmental Engineering: A Design Approach, Prentice Hall of India, Delhi</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>Wilson- Design calculations in waste water treatment, McGraw Hill Kogakusha</li> </ol>			
COURSE PLAN			
Module	Contents	Contact Hours	Sem.Exam Marks ;%
I	Environmental Engineering hydraulic design: Water distribution systems- Design of distribution systems- Hydraulic analysis – Distribution system components – Storage tanks.	8	15
II	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.	8	15
FIRST INTERNAL EXAM			

<b>III</b>	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.	<b>7</b>	<b>15</b>
<b>IV</b>	Design of waste water treatment units – Design of screens, Grit chamber, Sedimentation tank, Activated sludge process, Trickling filter, Aerated lagoons.	<b>7</b>	<b>15</b>
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Analysis – Hardy Cross method – Equivalent Pipe method – Computer Programmes Pumps – Design of water and waste water pumping system.	<b>6</b>	<b>20</b>
<b>VI</b>	Design of- Stabilization ponds, Oxidation ditch, Septic tank, Imhoff tank, Sequencing batch reactor, Sludge digestion tank.	<b>6</b>	<b>20</b>
<b>END SEMESTER EXAMINATION</b>			



<b>Course No.</b>	<b>Course Name</b>	<b>Credits</b>	<b>Year of Introduction</b>
<b>02CE 7331</b>	<b>SEMINAR</b>	<b>2</b>	<b>2015</b>

**Course Objectives**

- 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.

**Syllabus**

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.

**Course Outcome**

Students who successfully complete this course will have demonstrated an ability to convey their ideas properly. It also helps the students to improve their personality in the field of teaching.

Course No.	Course Name	Credits	Year of Introduction
02CE 7341	PROJECT PHASE I	6	2015

**Course Objectives**

- 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.
- 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.

**Syllabus**

Environmentally and economically feasible project has to be chosen which should be relevant to the field and should also contribute to the same. Interim presentations should be done 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 the end of the semester at least 40 % completion of the project work should be done by each student.

**Course Outcome**

Students who successfully complete this course will have demonstrated an ability to convey their ideas properly. It imparts the practical applications of various theoretical knowledges procured throughout the completion of the course.

## **SEMESTER 4**

<b>Course No.</b>	<b>Course Name</b>	<b>Credits</b>	<b>Year of Introduction</b>
<b>02CE 7312</b>	<b>PROJECT PHASE II</b>	<b>12</b>	<b>2015</b>
<b>Course Objectives</b> <ul style="list-style-type: none"><li>• To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes.</li><li>• 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.</li><li>• 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.</li></ul>			
<b>Syllabus</b> <p>Master Research project phase II is a continuation of project phase I, 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.</p>			
<b>Course Outcome</b> <p>Students who successfully complete this course will have demonstrated an ability to convey their ideas properly. It imparts the practical applications of various theoretical knowledges procured throughout the completion of the course.</p>			