KERALA TECHNOLOGICAL UNIVERSITY

(THRISSUR CLUSTER - 07)

SCHEME AND SYLLABI

of

M. TECH.

in

ENVIRONMENTAL ENGINEERING

OFFERING DEPARTMENT

CIVIL ENGINEERING

CLUSTER LEVEL GRADUATE PROGRAM COMMITTEE

1.	Dr Devdas Menon, Professor, IIT Madras	Chairman
2	Principal, Government Engineering College Thrissur	Convener
3	Principal, AXIS College of Engineering & Technology, East Kodaly, Murikkingal, Thrissur	Member
4	Principal, IES College of Engineering, Chittilapally, Thrissur	Member
5	Principal, MET'S School of Engineering, Mala, Thrissur	Member
6	Principal, Royal College of Engineering & Technology, Akkikkavu, Thrissur	Member
7	Principal, Vidya academy of Science & Technology, Thalakkottukara, Thrissur	Member
8	Principal, Thejus Engineering College, Vellarakkad, Erumappetty, Thrissur	Member
9	Principal, Universal Engineering College, Vallivattom, Konathakunnu , Thrissur	Member
10	Principal, Sahrdaya College of Engineering & Technology, Kodakara, Thrissur	Member

CERTIFICATE

This is to certify that

1. The scheme and syllabi are prepared in accordance with the regulation 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 25.6.2015 has 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

Prof. Anand Lali Neera

Associate professor

Government Engineering College, Thrissur

(Name, designation and College Name)

Principal of the lead college

Dr. Indiradevi P.
Principal
Government Engineering College Trichur
Thrissur-680009

Principals of the colleges in which the programme is offered

No	Name of the college	Principal's Name	Signature
1	Government Engineering College, Thrissur	Dr. Indiradevi P	
2			
3			
4			
5			

Date: Chairman
Place:Thrissur

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To successfully equip and educate the students with a firm foundation related to environment and its management, environmental planning and design, environmental sustainability, waste management, water conservation and management, environmental impact analysis, environmental monitoring, modelling, environmental biotechnology, industrial water pollution control, ecology, green and clean technology, hazardous waste management etc. and problem solving skills to address contemporary environmental issues.
2. Enable them to apply their knowledge for the sustainable development of environment while working in their field of employment in organisations such as government agencies, industries, research organisations, policy making bodies etc.
3. Imbibe in them the ability to promote ethical and professional values/standards in their career and among the public in relation to protection of environment and sustainable development.
4. Enable them to maintain state of the art knowledge through lifelong learning by organising and participating in continuing education programmes related to environmental sustainability.
5. Advance and support the engineering profession through student association/interaction with professional bodies, educational and research institutions etc. Also create potential to adapt the changing environment.
6. Motivate them to respond to various issues in a global and social context

PROGRAM OBJECTIVES (POs)

A. To apply knowledge of mathematics, chemistry, biological science and engineering to identify, formulate and solve engineering problems.

B. To plan and design a system component/process to meet the desired needs of the society within economic, social, environmental, ethical and sustainability constraints.

C. To design and conduct experiments and to analyse and interpret data efficiently.

D. To identify, formulate and solve various Environmental Engineering problems and issues like pollution abatement, effective management of environmental resources and their development and applications.

E. To find professional level employment and/pursue higher degree

F. To understand, predict and quantify impacts of new projects and developments

G. To gain knowledge about contemporary issues and research challenges/opportunities

H. To use techniques/skills and modern Engineering tools for engineering practice

I. Communicate effectively and professionally in written and oral form, individually and in teams.

Mapping of programme outcomes with programme educational objectives

Programme educational objectives	Programme outcomes (POs)									
PEOs	A	B	C	D	E	F	G	H	I	Correlation
1	1	1	1	1	1	1	1	1	1	Highly Correlated
2	1	1	1	1	0	1	1	1	1	Highly Correlated
3	1	1	1	1	0	1	1	1	1	Highly Correlated
4	1	0	0	0	1	0	0	1	1	Weakly Correlated
5	1	0	1	0	0	0	1	1	1	moderately Correlated
6	1	1	1	1	1	1	1	1	1	Highly Correlated

Mapping of programme outcomes with graduate attributes

Programme outcomes	Graduate attributes										
	a	b	c	D	E	f	g	h	I	j	K
A	*	*	*		*			*		*	*
B	*	*	*	*	*	*	*	*	*	*	*
C	*	*	*	*	*	*		*	*	*	*
D	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*		*			*	*	*	*
F	*	*	*		*	*	*	*	*		*
G	*	*	*	*	*	*		*		*	*

H	*	*	*		*	*		*	*	*	*
I	*	*				*	*	*	*	*	

COURSE OUTCOMES

I. Engineering knowledge
II. Problem Analysis skills
III. Expertise for Design/development of solutions
IV. Conduct investigations of complex problems
V. Modern tool design
VI. Interaction of Engineer and the society
VII. Environment and sustainability
VIII. Ethics
IX. Individual and team work
X. Effective communication
XI. Project management and finance
XII. Lifelong learning

M.Tech- Environmental Engineering

Total credits for the course- 68

SEMESTER- I - 21

SEMESTER-II - 21

SEMESTER-III - 14

SEMESTER-IV - 12

SCHEME

SCHEME FOR M.TECH PROGRAMME IN ENVIRONMENTAL ENGINEERING

SEMESTER-I

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	07 MA 6001	Applied Statistics	4-0-0	40	60	3	4
B	07CE 6103	Environmental Chemistry	4-0-0	40	60	3	4
C	07CE 6105	Physico Chemical Methods In Environmental Engineering	4-0-0	40	60	3	4
D	07CE 6107	Environmental Microbiology	3-0-0	40	60	3	3
E		Elective	3-0-0	40	60	3	3
	07GN 6001	Research Methodology	0-2-0	100	0	0	2
	07CE 6109	Advanced Environmental Engineering Lab –I	0-0-2	100	0	0	1
	07CE 6111	Introduction to seminar	0-0-1	0	0	0	0
TOTAL CREDITS							**21**

LIST OF ELECTIVES FOR FIRST SEMESTER

07 CE 6113	-	Industrial Water Pollution Control
07 CE 6115	-	Environmental Health and Hygiene
07 CE 6117	-	Instrumental Methods in Environmental Engineering
07 CE 6411	-	Watershed Conservation and Management
07 CE 6413	-	Information Technology for GIS Data Management
07 CE 6407	-	Surface Water Hydrology

SEMESTER- II

Exam Slot	Course No.	Name	L-T-P	Internal	End semester		Credits
					Marks	Duration (3 hrs)	
A	07CE 6102	Biological Methods In Environmental Engineering	4-0-0	40	60	3	4
B	07CE 6104	Air Quality Management And Meteorology	3-0-0	40	60	3	3
C	07CE 6106	Environmental Impact Assessment	3-0-0	40	60	3	3
D		Elective II	3-0-0	40	60	3	3
E		Elective III	3-0-0	40	60	3	3
	07CE 6108	Seminar	0-0-2	100	0	0	2
	07CE 6112	Mini Project	0-0-4	100	0	0	2
	07CE 6114	Advanced Environmental Engineering Lab-II	0-0-2	100	0	0	1
TOTAL CREDITS							**21**

LIST OF ELECTIVES FOR SEMESTER-II

07 CE 6116 - Water Pollution Control and Stream Sanitation

07 CE 6118 - Environmental System Analysis

07 CE 6404 - Advanced Groundwater Hydrology

07 CE 6414 - Water Power Engg.

07 CE 6418 - Fluvial Hydraulics

07 CE 6424 - Data Acquisition in Hydroinformatics

07 CE 6422 - Groundwater Contamination and Pollution Transport

SEMESTER- III

Exam Slot	Course No.	Name	L-T-P	Internal	End semester		Credits
					Marks	Duration (3 hrs)	
A		Elective IV	3-0-0	40	60	3	3
B		Elective V	3-0-0	40	60	3	3
	07CE7101	Seminar	0-0-2	100	0	0	2
	07CE7103	Project (Phase 1)	0-0-12	50	0	0	6
TOTAL CREDITS							**14**

LIST OF ELECTIVES FOR THIRD SEMESTER

07 CE 7107 - Environmental Biotechnology

07 CE 7109 - Solid and Hazardous Waste Management

07 CE 7111 - Planning and Design of Environmental Facilities

07 CE 7113 - Bioremediation Principles and Applications

07 CE 7115 - Environmental Geology

07 CE 7117 - Environmental Legislation

07 CE 7405 - Groundwater Modelling and Management

07 CE 7409 - Numerical Methods

07 CE 7413 - Soft Computing Techniques

07 CE 7415 - Spatial Analysis in Watershed Management

07 CE 7417 - Artificial Neural Networks

SEMESTER- IV

Exam Slot	Course No.	Name	L-T-P	Internal	End semester		Credits
					Marks	Duration (3 hrs)	
	07CE7104	Project (Phase 2)	0-0-21	70	30	0	12

Syllabi & Course plan

Course No:07 MA 6001 Course Title: APPLIED STATISTICS

Credits: 4-0-0: 4 Year :2015

Pre-requisites: Nil

Course Objective:

- To enable the students apply statistics in various areas of Environmental /Water Resources Engineering like sampling and analysis, stochastic modeling etc.

Syllabus

Probability distributions: Probability mass functions and probability density functions. Mean and variance. Binomial Poisson, Exponential, Gamma, Uniform and normal distribution. Regression and correlation: Linear regression and correlation, partial and multiple correlation and regression. Population, random samples, parameter, statistic, sampling distribution of mean, variance. Central limit theorem (no proof). Point Estimators, Unbiasedness, maximum likelihood estimator, error estimates, interval estimation, confidence interval for means, difference between means and variances. Testing of Hypotheses: Hypothesis concerning one mean, two means, paired t-test, proportions, one variance, two variances, two observed correlation Coefficients-Fishers' Z-transformation. Fitting of distributions, Chi-square test of goodness of fit. Applications: Analysis of variance. Completely randomized designs and randomized block designs. Latin squares. Factorial experiments. Time Series Models: Components of time series, moving average method.

Course Outcomes

- Apply the basic knowledge of the probabilistic distribution function to the field of engineering
- Develop the regression equation for various phenomenon under consideration
- Design and Testing of hypothesis
- Distinguish different time series models

References:

1. Gupta.S.C. and Kapoor.V.K, Fundamentals 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: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan:

Course No:07 MA 6001 Course Title: Applied Statistics (L-T-P : 4-0-0) Credits:4		
MODULES	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 Probability distributions: Probability mass functions and probability density functions. Mean and variance. Binomial Poisson, Exponential, Gamma, Uniform and normal distribution.	**9**	**15**
MODULE 2 Regression and correlation: Linear regression and correlation, partial and multiple correlation and regression.	**8**	**15**
FIRST INTERNAL TEST		
MODULE 3 Population, random samples, parameter, statistic, sampling distribution of mean, variance. Central limit theorem (no proof)	**8**	**15**
MODULE 4 Point Estimators, Unbiasedness, maximum likelihood estimator, error estimates, interval estimation, confidence interval for means, difference between means and variances.	**9**	**15**
SECOND INTERNAL TEST		
MODULE 5 Testing of Hypotheses: Hypothesis concerning one mean, two means, paired test, proportions, one variance, two variances, two observed correlation Coefficients-Fishers' Z-transformation. Fitting of distributions, Chi-square te of goodness of fit.	**11**	**20**
MODULE 6 Applications: Analysis of variance. Completely randomized designs and randomized block designs. Latin squares. Factorial experiments. Time Series Models: Components of time series, moving average method.	**11**	**20**

Course No: 07 CE 6103 Course Title: ENVIRONMENTAL CHEMISTRY

Credits: 4-0-0: 4 Year : 2015

Course Objectives:

- Emphasis on fields of Chemistry which are particularly valuable for understanding environmental problems.
- Essential understanding of instrumental techniques used for identification and quantification of various types of contaminants

Syllabus

Introduction to Adsorption, Buffer capacity of soil; Colloids, Aerosols, Desalination by reverse osmosis; Radioactivity, Nuclear energy, Radioactive waste disposal; Chemistry of water, water pollution, Advanced Oxidation Processes; Organic pollutants in the environment, Biodegradation of pesticides; Chromatography, Electrophoresis, Spectroscopic methods of analysis

Course outcomes:

- The concepts, processes and technologies discussed in this course will benefit the student to enrich his/her basic knowledge and have profound importance to fill the gap between the root-cause and protection of environment.
- Obviously, different analytical techniques discussed in this course allows him/her to select the most appropriate for the specific treatment problems.

Text Books:

References:

1. C.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)

6. David Harvey - Modern Analytical Chemistry (McGraw-Hill Higher Edn)

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 6103 Course Title: Environmental Chemistry (L-T-P : 4-0-0) Credits:4		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Introduction to Adsorption – physisorption and chemisorption. Adsorption of pollutants and nutrients introduced to soil - principal factors governing sorption in soils. Acids and bases (different concepts), ionic product of water, pH and buffers – Henderson Hasselbalch's equation. Buffer capacity of soil, soil acidity and liming.	8	15
MODULE : 2 Colloids - classification, properties and their stability (zeta potential). Atmospheric (tropospheric and stratospheric) aerosols. Destruction of colloids – basic methods of coagulation. Desalination by reverse osmosis. Spectroscopy based on scattering (Turbidimetry and Nephelometry).	8	15
FIRST INTERNAL TEST		
MODULE : 3 Radioactivity: Atoms, nuclear stability and radioactivity, radioactive decay (α, β, γ), half life period, nuclear fission, nuclear energy, storage and disposal of spent fuel and high level radioactive waste. Principles and applications of neutron activation analysis and radiocarbon dating.	9	15
MODULE : 4 Chemistry of water: Pollutants in water – determination of water quality parameters like acidity, alkalinity, BOD, COD. Hardness, hardness removal techniques, analysis of minerals such as Fe, Ca, and Mg in water. Mineralization of organic contaminants in water by advanced oxidation processes.	9	15
SECOND INTERNAL TEST		
MODULE : 5 Major organic pollutants in the environment: Polycyclic aromatic hydrocarbons, persistent organic pollutants (like DDT and hexachlorobenzene) polychlorinated biphenyls, synthetic pesticides (classification), and volatile organic compounds. Biodegradation of pesticides - enzymatic activities.	11	20
MODULE : 6 Chromatography: Thin layer, gas (flame ionization and electron capture detectors), HPLC, size exclusion and supercritical fluid chromatography. Electrophoresis - Theory of capillary electrophoresis and capillary electrochromatography. Spectroscopic methods of analysis – IR, UV-visible – atomic absorption spectroscopy	11	20

Course No: 07CE 6105

Course Title: PHYSICO CHEMICAL METHODS IN ENVIRONMENTAL ENGINEERING

Credits: 4-0-0: 4 Year : 2015

Pre-requisites: Basic course on water supply engineering (desirable)

Course Objectives:

- To make the students understand the principles of physico-chemical treatment methods in Environmental Engineering.
- To equip them with various advanced treatment methods for the removal of specific constituents.
- To equip them to think about a green and clean technology.
- Select the right treatment process for up-gradation and understand the cost-benefit analysis of the treatment process.

Syllabus:

Process dynamics-Reactions and Reactors- Mass balance analysis. Screenings-types of screens-Equalization process-types of equalization process-volume of equalization basins. Sedimentation- -design of sedimentation tanks. Coagulation and flocculation- types of mixers used- chemical precipitation- for phosphorous removal. Floatation and aerosol separation-Filtration-filtration processes-design of filters- depth filtration- surface filtration. Disinfection-processes- -modelling of chlorine disinfection- Adsorption-adsorption isotherm-adsorption kinetics-factors influencing-design of adsorption units. Chemical oxidation-principles and theories-generation and application of chemical methods-Advanced oxidation process. Ion exchange- process- design of units.Membrane Filtration Processes- Reverse osmosis-electrodialysis-design of units -ultra filtration- Nano filtration

Course Outcomes:

- Able to get a professional level knowledge enhancement and employment facility and or pursue higher degree
- The students are able to design a treatment unit or treatment plant with respect to inorganic waste
- Students will understand the engineering design process of membrane bioreactor and compare the design parameters with a conventional treatment plant.
- Furthermore, students will develop and assess the capability of student to apply their knowledge to the design of an advanced water/wastewater treatment plant for wastewater reuse.

Text books

1. Metcalf & Eddy. Wastewater Engineering (Tata Mc Graw Hill Publishing Company Limited, Fifth Edition)
2. Weber, W.J. Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983

References

1. Peavy, H.S., Rowe, D.R., Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985
2. Mark J. Hammer and Mark J Hammer Jr., Fourth Edition, Water and Wastewater Technology, Prentice Hall of India Pvt. Ltd.
3. M N Rao and A K Dutta, Wastewater Treatment, Oxford-IBH Publishers
4. R.D. Noble and S.A. Stern, Membrane Separation Technology: Principles and Applications, Elservier, 1995.
5. Rich L. G. Unit operations of sanity engineers(Wiley Topan)
6. Fair G. M. etal- Water and wastewater engg
7. Stermm,W& Morgan J. J.-Aquatic chemistry
8. Gerard Kiely ,Environmental engineering , 2007 Edition, Tata Mc Graw Hill Publishing Co. Ltd.
9. E.D. Schroeder, Water & Wastewater Treatment, McGraw Hill, 1977.
10. J.G. Crespo and K.W. Boddekes, Membrane Processes in Separation and Purification, Kluwer Academic Publications,1994
11. R. Rautanbach and R.Albrecht, Membrane Process, John Wiley & Sons, 1989
12. Wilf, M. (2007) The guidebook to membrane desalination technology: reverse osmosis, nanofiltration and hybrid systems: process, design, applications, and economics, Balaban Desalination Publications.
13. Faust, S.D. (1996) Chemistry of water treatment, Chelsea, MI : Ann Arbor Press

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 6105 **Course Title: Physico Chemical Methods in Environmental Engineering** **(L-T-P : 4-0-0) credits:4**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1		
Process dynamics-Reactions – order of reactions	2	
Reactors- Types of reactors- hydraulic characters of reactors	2	
Mass Balance analysis- PFR, CFSTR, CFSTR in series etc.	2	15
Reaction kinetics and process design.	2	
Total hrs	**8**	
MODULE : 2		
Screenings-types of screens	2	
Head loss in screens- Screenings handling, processing and disposal	2	
Coarse solids reduction methods.	2	15
Equalization process-types of equalization process-volume of equalization basins	2	
Sedimentation-sedimentation processes- types of settlings in detail	2	
tube settlers-design of sedimentation tanks	1	
Total hrs	9	
FIRST INTERNAL TEST		
MODULE : 3		
Coagulation and flocculation- types of mixers used	2	
High rate clarification-different methods	2	
coagulation processes-stability of colloids	1	
destabilisation of colloids in water and wastewater treatment-transport of colloidal particles	1	15
chemical precipitation- for phosphorous removal	1	
Floatation and aerosol separation-methods of floatation	1	
gas particle contact-dissolved air floatation.	1	
Total hrs	9	
MODULE : 4		
Filtration-filtration processes-filter media	2	
types of filters-mechanisms of filtration-hydraulics of filtration	1	
filter problems –head loss in filters-effluent quality-design of filters	2	15
depth filtration- surface filtration	2	
Disinfection-processes-methods of disinfection-factors influencing-nonchemical methods-	1	
Total hrs	8	
SECOND INTERNAL TEST		
MODULE : 5		
Details of chlorination-modelling of chlorine disinfection	2	
disinfection with chlorine dioxide-dechlorination-disinfection with ozone	2	
other chemical disinfection methods-UV radiation disinfection.	1	
Adsorption-adsorption process-adsorption isotherm-	2	
Adsorption kinetics-factors influencing-design of adsorption units	1	20
Chemical oxidation-principles and theories-generation and application of chemical methods	2	
Advanced oxidation process	1	
Total hrs	11	

MODULE : 6		
Ion exchange- process-materials-exchange reactions	2	
application in water and wastewater treatment-design of units	2	
Membrane Filtration Processes- membrane properties-process design-	2	20
Reverse osmosis-design of units-problems	2	
Electrodialysis-design of units –problems	2	
Ultra filtration- Nano filtration	1	
Total hrs	11	

Course No: 07CE 6107 Course Title: ENVIRONMENTAL MICROBIOLOGY

Credits: 3-0-0: 3 Year :2015

Pre-requisites: nil

Course Objectives:

- To understand the fundamentals of biological treatment process in environmental engineering
- To understand the role of microorganisms, in various fields viz industry, water and waste water ,soil and air
- This course provides students with a foundation in environmental microbiology for applications in pollution control and biotechnology

Syllabus

Microbiology- Introduction. General properties of bacteria, fungi, algae, protozoa, Viruses. Application in sanitary Engineering. Methods of examination of microorganism. Characteristics of bacteria, Microbial growth. Microbial metabolism. Culture Media. Microbiology of water, wastewater, soil and air.Bacteriological analysis of water. Water borne diseases and their causative organisms. Industrial microbiology and products. Role of microorganisms in biogeochemical cycling. Dairy microbiology-diseases transmitted through milk. Importance of sterilization, factors influencing sterilization, principles and methods

Course outcomes:

- For effective planning and design of biological processes and treatment methods.
- Effective implementation in Biotechnology field

Text Books

1. Rose E Mckinney. Microbiology for sanitary engineers-Tata McGraw Hill series in sanitary engineering and science.
2. Gamey and Lord. Microbiology for waste water and sewage
3. Pelczar, M.J., Chan E.C.S. and Krieg, N.R. Microbiology, Tata McGraw Hill, New Delhi, 1993.
4. Alan H Varnam, Malcon G Evans, Environmental microbiology, CRC Press

References

1. Tortora. G.J, B.R. Furke, and C.L.Case, Microbiology-An introduction (4thEd.), Benjammin/Cummings publ.Co.,Inc., California,1992.

2. Keya Sen, Nicholas J Ashbolt, Environmental microbiology: Current technology and water applications, Caister Academic press
3. Standard methods .APHA.

4. Roger T Stainer and Michael Dandroff. General Microbiology.

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan:

Course No: 01CE 6107 Course Title :Environmental Microbiology (L-T-P:3-0-0) Credits:3		
MODULES	**Contact hrs**	**Sem.exam Marks %**
MODULE:1		
Introduction to microbiology	1	
Microorganism and their characteristics- classification	2	15
Application in sanitary engineering.	2	
General characteristics of the bacteria, algae, fungi, protozoa, viruses.	2	
Total hrs	***7***	
MODULE:2		
Principles and use of light microscopes	1	
Dark field, bright field, phase contrast and fluorescent.	2	
Electron microscopes- Scanning and Transmission type.	1	
Comparison between various types, Merits and Demerits	1	15
Characteristics of bacteria - Morphology and structure of bacteria		
Observation of wet and stained preparation - Grams stain.	1	
Total hrs	***6***	
FIRST INTERNAL TEST		
MODULE:3		
Growth of bacteria, growth curve factors influencing growth	2	
Aerobic and anaerobic growth	1	
Role of enzymes, mechanism of action and factors influencing enzyme action	1	15
Basic concepts of metabolism. Principle of bioenergetics	2	
Culture media, composition, classification.	1	

Total hrs	***7***	
MODULE:4		
Microbiology of water, wastewater	2	
Soil and air	1	15
Water borne diseases and their causative organisms,		
Bacteriological analysis of water and sewage, test for coliforms, their significance	2	
Bacteriological standards, MPN, Membrane filter technique.	1	
Total hrs	*6*	
SECOND INTERNAL TEST		
MODULE:5		
Microbial production of industrial products-	2	
Microorganisms and Industry	2	
Major classes of products and Processes	2	
Principles of bio technology applied to waste treatment,	1	20
Waste utilization		
Bio-energy conversion	1	
Total hrs	8	
MODULE:6		
Biogeochemical cycling.	2	
Role of microorganisms in biogeochemical cycle	1	
Dairy microbiology-diseases transmitted through milk	2	20
Pasteurization-different methods-Test for Pasteurization	1	
Importance of sterilization, factors influencing sterilization,		
principles and methods	2	
Total hrs	8	

Course No: 07 CE 6113

Course Title: INDUSTRIAL WATER POLLUTION CONTROL ENGINEERING

Credits: 3-0-0: 3 Year :2015

Pre-Requisites: Knowledge about the treatment of wastewater

Course Objectives:

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

Syllabus

Damages caused by industrial pollution- Effects of industrial waste on stream- sewage treatment plants- Study of some typical problem caused by industrial pollution in India. Volume reduction of industrial waste- strength reduction of industrial waste- Treatment using advanced technologies like MBR, MBBR, FBR.Joint treatment of raw industrial waste with domestic sewage- Discharge of treated waste to municipal sewers- Stream protection measures. Industrial manufacturing process, characteristics of waste, waste management and treatment methods of the following industries Dairy plant, Canneries, Distilleries, Fishing industry and Sugar mills, Textile mills, Tanneries, Pulp and paper mills, Rubber industry and Metal plating industry, Oil refineries, Petrochemicals , Fertilizer plant, steam power plant-management and disposal of radioactive wastes.

Course Outcomes:

- Various treatment methods and preventive aspects of pollution of chemical process industries which release emissions, wastewater, solid residue and effluent, leading to degradation of the environment can be assessed in a broad overview.
- Indiscriminate and unregulated exploitations of both renewable and non renewable resources can be avoided.
- Increase awareness regarding imperative need for proper treatment Systems to control pollution.

References

1. N.L. Nemerrow –Theories and practices of Industrial Waste Engineering. Addison- Wesley Pub.Co.
2. Charles .Fred. Gurnham –Principles of Industrial Waste Engineering., Wiley publishers
3. M.N. Rao and Dutta – WasteWater Treatment, Oxford-IBH Publishers.
4. Berne F. – Industrial Water Treatment, gulf Publishing Company

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course plan

Course N0: 07CE 6113 **Course Title: Industrial Water Pollution Control** **(L-T-P : 3-0-0) Credits :3**		
MODULES	Contact hours	Sem.Exam Marks; %
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	7	15
MODULE 2 Need for environment impact assessment for major industries. Volume reduction of industrial waste- strength reduction of industrial waste-neutralization- equalization and proportioning	7	15
FIRST INTERNAL TEST		
MODULE 3 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.	7	15
MODULE 4 Industrial manufacturing process, characteristics of waste, waste management and treatment methods of the following industries Dairy plant, Canneries, Distilleries, Fishing industry and Sugar mills..	7	15
SECOND INTERNAL TEST		
MODULE 5 Industrial manufacturing process, characteristics of waste, waste management and treatment methods of the following industries Textile mills, Tanneries, Pulp and paper mills, Rubber industry and Metal plating industry	10	20
MODULE 6 Industrial manufacturing process, characteristics of waste, waste management and treatment methods of the following industries Oil refineries, Petrochemicals, Fertilizer plant, steam power plant-management and disposal of radioactive wastes.	10	20

Course No: 07 CE 6115

Course Title: ENVIRONMENTAL HEALTH AND HYGIENE

Credits: 3-0-0: 3 Year :2015

Pre-requisites: **Nil**

Course Objectives:

- To make the students aware about environmental issues like adverse effect of pollutants on health and control methods for mitigating the effects.
- Introduce the students to our natural environment and the human interactions with our environment and global community from a hygienic perspective.
- Analyze physical, chemical, biological and ergonomic agents, factors and/or stressors with the human body:
- Recognize, evaluate, and control the factors in the environment that may cause illness, injury, or impairment;

Syllabus

Health- various aspects-factors –diseases-world wide problems- Occupational health related problems- Disease-control, prevention, food borne and water borne diseases - Nuclear energy and environmental health- Environmental health planning-national and international level- law and human welfare- environmental education

Course Outcomes:

- Increase the awareness of environmental issues and how they affect society.
- Develop skills and insight into critical thinking and situational awareness of surrounding environment.
- Develop quantitative skills needed to function as a professional in occupational and environmental hygienist.
- Understand basic biological concepts needed to evaluate exposure-response relationships.

Text Books

References

1. N H Seemayer, W Hadmagy, Edited by Springer- Vorlag
   Willgoose-Environmental Health
2. Morgan-Environmental Health
3. Cairncross and Feachem-Environmental Health engineering in tropics
4. H. Koren, Handbook of Environ mental Health and Safety –principle and practices, Lewis Publishers, 1991.
5. I. C. Shaw and J. Chadwick, Principles of Environmental Toxicology, Taylor & Francis ltd, 1998

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End Semester Examination:60 Marks

Course No: 07CE 6115 Course Title: Environmental Health and Hygiene (L-T-P : 3-0-0) Credits:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
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	6	15
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 .	7	15
FIRST INTERNAL TEST		
MODULE : 3 Foodborne, air borne and waterborne diseases outbreaks, Disease control, disease prevention, morbidity and mortality, diseases and progressive deterioration, controlling diseases and disability., epidemiology, chronic and communicable diseases, vector control, controlling stress of life.	6	15
MODULE : 4 Nuclear energy and environmental health, concerns and uncertainties about nuclear power, nuclear power plants, safety. E waste and environmental health. MSW and environmental health.	7	15
SECOND INTERNAL TEST		
MODULE : 5 Environmental health planning, need for planning, the planning process. Environmental health services, various agencies, International efforts, role of industry, voluntary health agencies. family health practices, health care planning and delivery.	8	20
MODULE : 6 Law and human welfare, constitutional right to healthy environment, environmental education. worldwide nutrition and population control.	8	20

Course No: 07CE 6117

Course Title: INSTRUMENTAL METHODS TO ENVIRONMENTAL ENGINEERING

Credits: 3-0-0: 3 Year :2015

Pre requisite: Basic understanding of chemistry, physics

Course Objectives:

- To provide information regarding principles and details of quantitative analysis of different parameters present in water and air.
- Teach the students about the principles and techniques of instrumental analysis which are utilized to support decision making in environmental engg.
- To provide a fundamental understanding of the principles, capabilities and limitations of modern chemical analysis used in environmental field.
- To provide a practical experience of the use of analytical instruments for the analysis of environmental samples
- To provide the necessary background for understanding the scientific literature that pertains to environmental chemical analysis.
- Develop an understanding of experimental, calibrational and analytical errors and the significance of statistical and quality assurance methods

Syllabus

This syllabus provides Basic Principles, Instrumentation and application Instrumental methods in environmental engineering, analytical methods, chemical, instrumental and biological method - Analytical instruments and process instruments used in the Environmental Engineering field- Optical methods of analysis:absorption and emission methods-Chromatography:general principles and specific techniques-,computer aided analysis,process instrumentation and control in lab and pilot experiments.

Course Outcomes:

- Ability to design experiments and conduct lab works pertinent to environmental analyses confidently, efficiently and in a safe manner.
- Ability to interpret results from laboratory tests, and analyse data and suggest remedies to common analytical problems encountered in the environmental engg
- Able to analyze waters and wastewaters for a wide range of advanced chemical characteristics like specific organic and inorganic contaminants, TOC,

Text books:

References:

1. Sawyer and McCarty-Chemistry for environmental engineering, Tata McGraw Hill
2. Kemmer-The NALCO Water Handbook, Tata McGraw Hill
3. Keith A Smith, Malcalm S Cressar, Soil & Environment Analysis, Modern Instrumental Techniques, Marcel Dekker, inc.
4. D.A. Skoog, D.M. West and T.A. Nieman, Principles of Instrumental Analysis,5th Ed. Thomson Asion (P) Ltd. Singapore, 2004
5. H.H, Willard, L.L. Merit, J.A. Dean and F.A. Settle, Instrumental Methods of Analysis, 7th Ed. CBP Publishers and Distributors, New Delhi, 1986
6. Daniel C Harris, Quantitative chemical analysis, 8th edn (2011)
7. Prdyot Patnaik, Hand bok of envtl analysis:chemical pollutants in air, water soil and solid wsats, 2nd edn.
8. Principles of instrumentsal abnalysis, 6th edn Skog, Holler and Nieman

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 6117 Course Title: Instrumental Methods in Environmental Engineering (L-T-P : 3-0-0) Credits:3		
MODULES	**Contact hours**	**Sem.Exam Marks; %**
MODULE : 1 Basic Principles, Instrumentation and application of solvent extraction, ion exchange,electrophoresis, Limitations of analytical methods Accuracy and precision classification and minimization of errors. Instrumental methods in environmental engineering, analytical methods, chemical, instrumental and biological methods. Analytical instruments and process instruments	6	15
MODULE : 2 Sensors, body of the instrument, read out, accuracy, precision, sensibility, range, resolution.Transducers- measurement of nonelectrical quantities like pressure,temperature,displacement,velocity,accelerationetc.strain gauge and its applications, use of microprocessors in instrumentation. Potentiometer:pHmeter,ionselectiveelectrodes,redoxpotential.Polarographicanalysis,photometry, DO meter, conductivty, coulometry and its applications.	7	15
FIRST INTERNAL TEST		
MODULE : 3 Optical methods of analysis:absorption and emission methods, interaction of radiation with different types of molecular energy Basic principles, Instrumentation and Applications of visible spectrum photometer, Spectrophotometry- U.V. Spectrometer,infraredspectrometer,flame photometer, atomic absorption spectrophotometer.X-ray diffraction method,massspectrometer,methods using microscopy,refractrometric method	6	15
MODULE : 4 Dispersion and scattering:turbidimetry and nephelometry,fluorimetry.Thermal conductivity method ,radioactivity methods,sound absorption method	7	15
SECOND INTERNAL TEST		
MODULE : 5 Chromatography:general principles and specific techniques-thin layer,column,liquid, high performance, ion etc	8	20
MODULE : 6 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	8	20

Course No: 07 CE 6411

Course Title: WATERSHED CONSERVATION AND MANAGEMENT

Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objective:

- To provide a comprehensive treatise on the engineering practices of watershed management for realizing the higher benefits of watershed management.

Syllabus:

Introduction to watershed – Significance – Geology – Soil – Morphological Characteristics – Elements – Land Capability Classification –Delineation – Codification – Factors Influencing Watershed Development. Fundamental concepts of geomorphology, Geomorphic agents and processes; Weathering and soil processes; Soil Conservation Practice**:** Types of Erosion – Wind Erosion: Causes, Factors, Effects and Control – Water Erosion: Types, Factors, Effects – Engineering Measures for Erosion Control in Agricultural and Non-Agricultural Lands – Estimation of Soil Loss. Water Harvesting Techniques – Design of Small Water Harvesting Structures – Types of Storage Structures – Yield from a Catchment – Losses of Stored Water. Watershed Management: Strategies – Identification of Problems – Watershed Development Plan – Entry Point Activities — Concept of Priority Watersheds – Agro forestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes –Developing Collaborative know how – People's Participation – Evaluation of Watershed Management. Watershed Assessment Models: Regulation and Restoration – A Brief Description and Significance of Watershed Models: SWAT, TMDL, AGNPS, BASINS, CREAMS – Case Studies.

Course Outcomes:

- Plan and design soil conservation measures in a watershed
- Plan and design water harvesting and groundwater recharge structures
- Use watershed models for planning and management of watersheds

References:

1. Debarry A. Paul, Watersheds, Wiley and Sons, 2004.
2. Devanport E. Thomas, Watershed Project Management Guide, Lewis Publishers, London, 2003.
3. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India Private Limited, New Delhi, 2000.
4. Glenn O. Schwab, Soil and Water Conservation Engineering, John Wiley and Sons, 1981.
5. Gurmail Singh, A Manual on Soil and Water Conservation, ICAR Publication, New Delhi, 1982.
6. Suresh, R. Soil and Water Conservation Engineering, Standard Publication, New Delhi, 1982.
7. Thornbury, W.D. *Principles of Geomorphology*, Wiley, 1968.

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan:

Course No:07 CE 6411 Course Title: Watershed Conservation and Management **(L-T-P : 3-0-0) Credits:3**		
MODULES	**Contact Hours**	**Sem. Exam marks %**
MODULE 1 **Water shed**: Introduction – Significance – Geology – Soil – Morphological Characteristics – Elements – Land Capability Classification –Delineation – Codification – Factors Influencing Watershed Development. Fundamental concepts of geomorphology, Geomorphic agents and processes; Weathering and soil processes	**7**	**15**
MODULE 2 **Soil Conservation Practice:** Types of Erosion – Wind Erosion: Causes, Factors, Effects and Control – Water Erosion: Types, Factors, Effects – Engineering Measures for Erosion Control in Agricultural and Non-Agricultural Lands – Estimation of Soil Loss	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 **Water Harvesting Techniques** – Design of Small Water Harvesting Structures – Types of Storage Structures – Yield from a Catchment – Losses of Stored Water. Water conservation practices – manuals and guidelines	**7**	**15**
MODULE 4 **Watershed Management:** Strategies – Identification of Problems – Watershed Development Plan – Entry Point Activities — Concept of Priority Watersheds – Agro forestry – Grassland Management – Wasteland Management	**7**	**15**
SECOND INTERNAL TEST		

MODULE 5 **Government Initiative**: Watershed Approach in Government Programmes –Developing Collaborative know-how – People's Participation – Evaluation of Watershed Management.	**7**	**20**
MODULE 6 **Watershed Assessment Models:** Regulation and Restoration – A Brief Description and Significance of Watershed Models: SWAT, TMDL, AGNPS, BASINS, CREAMS – Case Studies	**7**	**20**

Course No: 07 CE 6413

Course Title: INFORMATION TECHNOLOGY FOR GIS DATA MANAGEMENT

Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objectives:

To study the data base management systems and basic internet technologies for the effective introduction of Geographic Information Systems.

Syllabus:

Database Management Systems: Data - Information-Types – Database Models -Data encoding-Hardware and Software requirements -Database Management Systems-Types of DBMS - Hierarchial, Network, Relational Models - E-R diagram- Modern DBMS – Distributed Databases – Client Server Databases –Knowledge Based Systems- Geographic Databases -GIS. **File Organisation and Normalisation:** File Organisation-Sequential, Indexed Sequential, Random, Multi key file Organisation- advantages and disadvantages. Relational Database Management System- Relational Algebra – Normalisation up to BCNF – Basic SQL commands - case study for normalization using a Geographic data. **Fundamentals of computer networks:** Computer networks-network layers-data communication concepts-Land topology and transmission media– network security–OSI reference model. Network Security- Principles of Cryptography, Authentication, Integrity, Key Distribution and Certification. Access Control: Firewalls, Attacks and Countermeasures. **Web Technologies**: Principles of Application Layer Protocols –The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, DNS-The Internet's Directory Service - Static Web page: Types and Issues. HTML-different tags, sections image & pictures, listings, tables, frame, frameset, form. - Example pages- Dynamic Web Pages - The need of dynamic web pages.

Course Outcomes:

- Select an appropriate normalisation and Design a database for spatial information
- Manage network security and firewall
- Comprehend different web management protocols

References:

1. Elmasri & Navathe, *Fundamentals of Database Systems*, Pearson Education, fourth edition.
2. Keiser, G.E., Local area networks, Tata Mc Grawhill
3. C. J. Date, An Introduction to Database Systems, Addison Wesley, sixth edition, 1995
4. Kurose J.F. &Ross K.W, *Computer Networking:A Top –Down Approach Featuringthe Internet*, Pearson Education
5. Behrouz A Forouzan, Data Communications and Networking (SIE), Tata McGraw Hill.
6. Kenneth C. Laudon, Carol Guercio Traver, *E-Commerce-Business, Technology, Society*, Pearson Education.
7. Willian Stallings, Cryptography and Network Security, Fifth Edition, Pearson Education.
8. Bipin C. Desai, An Introduction to Database Systems,Galgotia Publications PVTLTD First edit1993
9. Ramakrishnan R. &Gehrke J., *Database Management Systems*, McGraw Hill
10. O'neil P. & O'neilE., *Database Principles, Programming, and Performance*, Harcourt Asia,Morgan Kaufman
11. Silberschatz A, Korth H.F., & Sudarshan S., *Database System Concepts*, Tata McGraw Hill
12. UllmanJ.D, *Principles of Database Systems*, Galgotia Publications
13. Nalin K. Sharda, *Multimedia Information Networking*, Prentice Hall of India.
14. Douglas E. Comer, *Computer Networks and Internets with Internet Applications*, Pearson Education
15. Stallings, *Computer Networking with Internet Protocols*, Pearson Education Asia.
16. Goncalves M, *Firewalls: A Complete Guide*, Tata McGraw Hill.
17. Kalakota R. &WhinstonA.B, *Frontiers of Electronic Commerce*, Addison Wesley.
18. Schneider G.P. &Perry J.T, *Electronic Commerce, Course Technology*, McGraw Hill, NewDelhi,2003.

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No:07 CE 6413 **Course Title: Information Technology for GIS Data Management** **(L-T-P : 3-0-0) Credits:3**		
MODULES	**Contact Hours**	**Sem Exam Marks %**
MODULE 1 **Database Management Systems:** Data - Information-Types – Database Models -Data encoding-Hardware and Software requirements -Database Management Systems-Types of DBMS - Hierarchial, Network, Relational Models - E-R diagram- Modern DBMS – Distributed Databases – Client Server Databases –Knowledge Based Systems- Geographic Databases -GIS.	6	10%
MODULE 2 **File Organisation and Normalisation:** File Organisation-Sequential, Indexed Sequential, Random, Multi key file Organisation- advantages and disadvantages	7	15%
FIRST INTERNAL TEST		
MODULE 3 Relational Database Management System- Relational Algebra – Normalisation up to BCNF – Basic SQL commands - case study for normalization using a Geographic data.	8	15%
MODULE 4 **Fundamentals of computer networks:** Computer networks-network layers-data communication concepts-Land topology and transmission media–network security–OSI reference model. Network Security- Principles of Cryptography, Authentication, Integrity, Key Distribution and Certification Access Control: Firewalls, Attacks and Countermeasures	7	15%
SECOND INTERNAL TEST		
MODULE 5 **Web Technologies**: Principles of Application Layer Protocols –The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, DNS-The Internet's Directory Service - Static Web page: Types and Issues	7	20%
MODULE 6 HTML-different tags, sections image & pictures, listings, tables, frame, frameset, form. - Example pages- Dynamic Web Pages - The need of dynamic web pages.	7	20%

Course No:07CE 6407

Course Title: SURFACE WATER HYDROLOGY

Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objective:

To comprehend the basic concepts of the water cycle and hydrology to get a conceptual and quantitative understanding of hydrology to perform engineering hydrology computations

Syllabus

Fundamental hydrology. Hydrological cycle. Introduction, Components. Catchment description. Introduction to hydrologic models. Precipitation: Characteristics, collection and presentation of rainfall data, Test for consistency and continuity of data, average precipitation depth-area-duration analysis. Hydrologic abstractions: Interception and depression storage, evaporation. Infiltration-process, Infiltration indices. Components of runoff, factors affecting runoff, Hydrograph and its components: Base flow and its separation, Unit hydrograph theory and its application. Synthetic unit hydrograph, conceptual models. Hydrometry .Computation of peak flow. Flood routing. Statistical analyses of hydrologic data - frequency analysis, probability distribution. . Recurrence interval, I-D-F curve, flow duration curve, flow mass curve. Probability distribution functions, extreme value distribution, Gumbel's, Pearson Type –III, Stochastic processes, time series analysis, synthetic data generation.

Course Outcome:

At the end of the course student will be able to

- Analyze components of hydrologic cycle
- Predict hydrologic extreme events for hydraulic and hydrologic design
- Apply stochastic methods in solving hydrologic problems
- Assess surface water resources

Text Books:

1. Subramanya, K, "Engineering Hydrology", Tata McGraw Hill
2. Chow, V.T., Maidment, D.R., Mays, L.W., Applied Hydrology, McGraw Hill
3. Jayarami Reddi, P, A Text Book of Engineering Hydrology, Laxmi Publications

References:

1. Linsley, Kohler & Paulhus, Engineering Hydrology, McGraw Hill.
2. Mays, L.W., Water Resources Engineering, John Willey and Sons, US, 2001.
3. Haan, C. T., Statistical Methods in Hydrology, Iowa State University Press, 1977.
4. Alfredo H-S. Ang, Wilson H. Tang Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan:

Course No:07 CE 6407 **Course Title: SURFACE WATER HYDROLOGY** **(L-T-P : 3-0-0) CREDITS:3**		
MODULES	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 **Fundamental hydrology**-Hydrological cycle-components of hydrologic cycle. Catchment – description- stream patterns. Introduction to hydrologic models. **Precipitation**- forms, measurement, analysis of data, consistency, supplementing missing data, hyetograph, analysis, raingauge network, mean rainfall, DAD curves	**2** **4**	**15**
MODULE 2 **Hydrologic abstractions**: Interception and depression storage, evaporation- factors influencing .Evapotranspiration. Infiltration- process, measurement of infiltration, infiltration models, infiltration indices Runoff: - factors affecting Runoff, components of runoff, basin yield	**1** **4** **1**	**15**
FIRST INTERNAL TEST		
MODULE 3 Hydrograph and its components: Base flow and its separation, Unit hydrograph theory and its application for isolated and complex storms, S- curve, Unit hydrograph of varied durations. Applications	**7**	**15**

MODULE 4 Synthetic unit hydrograph- Snyder method, CWC method, Instantaneous unit hydrograph, conceptual models. Computation of peak flow: - Rational and Empirical relationships. Design flood, design storm, PMP, PMF. Dam safety. Flood rules. - CWC guide line	**4** **2** **2**	**15**
SECOND INTERNAL TEST		
MODULE 5 Hydrometry: Gauge and discharge sites, velocity measurement, area-velocity method, stage-discharge relation, rating curve. Flood routing: Routing through reservoirs and channels .Muskingum Method, Pul's Method	**3** **4**	**20**
MODULE 6 Statistical analyses of hydrologic data - frequency analysis, probability distribution and its application to rainfall and discharge data. Recurrence interval, I-D-F curve, flow duration curve, flow mass curve Probability distribution functions, extreme value distribution, Gumbel, Pearson Type –III, Stochastic processes, time series analysis, synthetic data generation	**4** **4**	**20**

Course No: 07 GN 6001 Course Title: RESEARCH METHODOLOGY

Credits: 0-2-0 : 2 Year : 2015

Prerequisites : Nil

Course Objectives

The main objective of the course is to provide a familiarization with research methodology and to induct the student into the overall research process and methodologies. This course addresses:

- The scientific research process and the various steps involved
- Formulation of research problem and research design
- Thesis preparation and presentation.
- Research proposals, publications and ethics
- Important research methods in engineering

As a tutorial type course, this course is expected to be more learner centric and active involvement from the learners are expected which encourages self study and group discussions. The faculty mainly performs a facilitator's role.

Syllabus

Overview of research methodology - Research process, scientific method, research design process.
Research Problem and Design - Formulation of research task, literature review, web as a source, problem solving approaches, experimental research, and ex post facto research.
Thesis writing, reporting and presentation -Interpretation and report writing, principles of thesis writing- format of reporting, oral presentation.
Research proposals, publications and ethics - Research proposals, research paper writing, considerations in publishing, citation, plagiarism and intellectual property rights.
Research methods – Modeling and Simulation, mathematical modeling, graphs, heuristic optimization, simulation modeling, measurement design, validity, reliability, scaling, sample design, data collection methods and data analysis

Course Outcomes

At the end of course, the student will be able to:

- Discuss research methodology concepts, research problems, research designs, thesis preparations, publications and research methods.
- Analyze and evaluate research works and to formulate a research problem to pursue research
- Prepare a thesis or a technical paper, and present or publish them
- Apply the various research methods followed in engineering research for formulation and design of own research problems and to utilize them in their research project.

References:

- C. R. Kothari, Research Methodology, Methods and Techniques, New Age International Publishers
- K. N. Krishnaswamy, Appa Iyer Sivakumar, M. Mathirajan, Management Research Methodology, Integration of principles, Methods and Techniques, Pearson Education
- R. Panneerselvam, Research Methodology, PHI Learning
- Deepak Chawla, Meena Sondhi, Research Methodology–concepts & cases, Vikas Publg House
- J.W Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York
- Schank Fr., Theories of Engineering Experiments, Tata Mc Graw Hill Publication.
- Willktnsion K. L, Bhandarkar P. L, Formulation of Hypothesis, Himalaya Publication.
- Fred M Kerlinger , Research Methodology
- Ranjit Kumar, Research Methodology – A step by step guide for beginners, Pearson Education
- John W Best, James V Kahan – Research in Education , PHI Learning
- Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co Ltd
- Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes
- Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
- Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
- Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
- Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
- Donald H.McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047- 0,2006
- Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers..
- Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing
- Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
- Additional suitable web resources
- Guidelines related to conference and journal publications

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests and assignments. There are three tests for the course (3 x 20 = 60 marks) and assignments (40 marks). The assignments can be in the form of seminar, group tasks, case studies, research work or in a suitable format as decided by the teacher. The assessment details are to be announced to students at the beginning of the semester by the teacher

Course Plan

Course No: 07 GN 6001 Course Title: RESEARCH METHODOLOGY (L-T-P : 0-2-0) CREDITS:2		
MODULES	**Contact hours**	**Int. Exam Marks %**
Module 1 Overview of Research Methodology Research concepts – meaning – objectives – motivation - types of research –research process – criteria for good research – problems encountered by Indian researchers - scientific method - research design process – decisional research	5	10%
Module 2 Research Problem and Design Formulation of research task – literature review – methods – primary and secondary sources – web as a source – browsing tools -formulation of research problems – exploration - hypothesis generation - problem solving approaches-introduction to TRIZ(TIPS)- experimental research – principles -Laboratory experiment - experimental designs - ex post facto research - qualitative research	5	10%
FIRST INTERNAL TEST		
Module 3 Thesis writing, reporting and presentation Interpretation and report writing – techniques of interpretation – precautions in interpretation – significance of report writing – principles of thesis writing- format of reporting - different steps in report writing – layout and mechanics of research report - references – tables – figures – conclusions. oral presentation – preparation - making presentation – use of visual aids - effective communication	4	10%
Module 4 Research proposals, publications, ethics and IPR Research proposals - development and evaluation – research paper writing – layout of a research paper - journals in engineering – considerations in publishing – scientometry-impact factor- other indexing like h-index – citations - open access publication -ethical issues - plagiarism –software for plagiarism checking- intellectual property right- patenting case studies	5	10%
SECOND INTERNAL TEST		
Module 5 Research methods – Modelling and Simulation Modelling and Simulation – concepts of modelling – mathematical modelling - composite modelling – modelling with – ordinary differential equations – partial differential equations – graphs heuristics and heuristic optimization - simulation modelling	5	10%
Module 6 – Research Methods – Measurement, sampling and Data acquisition Measurement design – errors -validity and reliability in measurement - scaling and scale construction - sample design - sample size determination - sampling errors - data collection procedures - sources of data - data collection methods - data preparation and data analysis	4	10%
END SEMESTER EXAMINATION		

Course No: 07CE 6109

Course Title: ADVANCED ENVIRONMENTAL ENGINEERING LAB-I

Credits: 0-0-2:1 Year : 2015

Pre-requisites: Basic course on Environmental Engineering Laboratory in Undergraduate level

Course Objectives:

- To analyse the characteristics of water/wastewater samples
- To analyse the parameters of soil sample

Syllabus:

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

Course outcome:

To equip the students with water and waste water quality analysis

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 Assessment:

Practical records/ Outputs: 40%
Regular class Viva Voce: 20%
Final Test (Objective): 40%

07 CE 6111 INTRODUCTION TO SEMINAR

Credits: 0-0-1: 0 Year: 2015

Pre- requisites:
Nil

Course Objectives:
1. To improve the debating capability of the student to present a general topic
2. To impart training to the student to face audience and present his ideas and thuscreating self esteem and courage essential for an engineer

Outline:
Individual students are required to choose a topic of their interest and give a seminar on that topic for about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar. The committee will provide feedback to the students about the scope for improvements in communication, presentation skills and body language.

Course Outcomes:
The graduate will have improved debating capability and presentation skills in anytopic of his choice.

SEMESTER II

Course No: 07CE 6102

Course Title: BIOLOGICAL METHODS IN ENVIRONMENTAL ENGINEERING

Credits: 4-0-0:4 Year : 2015

Pre-Requisites: Basic course on waste water engineering is required (desirable)

Course Objectives:

- To familiarize the students with collection and characterization of wastewater samples, their biological treatment and disposal.
- To effectively manage the biosolids resulting from the treatment of wastewater
- Introduces students to the biological aspects of wastewater biotechnology.
- This course will enable students to expand their background of environmental technology in the biological aspects of wastewater treatment processes, and to integrate the biological aspects of wastewater treatment after the physical and chemical methods.

Syllabus

Objectives of biological treatment – Types of biological processes for waste water treatment – Different microbial metabolisms – Microbiological treatment kinetics and flow regimes – Michaelis-Menten and Monod models – Kinetic coefficients – Effect of temperature – Oxygen requirements – Biomass yield – Observed yield – Kinetic constants evaluation of biological treatment.

Aerobic biological treatment – Attached growth and suspended growth treatment systems – Modeling - Activated sludge process – Sequencing Batch Reactor – Process description and operation. Trickling filter –Aerated lagoons – Stabilisation ponds – Sludge treatment and disposal –Aerobic digestion - Anaerobic digestion – Composting – Conditioning – Dewatering - Land application-Advanced biological treatment processes – Nitrogen removal – Economics of biological treatment – Constructional cost, capital cost, operational cost – Total cost.

Course Outcomes:

- Able to plan and design a system component / process with respect to biological treatment and sludge processing facilities
- Can design and conduct experiments and to analyze and interpret data efficiently
- Will gain knowledge about the contemporary issues and research challenges/ opportunities

Text Books

1. Metcalf & Eddy, Inc. Wastewater Engineering, Treatment and Reuse. 5th Edition, Tata McGraw-Hill, New Delhi, 2010
2. Mark J. Hammer and Mark J Hammer Jr., Fourth Edition, Water and Wastewater Technology, Prentice Hall of India Pvt. Ltd.

References

1. Benefield, L.D. and Randall C.W. Biological Processes Design for wastewaters, Prentice- Hall, Inc. Eaglewood Cliffs, 1982.
2. Grady Jr. C.P.L and Lin H.C. Biological wastewater treatment: Theory and Applications, Marcel Dekker, Inc New York, 1980.
2. Hammer- Water and Waste Water Technology, John Wiley and Sons
3. Quano- Principles of Waste Water Treatment,Vol. I, Oxford and IBH
4. Eckenfelder and Conner – Biological waste Treatment

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 6102 **Course Title: Biological Methods in Environmental Engineering** **(L-T-P : 4-0-0) Credits:4**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
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	7	15
MODULE : 2 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.	10	15
FIRST INTERNAL TEST		
MODULE : 3 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	9	15
MODULE : 4 Sequencing Batch Reactor – Process description and operation. Trickling filter – Filter classifications – Microbiology – Process design considerations – Design of physical facilities – Recirculation – NRC Equation – Operational difficulties	8	15
SECOND INTERNAL TEST		
MODULE : 5 Aerated lagoons – Types – Process design considerations. Stabilisation ponds – Classification – Design considerations. Sludge treatment and disposal – Characteristics of sludge – Sludge processing – Preliminary operations – Thickening – Stabilization - Aerobic digestion - Anaerobic digestion – Composting – Conditioning – Dewatering - Heat drying - Incineration- Wet air oxidation – Land application	11	20
MODULE 6 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.	11	20

Course No: 07CE 6104

Course Title: AIR QUALITY MANAGEMENT AND METEOROLOGY

Credits: 3-0-0:3 Year : 2015

Pre-requisites: Nil

Course Objectives:

- To familiarize the students with collection and characterization of ambient and stack air samples, their treatment and control.
- To analyse the Importance of mathematical models and meteorology in air pollutant dispersion and its concentration.
- To equip them with the importance of noise pollution and its control

Syllabus:

Air pollution – sources and effects .classification and properties of air pollutants, Photochemical smog, Effects of air pollution -Meteorological aspects of air pollutant dispersion –plume behaviour, solutions to the atmospheric dispersion equation, The Gaussian plume model. Air pollution sampling and measurement –ambient air sampling, collection of gaseous air pollutants, collection of particulate pollutants, stack sampling, analysis of air pollutants –Air pollution control methods and equipment – Source correction methods, particulate emission control –Particulate collector, control of gaseous emissions, absorption by liquids, adsorption by solids, combustion, biological methods. Control of specific gaseous pollutants, modification of design conditions, effluent gas treatment methods, Noise Pollution- sources-effects-control.

Course Outcomes:

- Able to get awareness about the behavior of air pollutants
- Able to achieve fundamental aspects to design air pollution control methodologies
- Air monitoring strategy must be comprehensive, continuous and carefully planned of ambient air monitoring is done so that pollution control measures are effective.

Text books

1. C.S.Rao,. Environmental Pollution Control Engineering, New Age International (P) Ltd. Publishers, revised Second Edition
2. Noel de Nevers, Air Pollution Control Engineering, Waveland Press

References:-

1. Stern A. Air pollution Control ,vols 1, 2, 3. Academic press, Newyork
2. Magill. P. L. Air pollution hand book McGraw -Hill.
3. Richard Segar Scorer, Air Pollution Meteorology, HorWood publishers.
4. Chhatwal G.R. Encyclopedia of Environmental Pollution and Control. Vol 1,2,3 Anmol Publications
5. Wark Kenneth and Warner C.F, Air pollution its origin and control. Harper and Row Publishers, New York, 1981.
6. Lawrence K.Wang, Norman C Perelra, Yung Tse Hung, Air pollution control Engineering

   Tokyo.

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 6104 Course Title: Air Quality Management and Meteorology (L-T-P : 3-0-0) Credits:3		
MODULES	**Contact hours**	**Sem. Exam Marks;%**
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, mobile sources.Behaviour and fate of air pollutants. Photochemical smog, Effects of air pollution on health, vegetation and materials damages	6	15
MODULE : 2 Meteorological aspects of air pollutant dispersion .Temperature lapse rates and stability, wind velocity and turbulence, plume behavior.Dispersion of air pollutants, solutions to the atmospheric dispersion equation, The Gaussian plume model.-design- Mathematical problems.	7	15
FIRST INTERNAL TEST		
MODULE : 3 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.	6	15
MODULE : 4 Air pollution control methods and equipment – Control methods- source correction methods, cleaning of gaseous effluents - particulate emission control – gravitational settling chambers, cyclone separators-its design selection of a particulate collector	7	15
SECOND INTERNAL TEST		
MODULE : 5 Air pollution control methods -fabric filters and its design electrostatic precipitators and its design- wet scrubbers, control of gaseous emissions, absorption by liquids, adsorption by solids, combustion, biological methods	8	20
MODULE : 6 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. Noise Pollution- sources-effects-control	8	20

Course No: 07CE 6106

Course Title: ENVIRONMENTAL IMPACT ASSESSMENT

Credits: 3-0-0:3 Year : 2015

Pre-requisites: Nil

Course Objectives:

- 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.
- To provide an understanding of the basic principles and technical and social limitations of an EIA
- Introduces basic scientific knowledge necessary to understand the nature of environmental problems and to be able to quantify them

Syllabus:

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- Air quality impact analysis - Noise impact analysis-Visual impact analysis- Energy impact analysis-Energy impact considerations, organization and methodology. Water quality impact analysis - Vegetation and wildlife impact analysis -Environmental monitoring and auditing.Summarization of Environmental Impact –Checklist method, Matrix method, Network method.

Course Outcomes:

- Students will gain basic knowledge and understanding of the role of EIA in environmental management for sustainable develop
- Students will gain awareness regarding ecologically sustainable development and environmental friendly technologies and also the regulatory provisions for environmental protect
- Students will be familiar with the undertaking of EIA studies and able to quantify EIA and make EIA report

References:-

1. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.
2. Larry W. Canter –Environmental Impact Assessment, Mcgraw-Hill international Editions.
3. Suresh K.Dhameja-Environmental Engineering and Management, S.K. Kataria & Sons
4. Davis, M.L., and Cornell, D.A. Introduction to Environmental Engineering, Mc Graw Hill International Editions, 1998.
5. www.moef.nic.in
6. EIA Guidelines, Notification of Govt of India, Environment Impact Assessment, 2006

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course plan

Course No: 01CE 6106 **Course Title: Environmental Impact Assessment** **(L-T-P : 3-0-0) Credits :3**		
Description	Contact hours	Sem.Exam Marks; %
MODULE 1 Concept of environmental impact analysis - Legislations, laws and Acts relevant to Environmental protection in India-The environment (protection)Act,1986- The Air(prevention and control of pollution)Act,1981- The Motor Vehicle Act,1988 -The Water(prevention and control of pollution)Act,1974- Wildlife protection Act,1972- Indian Forest Act,1927	7	15
MODULE 2 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.	7	15
FIRST INTERNAL TEST		
MODULE 3 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.	7	15
MODULE 4 Visual impact analysis- conceptual approach for visual impact prediction and assessment Energy impact analysis- Energy impact considerations, organization and methodology.	7	15
SECOND INTERNAL TEST		
MODULE 5 Water quality impact analysis – water quality criteria and standards – Environmental setting- modeling - water quality impacts by projects like highways, power plants, mining, agriculture and irrigation, forest management	10	20
MODULE 6 Vegetation and wildlife impact analysis – Environment assessment – assessment methodologies Environmental monitoring and auditing Summarization of Environmental Impact –Checklist method, Matrix method, Network method	10	20

Course No: 07 CE 6116
Course Title: WATER POLLUTION CONTROL AND STREAM SANITATION
Credits: 3-0-0: 3 Year :2015

Pre- Requisites: Basic mathematics

Course Objectives:

- To make the students aware about the sources of surface water pollution, their control and stream quality standards
- To create awareness about the various stream sanitation practices to protect the natural resources.
- Able to describe the major sources of water, soil, and sediment pollution and methods for their management.

Syllabus

Introduction-importance of water sources-socio-economic importance-sources of pollution-types of waste- sources of stream pollution -location and management of waste loads- assessing the carrying capacity of receiving water bodies-Water quality and stream quality standards-Eutrophication-organic pollution-oil pollution-radioactive pollution-marine pollution-thermal pollution-pesticide pollution-heavy metal pollution. Organic self purification- oxygen sag curve-Streeter Phelp's equation-Critical deficit-problems- Microbial self purification-Classification of streams-natural self purification process-disposal of wastewater-Rational stream sanitation practices-dual objectives of stream sanitation practices- stream survey-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. Impacts of river developments on waste assimilation capacity-detrimental and beneficial effects-hydroelectric power-navigation works-flood control works-irrigation and other diversions.

Course Outcomes:

- Capable to formulate and solve various water pollution problems both quantitatively and qualitatively.
- Able to understand, predict and quantify the impacts of various industrial discharges and river development works.
- Application of mathematical techniques to quantify the above.

Text Books:

1. P. K. Goel, Water pollution, causes, effects and control, New Age Publishers
2. Phelps E. Stream Sanitation, J.Wiley Publishers

References:-

1. Roy M Harrison, Pollution Causes, effects and control, Royal Society of Chemistry

2. Clarence J Velz, Applied stream sanitation, John Wiley & Sons

3. Todd G. K. Applied Groundwater hydrology

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course NO: 07 CE 6116 Course Title: Water Pollution Control And Stream Sanitation (L-T-P : 3-0-0) Credits:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
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-	6	15
MODULE : 2 Assessing the carrying capacity of receiving water bodies Water quality and stream quality standards Eutrophication-organic pollution-oil pollution-radioactive pollution-marine pollution-thermal pollution-pesticide pollution-heavy metal pollution	6	15
FIRST INTERNAL TEST		
MODULE : 3 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	7	15
MODULE : 4 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	7	15
SECOND INTERNAL TEST		
MODULE : 5 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	8	20
MODULE : 6 Impacts of river developments on waste assimilation capacity-detrimental and beneficial effects-hydroelectric power-navigation works-flood control works-irrigation and other diversions	8	20

Course No: 07 CE 6404 Course Title: ADVANCED GROUND WATER HYDROLOGY

Credits: 3-0-0: 3 Year :2015

Pre-requisites: Nil

Course Objective:

- To understand the key concepts of ground water occurrence and movement to understand the ground water potential.
- To get an exhaustive theoretical approach in planning and design of wells.

Syllabus

Introduction. Occurrence of ground water, types of aquifers. Aquifer parameters Ground Water movement. Darcy's law, steady unidirectional flow- confined and unconfined aquifer Well Hydraulics. Dupuit's Theory. steady/ uniform/ radial flow to a well in a confined/ unconfined /leaky aquifer, Multiple well systems-partially penetrating wells. Unsteady ground water flow. Non-equilibrium equation of a fully penetrating well in a confined aquifer, solution by Theiss, Jacob's and Chow's methods. Open wells – Design of open well –yield test.- Safe yields, estimation, pumping and recuperation tests. Well loss- determination of well loss by step pumping method. Tube wells. Salt water intrusion. Shape & structure of the fresh & saline water interface, upconing of saline water. Artificial Recharge: Concept, methods, waste water recharge, recharge estimation. Recharge mounds and induced recharge. Water spreading. Surface and Sub-surface investigation of ground water-different methods.

Course Outcomes

- Understands the availability and movement of groundwater
- Design water wells
- Identify sites for artificial recharge of Groundwater and determine the consequences of artificial recharge
- Conduct Geophysical exploration studies for groundwater source identification

References:

1. Bear J., Hydraulics of Groundwater, McGrow-Hill International, 1979.
2. Todd D.K., Ground Water Hydrology, John Wiley and Sons, 2000.
3. Driscoll, F., Groundwater and Wells, St. Paul, Minnesota, II Ed., 1986.
4. Raghunath H.M., Ground Water Hydrology, Wiley Eastern Ltd., Second reprint, 2000.
5. Jayarami Reddi, P, A Text Book of Engineering Hydrology, Laxmi Publications
6. O.D.L. Strack, Groundwater Mechanics, Prentice Hall, 1989.
7. S.P. Garg, Groundwater and Tube Wells, Oxford & IBH Publising Co., 1993.
8. K. R. Karanth, "Hydrogeology", TataMcGraw Hill Publishing Company.
9. Literature of the Central Ground Water Board (CGWB);

Internal continuous assessment: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No:07 CE 6404 Course Title: Advanced Ground Water Hydrology **(L-T-P : 3-0-0) Credits:3**		
Description	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 **Introduction**: Occurrence of ground water, geological formations as aquifers, types of aquifers. Aquifer parameters, sp. yield, permeability, porosity, storativity, transmitivity, **Ground Water movement**: Darcy's law, steady unidirectional flow-confined and unconfined aquifer. Base flow to a stream.	**3** **3**	**15**
MODULE 2 **Well Hydraulics**: Dupuit's Theory. steady/ uniform/ radial flow to a well in a confined/ unconfined /leaky aquifer, **Well near aquifer boundaries** -image wells. Multiple well systems-partially penetrating wells	**5** **3**	**15**
FIRST INTERNAL TEST		
MODULE 3 **Unsteady ground water flow**: Non-equilibrium equation of a fully penetrating well in a confined aquifer, solution by Theiss, Jacob's and Chow's methods. Extension to unconfined aquifer situations .	**7**	**15**
MODULE 4 **Open wells** – Design of open well –yield test. Safe yields, estimation, pumping and recuperation tests. Well loss- determination of well loss by step pumping method. Tube wells –design-screened wells-gravel packed wells- -selection of screen size-yield of a well Radial collector wells. Cavity wells and Infiltration galleries	**4** **3**	**15**
SECOND INTERNAL TEST		

MODULE 5 **Saline Water Intrusion in Aquifers** Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh & saline water interface, upconing of saline water, fresh-saline water relations on oceanic islands Artificial Recharge: Concept, methods, waste water recharge, recharge estimation. recharge mounds and induced recharge. Water spreading	**4** **3**	**20**
MODULE 6 **Surface investigation of ground water** Geological method/ remote sensing / electric resistivity /seismic refraction based methods for surface investigation of ground water**.** **Sub-surface investigation of ground water**, Test drilling & ground water level measurement, sub-surface ground water investigation through geophysical / resistivity /spontaneous potential /radiation / temperature / caliper / fluid conductivity / fluid velocity /miscellaneous logging.	 **3** **4**	**20**

Course No: 07 CE 6118 Course Title: ENVIRONMENTAL SYSTEM ANALYSIS

Credits: 3-0-0: 3 Year :2015

Pre-Requisites: Knowledge about numerical algorithms, linear programming methods.

Course Objectives:

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

Syllabus .

Significance of Systems Engineering: Systems Analysis, Systems Design and system synthesis.Scope of applications to environmental engineering Systems . Role of optimization models: Deterministic models/Linear programming, Dynamic programming, separable and nonlinear programming models. Formulation of objective functions and constraints for environmental engineering planning and design. Applications to environmental systems analysis. Introduction to modern tools: Expert systems, Neural networks, Genetic Algorithm

Course Outcomes:

- Able to understand the concepts of systems approach and analysis in Environmental Management
- To apply appropriate models for optimisation and management of environment

Text Books:

1. Douglas A Haith, Environmental systems optimization, John Wiley &Sons, Newyork
2. B.S.Goel, S.K.Mittal, Operation research, Pragathyprakasham
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

References:

1. Robert V Thomann, Systems Analysis and Water Quality Management, McGraw Hill, New York 1974.
2. S Vedula& P PMujumdar, Water Resources Systems – Modelling techniques and analysis, Tata MC Graw Hill publishing company, Tata MC Graw Hill publishing company 2005.
3. Hall &Dracup, Water Resources systems Engineering, Tata MC Graw Hill publishing company 1970.
4. Douglas A Haith, Environmental systems optimization, John Wiley & sons, New York 1982.
5. Rich L.G., Environmental Systems Engineering, McGraw Hill, 1973.
6. Thoman R.V., Systems Analysis & water Quality control, McGraw Hill, 1978

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No. 07CE 6118 Course Title: Environmental Systems Analysis L-T-P: 3-0-0 Credits:3		
Description	**Contact hours**	**Sem.Exam** marks %
MODULE 1 Introduction- Introduction-Definition of a Systems, Types of systems -Significance of Systems Engineering, Steps, Role Of optimization models-Systems Analysis, Systems Design and system synthesis.Role of water quality and effluent standards	6	15
MODULE 2 Scope of applications to environmental engineering Systems-Addressing specific environmental problems. Water pollution and transport -Atmospheric processes	7	15
FIRST INTERNAL TEST		
MODULE 3 Role of optimization models, deterministic models- Linear programming- Separable and nonlinear programming model	7	15
MODULE 4 Dynamic programming- Introduction- Application in Environmental Engineering-Water storage Inventory	6	15
SECOND INTERNAL TEST		
MODULE 5 Formulation of objective functions and constraints for environmental engineering planning and design. Applications to environmental systems analysis.Water resources systems ,Air quality, Municipal wastewater treatment	8	15
MODULE 6 Introduction to modern tools, Expert systems, Artificial neural networks-Genetic algorithms	8	20

Course No: 07 CE 6414 Course Title: WATER POWER ENGINEERING

Credits: 3-0-0: 3 Year :2015

Course Objective:

- To introduce the students to the essentials of the water power engineering
- To equip the students to design the various hydraulic components of water power generation

Syllabus

Introduction: Sources of energy, types of power, types of hydropower schemes and their general layouts. Concept of Power transmission. Estimation of Hydropower. Nature of demand: Load curves, load duration curves, load factor. Intakes. Conveyance System. General concepts of design and the economics. Protection devices: Surge tank air cushion chamber

Power Station: Types, elements of a power station. Pumped storage plants: Concepts, general layout, types and economics. Turbines: Classification, characteristics of different types, choice of types. Turbine setting and cavitation. Tail race:. Tidal power stations: Concepts, general layout, classification, types. Introduction to hydraulic transients- Governing Equations in transient flow and Numerical Modelling concepts-Applications. Other types of power plant

References:

1. Mosonyl, E.-"Water Power Development" Vol. I & II
2. Brown, G. Etal -"Hydro – electric engineering practice" Vol. I, II & III.
3. Dandekar M.M-and Sharma N.K. "Water Power Engineering, Vikas Pub. House Pvt. Ltd.
4. Jog M.G. Hydro Electric and Pumped Storage Plants,
5. CBIP , Manual on Development of Small HydroElectric Projects, CBIP
6. H K Barrows, Water Power Engineering, Second Edition, , Mc Graw Hill Book Company 1934.

Course outcome:

- Estimate hydropower potential
- Design penstocks and surge shafts
- Select appropriate turbine for a power plant and design its components

Internal continuous assessment: 40 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 two tests per subject.

iii) Two internal tests, each having 15 marks

iv) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan:

Course No: 07 CE 6414 Course Title: Water Power Engineering (L-T-P : 3-0-0) Credits:3		
MODULES	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 Introduction: Sources of energy, types of power, choice of type of generation Components of a water power project, types of hydropower schemes and their general layouts. Concept of Power transmission. Estimation of Hydropower available-Basic water power equation, estimation of discharge and available head.	**7**	**15**
MODULE 2 Nature of demand: Load curves, load duration curves, load factor. Plant capacity factor, plant-use factor, firm and secondary power. Intakes: Types, elements of an intake, hydraulic design of various elements.	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 Conveyance System: Power channel, pressure conduits, tunnels. General concepts of design and the economics. Protection devices: Surge tank-Function, location, types such as simple, restricted orifice, differential, air cushion chamber type -Basic design criteria, Forebay (introduction only).	**7**	**15**
MODULE 4 Power Station: Types, elements of a power station. General criterion for the design of main dimensions of the power house. Economic comparison of underground power stations with the surface power stations.	**7**	**15**
SECOND INTERNAL TEST		
MODULE 5 Pumped storage plants: Concepts, general layout, types and economics. Turbines: Classification, characteristics of different types, choice of types. Turbine setting and cavitation Tail race: Functions, types (channel and tunnel) Draft tubes, function and principal types.	**7**	**20**
MODULE 6 Tidal power stations: Concepts, general layout, classification, types. Introduction to hydraulic transients- Governing equations in transient flow and Numerical modelling concepts-Applications Other types of power plant :(a)Depression power plant (b)Micro Power Station – Need for the development and the problems faced	**7**	**20**

Course No:07 CE 6418 Course Title: FLUVIAL HYDRAULICS

Credits: 3-0-0: 3 Year :2015

Course Objective: To make the student aware of

- The river Characteristics and behaviour of the rivers
- The importance of bank protection the various methods of protection.
- The Design methods of stable channels.
- The concepts of sediment properties and flow profiles
- The concepts of sediment transport and its assessment
- The various theories regarding the transportation of sediments

Syllabus:

River Characteristics; River behavior; Stream Profiles; Stabilization and rectification of rivers; Design of Stable channels; Sediment Engineering; Regimes of flow; Incipient motion; Sampling of Sediment Load; Bed load transport; Suspended load transport.

Course Outcome:

- Students who successfully complete this course will be able to understand all features of River. With the thorough knowledge about the river.
- It will be possible to train it to meet the various human needs.
- It will be possible to assess the sediment quantity that can be drawn from a river for construction purpose and also to calculate the life of reservoir.

References

1. Margaret Peterson, River Engineering-
2. R.J.Garde, K.G.RangaRaj, Mechanics of sediment transportation and alluvial stream problems-
3. W.W. Graf, Hydraulics of Sediment transport-
4. Serge Leliavsky, An Introduction to Fluvial Hydraulics

Internal continuous assessment: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan:

Course No:07 CE 6418 Course Title:FLUVIAL HYDRAULICS (L-T-P : 3-0-0) Credits:3		
Description	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 **River Characteristics :** River morphology- Physical characteristics – Channel configurations such as straight channel, meandering channel, braided channel – Transitions - Cutoffs - Deltas. **River behavior:** Channel geometry- equilibrium, aggradations and degradation - Effects of long contraction - Effects of over bank flow - Super critical flow in rivers.	**7**	**15**
MODULE 2 **Stream Profiles:** Stream profiles and bed material- Bank erosion – Importance of bank erodability. **Stabilization and rectification of rivers:** Alignment- Radius of curvature – Revetments -Hydraulic models for river engineering.	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 **Design of Stable channels:** Stable channels carrying sediment laden water in Alluvial Materials -Blench's Method of Design – Tractive Force Method of Design – Application of optimization Principles to Channels Design.	**7**	**15**
MODULE 4 **Sediment Engineering:** Origin and formation of sediments - Fundamental properties of individual sediment particle - Bulk properties of sediments.**Regimes of flow:** Description of regimes of flow, origin and characteristics, importance	**7**	**15**
SECOND INTERNAL TEST		
MODULE 5 **Incipient motion:** Competent Velocity- **B**rahms & Airy's concept- Lift concept - Critical Tractive force- Shield analysis. **Sampling of Sediment Load:**– Sampling of bed load and suspended load in streams - Bed load samplers - Suspended load samplers	**7**	**20**
MODULE 6 **Bed load transport:** Du-Bouy's equation, Einstein's equation – Saltation. **Suspended load transport:** Method of Integrating Curves - Einstein's Approach- Simple Relations for Suspended Load.	**7**	**20**

Course No:07 CE 6424 Course Title: DATA ACQUISITION IN HYDROINFORMATICS

Credits: 3-0-0: 3 Year :2015

Prerequisites : 07CE6405

Course Objectives:

- To provide in depth knowledge to the student regarding various options of data acquisition system required for processing the data in Hydroinformatics

Syllabus

Automatic and digital levels, EDM total station principle-errors data transfer-file formats- coordinate systems- Global position system -NAVSTAR, GLONASS, GALILEO. Satellite orbits-Coordinates systems. signal structure Errors and bias- ephemeris- Planning and observation. Conversion from cad files – file conversion modules. Maps preparation

References:

1. Hoffman-Wellenhof B., *GPS theory and Practice*, Springer Wien, New York, 1997
2. Wells D.E., *Guide to GPS Positioning*, Canadian GPS Association, New Brunswick, Canada, 1988
3. Anderle R, *The Global Positioning System*, Royal Society of London, U.K.
4. Kennedy M., *The Global Positioning System and GIS: an Introduction*, Ann Arbor Press, Chelsea, 1996
5. Sickle J.V., *GPS for Land Surveyors*, Ann Arbor Press, Chelsea, 1996

Internal continuous assessment: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No:07 CE 6424 Course Title: Data Acquisition In Hydroinformatics (L-T-P : 3-0-0) Credits:3		
Description	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 Use of automatic and digital levels, electronic theodolites, total stations, Principle of EDM and electronic theodlite. Method of assessing errors	**7**	**15**
MODULE 2 Data acquisition and transfer of data from machine to computer system -formats used. Use of total station for collecting GIS compatible data-file formats- File transfer. Introduction to GPS – Basic components	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 Satellite Navigational Systems. **Global Positioning Systems:** (NAVSTAR, GLONASS, GALILEO). Indian Regional Navigation Satellite System.	**7**	**15**
MODULE 4 **Signal structure-** pseudo range and carrier phase measurements, signal structure, GPS coordinate systems:	**7**	**15**
SECOND INTERNAL TEST		
MODULE 5 GPS time; GPS Errors and biases; GPS orbital Geometry and Navigatio solution; Surveying with GPS; Planning and field observations; Data pc processing; GIS and GPS integration;	**7**	**20**
MODULE 6 Differential GPS, Component of base station and rouver -Real time processing and Post processing. Map concepts, co-ordinates and Map projection. Control surveys using GPS, triangulation methods (adjustme and computations of coordinates); Cartography and report writing.	**7**	**20**

Course No:07 CE 6422
Course Title: GROUND WATER CONTAMINATION AND POLLUTION TRANSPORT
Credits: 3-0-0: 3 Year :2015

Course Objective:

- To learn the principles of pollution transport and estimation of extent of contamination by modelling

Syllabus

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 principlesEquations of ground water flow.

Resource evaluation: development of ground water resources-Exploration of Aquifers-the response of ideal aquifers to pumping. Numerical simulation for aquifer yield prediction-Artificial recharge

Chemical properties and principles: constituents -chemical equilibrium-association and dissociation of dissolved species. 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. Solute transport: water quality standards-transport process. Hydro chemical behaviour of contaminants-trace metals-nitrogensources of contamination-land disposal of solid waste-sewage disposal on land. USGS-Moc model: modelling principles-MOC modelling.

Course outcomes:

- Get fundamental Concepts of Groundwater Flow, Transport and Contamination
- Demonstrate conceptual understanding of the contamination of the soil and groundwater media
- Explain the governing processes and identify factors controlling transport and fate of contaminants in soil and groundwater
- Suggest most suitable remediation technologies for real life contamination problems

References

2. Randall J. Charbeneau-Ground water Hydraulics and Pollutant Transport
3. Allen Freeze R. and John A. Cherry -Ground water. Prentice Hall.Inc
4. Manual on water supply and Treatment, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2000.
5. Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2000

Internal continuous assessment: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No:07 CE 6422 **Course Title: Ground Water Contamination And Pollution Transport** **(L-T-P : 3-0-0) Credits:3**		
MODULES	**Contact Hours**	**Sem. Exam Marks %**
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 l-piezometers and nests. Hydraulic conductivity and permeability-homogenicity and anisotropy-porosity and voids ratio.	**7**	**15**
MODULE 2 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.	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 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.	**7**	**15**
MODULE 4 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.	**7**	**15**
SECOND INTERNAL TEST		

MODULE 5	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. Sources of contamination -land disposal of solid waste - sewage disposal on land.	**7**	**20**
MODULE 6	Solute transport: water quality standards-transport process-non reactive constituents in homogeneous media-transport in fracture media-hydro chemical behaviour of contaminants-trace metals-nitrogen-trace non-metals-organic substances-measurement of parameters – velocity-dispersivity-chemical partitioning. USGS-Moc model: modelling principles-MOC modelling.	**7**	**20**

07 CE 6108: SEMINAR

(L-T-P : 0-2-0) CREDITS: 2 Year: 2015

Course Objective:

To assess the debating capability of the student to present a technical topic.

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.

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. The seminar shall be of 30 minutes. A detailed write-up on the topic of the seminar is to be prepared in the prescribed format given by the Department. 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 department library.

A committee constituted within the department shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee/students.

Course outcome :

- To face the audience with confidence and self esteem
- Enhance the debating capability and presentation skills in a technical topic of his interest.
- Develop the knowledge about contemporary issues and research opportunities
- Enhance the capability to communicate effectively and professionally in both verbal and written forms
- Capability for self education and lifelong learning

Internal continuous assessment: 100 marks

Faculty member in charge of the seminar and another faculty member in the department nominated by the Head of the Department are the evaluators for the seminar. Distribution of marks for the seminar is as follows.

Marks for the report:	30%
Presentation:	40%
Ability to answer questions on the topic	: 30%

Course No: 07CE 6112 Course Title: MINI PROJECT

(L-T-P: 0-0-4) Credits: 2 Year : 2015

Course 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
- Run as a for runner for master research project

Guideline

The mini project work can be a computer based modeling project or field work on any of the topics in Environmental Engineering or related topics. A field work related to the field of Environmental Engineering can also be conducted as a mini project work. The project work is allotted individually/group on different topics.

Department will constitute an Evaluation Committee to review the project work. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the outcome of the work.. The Evaluation committee consists of at least three faculty members of which one should be internal guide.

Course outcome

- Have confidence in taking up field problems and model it using any of the existing modelling software related to Environmental Engineering
- Take up a field survey or work to solve a problem in Environmental Engineering
- have sustainable perspective for designing environment friendly development programmes for the society
- Gain right outlook to maintain professional code of practice and ethics
- Critically evaluate financial viability and implementation feasibility of various engineering solutions
- Get hankering for Lifelong learning.

Internal continuous assessment: 100 marks

Total marks : 100marks

Project Progress evaluation:

Progress evaluation by the Project Supervisor : 40 Marks

Presentation and evaluation by the committee : 60 Marks

Course No: 07CE 6114

Course Title: ADVANCED ENVIRONMENTAL ENGINEERING LAB-II

Credits: 0-0-2:1 Year : 2015

Pre-Requisite: 07CE 6109

Course Objectives:

- To determine the biological characteristics of water/waste water samples, estimation of metals by atomic absorption spectrophotometer and flame photometer and estimation of air and noise quality.

Syllabus:

Culture media preparation – solid and liquid media.Preparation, distribution and sterilization.

Inoculation, streaking, colony observation.Colony counting technique for bacteria.Determination of total bacterial population by standard plate count technique.

Bacteriological examination of water. Multiple tube fermentation test – MPN technique for coliforms in water and sewage- membrane filter technique

Estimation of heavy metals using atomic absorption spectrophotometer

Estimation of Na and Ca by flame photometer

Measurement of noise level

Air quality sampling and analysis

Course Outcome

- To equip the students with the biological analysis of waste water samples.
- Estimation of metals by advanced instruments.
- Estimation of air and noise quality.

Internal continuous assessment: 100 marks

Internal Assessment:

Practical records/ Outputs: 40%
Regular class Viva Voce: 20%
Final Test (Objective): 40%

SEMESTER III

Course No: 07 CE 7107

Course Title: ENVIRONMENTAL BIOTECHNOLOGY

Credit: 3-0-0:3 Year: 2015

Pre-requisites: Nil

Course Objectives:

- To give a fundamental perspective of the microbial technology for adopting cleaner environmental practices
- To use scientific and engineering principles of microbiological treatment technologies for pollution abatement and effective management ofenvironment

Syllabus

Introduction to microbial genetics;. Introduction to DNA technology- Genetic engineering and gene therapy. Bioengineering of microorganisms for industrial Techniques used in molecular biology- Industrially important microbial products. Immobilsation of microbial cells and enzymes- Microbiology of Nitrification and denitrification. Aerobic and anaerobic treatment-. Waste treatment and reuse.Microbes and organic pollutants. Bioremediation- Microbial management of hazardous waste and wastelands.

Course Outcomes

- Able to plan and execute a substantial environmental research based project
- Enable them to understand the importance of microbial diversity in environmental systems, processes and biotechnology.
- Describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling;

Text Books:

1. Bruce. E. Rittmann&Perry.L.McCarty Environmental Biotechnology Principles and applications, published by McGraw Hills International edition.
2. S.S.Purohit Biotechnology - published by Agrobios (India), Agro House, Chopasani Road, Jodhpur
3. Albert L. Lehninger Principles of Biochemistry - CBS publishers & disributors,485 Jain Bhavan, Delhi-32

References:

1 .Prescott & Dunn's Industrial microbiology- CBS publishers &distributors 4596/1 A 11 Darya Ganj, New Delhi- 110 002

2 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

3 Rittmann, B E and McCarty,P L . Envtl Biotechnology:principles and applns, Tata Mc Graw hill, 2001

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 7107 Course Title: Environmental Biotechnology (L-T-P : 3-1-0) Credits:4		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
MODULE : 1 Introduction to microbial genetics; mutation, genetic code-Protein synthesis, regulation of gene expression-operon concept-Reverse transcription, DNA repair	6	15
MODULE : 2 Introduction to DNA technology-Cloning, vectors, restriction enzymes, plasmids -Recombination in prokaryotes. Genetic engineering and gene therapy	7	15
FIRST INTERNAL TEST		
MODULE : 3 Bioengineering of microorganisms for industrial purposes. Techniques used in molecular biology- PCR, DNA fingerprtinting, DNA sequencing	7	15
MODULE : 4 Industrially important microbial products. Immobilisation of microbial cells and enzymes.Immobilized cells and enzymes for waste water treatment	6	15
SECOND INTERNAL TEST		
MODULE : 5 Microbial aggregation, idealized biofilm-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	8	20
MODULE : 6 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	8	20

Course No: 07CE 7109

Course Title: SOLID AND HAZARDOUS WASTE MANAGEMENT

Credit: 3-0-0:3 Year :2015

Pre-requisites:Nil

Course Objectives

- To provide information regarding different elements of land pollution, various hazardous wastes, their origin, characteristics and treatment.
- Maintain a comprehensive integrated solid waste management approaches that addresses collection, transportation and disposal.
- Enable them to protect the environment by fulfilling the laws, regulations, ordinances and other requirements as set forth by the country.
- Provide safe recycling and disposal options for special wastes that may pose harm to the environment and /or to public health and safety.
- Make them aware of advanced principles related to the separation, processing and transform technologies of Solid Wastes.

Syllabus:

Legal and Organizational foundation: Definition of solid waste- Determination of composition of MSW- storage and handling of solid waste- Collection and transport of solid waste:. 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- Energy recovery – Incinerators. Transfer and Transport: Landfills: Hazardous waste management: Biomedical waste disposal.Solidification, chemical fixation and encapsulation, incineration.

Course outcomes:

- Able to promote the management of hazardous substances from the waste point of view
- Able to suggest more efficient recycling methods and to reduce the harmful climatic impacts of waste management.

Text Books:

References

1. Technobanoglous et al –Integrated Solid Waste Management, McGraw- Hill
2. Charles A. Wentz – Hazardous Waste Management, McGraw- Hill
3. Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000
4. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw-Hill, New York, 1993
5. Vesilind, Worrell, Reihhart, Solid Waste Engg, RCRA Orientn Mnaula 2006, US EPA

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 7109 **Course Title: Solid and Hazardous Waste Management** **(L-T-P : 3-1-0) CREDITS:4**		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
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.	6	15
MODULE : 2 Collection and transport of solid waste: Collection of Solid waste: type of waste collection systems, analysis of collection system- alternative techniques for collection system. Separation and Processing and Transformation of Solid Waste: unit operations used for separation and processing, Materials Recovery facilities.	7	15
FIRST INTERNAL TEST		
MODULE : 3 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	7	15
MODULE : 4 Landfills: Site selection, design and operation, drainage and leachate collection systems – requirements and technical solutions, designated waste landfill remediation – Integrated waste management facilities.	6	15
SECOND INTERNAL TEST		
MODULE : 5 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 transportHazardous waste treatment and design: Hazardous waste treatment technologies – Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste	8	20
MODULE : 6 Biomedical waste disposal.Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation – remediation of hazardous waste disposal sites.	8	20

Course No:07 CE 7111

Course Title: PLANNING AND DESIGN OF ENVIRONMENTAL FACILITIES

Credit: 3-0-0:3 Year :2015

Pre Requisites: Water supply engg, basic water chemistry and wastewater engg

Course Objectives:

- Students are expected to know in detail the various water and wastewater treatment systems and their layout and design.
- To successfully educate the students with a firm foundation related to environmental planning and design
- To equip them to think about a green and clean technology
- Exploring computer-based design tools for advanced water treatment purification process and wastewater reuse and desalination

Syllabus

Environmental Engineering hydraulic design: Water distribution systems- Design of distribution systems- Distribution system components – Analysis of networks– Computer Programmes. Types of sewerage system – Design of various sewer appurtenances - Structural requirement of sewer under various conditions. Roadways and Airport drainage -- Pumps – Design of water treatment units – sedimentation tanks, Mixing basins, Flash Mixer, Clariflocculator, Slow sand filter, Rapid sand filter, Spray and Cascade aerator, Chlorinator. Design of waste water treatment units – screens, Grit chamber, Sedimentation tank, Activated sludge process. Trickling filter, Aerated lagoons, Stabilization ponds, Oxidation ditch, Septic tank, Inhoff tank, Sequencing batch reactor, Sludge digestion tank.

Course Outcomes:

- Provides a comprehensive knowledge of the fundamental principles and practices in water and wastewater processing, distribution, collection and treatment
- To make them capable of avoiding or minimizing the production of wastes through technological changes and suggest design alternatives.

Text books:

1. Metcalf and Eddy Inc. - Waste water Engineering: Treatment, disposal & reuse,Tata Mc Graw Hill

References:

1. Peavy- Environmental Engineering, McGraw Hill
2. Rodger Walker- Water supply Treatment and distribution
3. Sincero- Environmental Engineering: A Design Approach, Prentice Hall of India, Delhi
4. Wilson- Design calculations in waste water treatment, McGraw Hill Kogakusha
5. Sharma, H.D. and Lewis, S.P, Waste Containment systems, Waste stabilization and Landfills: Design and evaluation, John Wiley & sons Inc., 1994

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07CE 7111 Course Title: Planning And Design of Environmental Facilities (L-T-P : 3-0-0) Credits:3		
MODULES	**Contact hours**	**Sem.Exam Marks;%**
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	6	15
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.	7	15
FIRST INTERNAL TEST		
MODULE : 3 Design of surface and subsurface drainage – Roadways and Airport drainage -- Pumps – Design of water and waste water pumping system	6	15
MODULE : 4 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	7	15
SECOND INTERNAL TEST		
MODULE : 5 Design of waste water treatment units – Design of screens, Grit chamber, Sedimentation tank, Activated sludge process.	8	20
MODULE : 6 Trickling filter, Aerated lagoons, Stabilization ponds, Oxidation ditch, Septic tank, Inhoff tank, Sequencing batch reactor, Sludge digestion tank	8	20

Course No:07 CE 7113

Course Title: BIOREMEDIATION PRINCIPLES AND APPLICATIONS

Credit: 3-0-0:3 Year :2015

Pre-requisites: Nil

Course Objective:

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

Syllabus

Current bioremediation practices and applications, Microbial systems of bioremediation, Genetic response of microorganisms to the presence of pollutants. Microbial detoxification of specialty chemicals, Bioremediation systems and processes. Microbial cleaning of gases (biofiltration and bioscrubbing), in situ bioremediation, laboratory scale biotreatability studies for bioremediation, management of bioremediation project

Course Outcomes:

- Enable them to suggest new bioremediation and treatment practices

Text Books:

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
5. A. Singh and O.P. Ward Biodegradation and bioremediation, Springer-Verlag Berlin Heidel berg New York 2004.
6. K.H. Baker and D.S. Herson, Bioremediation, McGraw-Hill, Inc., New York, 1994.
7. M. Alexander, Biodegradation and Bioremediation, Academic Press, 1999.
8. Chaudhury, G.R., Biological degradation and Bioremediation of toxic chemicals, Dioscorides Press, Oregon, 1994.
9. Martin.A.M, Biological degradation of wastes, Elsevier Applied Science, London, 1991.

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No 07CE 7113 **Course Title: Bioremediation Principles and Applications** **L-T-P:3-0-0 Credits:3**		
MODULES	**Contact hours**	**Sem. Exam marks %**
MODULE1 Current bioremediation practices and applications, Microbial systems of bioremediation, Factors influencing bioremediation (Environmental, physical and chemical factors).	**6**	15%
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).	**7**	15%
FIRST INTERNAL TEST		
MODULE 3 Microbial detoxification of specialty chemicals (insecticides, herbicides, fungicides, polychlorinated biphenyls, heavy metals), Bioremediation systems and processes (solid, liquid and slurry phase remediation)	**8**	15%
MODULE 4 Microbial cleaning of gases (biofiltration and bioscrubbing), in situ bioremediation, laboratory scale biotreatability studies for bioremediation, management of bioremediation project	**6**	15%
SECOND INTERNAL TEST		
MODULE 5 Bioremediation of Polluted sites– role of microbes & plants; microbial degradation of environmental pollutants; biomarkers, biosensors Biosorption; Microbial biosorption; Mechanisms of biosorption bioaccumulation Chemical and physical aspects of sorption process	**7**	20%
MODULE 6 Phytoremediation: Mechanisms & techniques of Phytoremediation	8	20%
END SEMESTER EXAMINATION		

Course No: 07 CE 7115

Course Title: ENVIRONMENTAL GEOLOGY

Credit: 3-0-0:3 Year :2015

Pre-requisites:

- Basic understanding of Earth's physical properties, common rock types etc**.**
- Review basic concepts of mathematics, chemistry, physics, and biology as applied to geology.

Course Objectives:

- Aims at providing students with improved understanding of environmental geology.
- Integrated understanding of various systems and their interconnectedness with the geosphere, biosphere, atmosphere and hydrosphere.

Syllabus

Fundamental concepts of environmental geology-flood and impact on environment-Hydel projects and environment-resources and silting-lakes-lagoons and estuarine environments-coastal erosion and impact on beach environment-Aeolian deposits.Geology and urban planning- Environmental consequences of natural calamities like volcanic activity, earth quakes and landslides. Disposal of waste from nuclear and thermal stations and factories. Natural resources utilization and the environment. Green house effect and global warming. Problems in mining environment. Environmental legislation in India. Marine pollution-Definition and scope of medical geology- Heavy metal pollutants and their effects

Course Outcomes:

- Develop the ability to critically discuss the issues related to geology that impact society and planet Earth.

- Capable them to think about the importance of environmental hazards and their remediation related to geology.

Text Books:

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
5. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Prentice-Hall of India Pvt. Ltd., Newdelhi
6. Blaine Metting.F (Jr.,) Soil Microbiology Ecology, Marcel Dekker Inc., 1993
7. Mitchell, J.K and Soga, K Fundamentals of soil behavior, John Wiley and sons Inc., 2005.
8. Fang, H-Y, Introduction to Environmental Geotechnology, CRC Press, 1997.
9. Daniel, D.E, Geotechnical practice for waste disposal, Chapman and Hall, 1993.

10. Rowe, R.K, Quigley, R.M and Booker, Clay Barrier systems for Waste disposal facilities, J.R., E & FN Spon, 1995.
11. Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook , Kluwer Academic publishers, 2001.
12. Reddi, L.N. and Inyang H.F, Geoenvironmental Engineering –Principles and Applications,

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07 CE 7115 **Course Title: Environmental Geology** **L-T-P:3-0-0 Credits:3**		
MODULES	**Contact hours**	**Sem.Exam marks %**
MODULE 1 Fundamental concepts of environmental geology-concepts of ecology-flood and impact on environment-Hydel 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	**6**	**15**
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.	**6**	**15**
FIRST INTERNAL TEST		
MODULE 3 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	**6**	**15**
MODULE 4 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	**7**	**15**
SECOND INTERNAL TEST		

MODULE 5 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	**8**	**20**
MODULE 6 Geology and Environmental Health, Contemporary Climate Change, Sea Level Rise and the Future – review of the modern carbon cycle	**8**	**20**
END SEMESTER EXAMINATIONS		

Course No: 07 CE 7117

Course title: ENVIRONMENTAL LEGISLATION

Credit: 3-0-0:3 Year :2015

Pre-requisites: Nil

Course Objective:

- Students are expected to know the various legal acts formulated to control and protect the environment.
- Understands the requirements imposed by sections and regulations of key pieces of environmental legislation and how to discharge these requirements
- Promote networking and sharing of experiences among participants to actively contribute towards conservation

Syllabus

The water (prevention and control of pollution) Act-its features-The Air (prevention and control of pollution) Act- Definition, powers and functions of boards, prevention and control of pollution, Penalties and procedure, 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.The Environmental (Protection) Act- Definition, General powers of the Central Govt., 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. Hazardous Wastes (Management and handling) Rules- Definition, esp, hazardous wastes, 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.

Course Outcomes:

1. Assess the value of environmental management and auditing in enterprises, and the importance of environmental legislation..
2. Examine how environmental legislation, management and auditing are integrated into the private and public sectors.
3. Analyse the principles and elements of environmental management and auditing systems that achieve sustainable development.
4. Understand the significance of environmental legislation in relation to the planning and implementation of ISO 14001.

References:

1. Aruna Venkat, Environmental Law and Policy, PHI learning India Ltd, 2011
2. The water (P& CP) Act and Rules.
3. The Air (P & CP) Rules.
4. The Env(Protection)Act and various rules.
5. Divan and A. Roseneranz, Environmental law and policy in India, Oxford University Press, New Delhi, 2001.
6. R. K. Sapru, Environmental Management in India Vol. I & II): Ashish Publishing House, 2004.
7. Gupta, K.R., Environmental Legislation of India, Atlantic Publishers, 2006
8. Jain, Urban, Stacey and Balbach (1993) *Environmental Assessment*, McGraw Hill.
9. Ledgewood, Street and Therivel (1992) *The Environmental Audit and Business Strategy -- A Total Quality Approach*, Financial Times, Pitman Publishing.

Internal continuous assessment: 40 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.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No: 07 CE 7117 **Course Title: Environmental Legislation** **(L-T-P : 3-0-0) Credits :3**		
MODULES	Contact hours	Sem.Exam Marks; %
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.	7	15
MODULE 2 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	7	15
FIRST INTERNAL TEST		

MODULE 3 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.	7	15
MODULE 4 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.	7	15
SECOND INTERNAL TEST		
MODULE 5 The Environmental (Protection) Act- Definition, General powers of the Central Govt., Prevention, Control and abatement of environmental pollution, miscellaneous.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.	10	20
MODULE 6 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.	10	20

Course No: 07 CE 7405

Course Title: GROUNDWATER MODELLING AND MANAGEMENT

Credit: 3-0-0:3 Year :2015

Course Objective:

- To introduce the students to the application of management models to estimate the groundwater quantity and qualities.
- After the completion of the course, the student should able to understand the inputs, system parameters, policy, variables and outputs of a groundwater management models.

Syllabus

Water potential assessment: Investigation and evaluation – Geophysical methods. Application of remote sensing techniques. Assessing yield. Physical models – Analog models – Mathematical modelling – Unsaturated flow models. Numerical modelling of groundwater flow – Finite Differential equations - Finite difference solution and Finite element method. Contaminant transport theory – Advection, dispersion equation –Hydrodynamic dispersion – Analytical models – Numerical simulation of solute transport- Density driven flow - Heat transport. **D**ata requirements – Conceptual model design : Conceptualization of aquifer system – Parameters, Input-output stresses, Initial and Boundary conditions - Model design and execution. Transient simulation – Model calibration : steady state and unsteady state Introduction to software for groundwater modelling under open source and proprietary schemes. Optimal groundwater development – Indian GEC norms – Conjunctive use models. Modelling multilayer groundwater flow system -Modelling contaminant migration – Modelling fracture flow system – Artificial recharge feasibility through modelling. Stochastic modelling of groundwater flow - Groundwater contamination, restoration and management

Course Outcomes:

- Explain in detail how groundwater systems function;
- Describe the interactions between groundwater systems and surface waters
- Understand the nature of conceptual, mathematical and numerical models of groundwater systems
- Develop a conceptual model of a groundwater flow system from typical data sets;
- Translate a conceptual model into a numerical model;

References:

1. Anderson M.P., and Woessner W.W., Applied Groundwater Modelling : Simulation of flow and advective transport, Academic Press, Inc., 1992
2. Fetter C.W., Contaminant Hydrogeology, Prentice Hall, 1999
3. Rushton K.R., Groundwater Hydrology : Conceptual and Computational Models, Wiley, 2003
4. Elango L. and Jayakumar, R. Modelling in Hydrology, Allied Publishers Ltd., 2001
5. Remson I., Hornberger G.M. and Moltz F.J., Numerical Methods in Subsurface Hydrology, Wiley, New York, 1971

6. Robert Willis and William W.G.Yenth, Groundwater System Planning and Management, Prentice Hall, Englewood Cliffs, New Jersey, 1987.

7. Groundwater Hydraulics and Pollutant Transport, Randall J.Charbeneau, Printice Hall, 2000

Internal continuous assessment: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No:07 CE 7405 **Course Title: Groundwater Modelling And Management** **(L-T-P : 3-0-0) Credits:3**		
MODULES	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 Investigation and evaluation – Geophysical methods- Electrical Resistivity methods – Interpretation of data – Seismic method – Subsurface investigation – Test drilling – Resistivity logging – Application of remote sensing techniques. Assessing yield - pumping tests-recuperation tests-yield of open well	**7**	**15**
MODULE 2 Physical models – Analog models – Mathematical modelling – Unsaturated flow models Numerical modelling of groundwater flow – Finite Differential equations - Finite difference solution – Successive over Relaxation, Alternating direction implicit procedure – Crank Nicolson equation – Iterative methods -Direct methods - Inverse problem – Finite element method	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 Physical models – Analog models – Mathematical modelling – Unsaturated flow models Numerical modelling of groundwater flow – Finite Differential equations - Finite difference solution – Successive over Relaxation, Alternating direction implicit procedure – Crank Nicolson equation – Iterative methods -Direct methods - Inverse problem – Finite element method	**7**	**15**
MODULE 4 Data requirements – Conceptual model design : Conceptualization of aquifer system – Parameters, Input-output stresses, Initial and Boundary conditions - Model design and execution : Grid design, Setting boundaries, Time discretization and Transient simulation – Model calibration : steady state and unsteady state – sensitivity analysis – Model validation and prediction – Uncertainty in the model prediction	**7**	**15**
SECOND INTERNAL TEST		

MODULE 5	Introduction to software for groundwater model under open source and proprietary schemes. Opti groundwater development – Indian GEC norms Conjunctive use models Modelling multila groundwater flow system.	**7**	**20**
MODULE 6	Modelling contaminant migration – Modelling fractur flow system – Artificial recharge feasibility through modelling – Simulation of movements of solutes in unsaturated zone – Stochastic modelling of groundwa flow - Groundwater contamination, restoration and management.	**7**	**20**

Course No:07 CE 7409 Course Title : NUMERICAL METHODS

Credit: 3-0-0:3 Year :2015

Course Objective:

- To equip the students to develop numerical models for engineering applications

Syllabus

Solution of algebraic and transcendental equations- Generalized Newton- Raphson method for multiple roots- Newton's method for non-linear systems. Solution of simultaneous equations- ill conditioning- pivoting –convergence-Eigen value problems-Vector iteration method. Interpolation-Inverse interpolation –Error estimates-Double interpolation-Trigonometric interpolation. Numerical differential-Numerical integration- Error estimates-Double integration. Curve fitting-method of least squares – non-linear relationships – Correlation and Regression – Multiple linear regressions. Solution of ordinary differential equations-. stability of solution – simultaneous first order differential equations - higher order difference 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.

Course Outcomes:

- The use of numerical method with proper understanding of the limitations and shortcomings
- Analyze the applicability and accuracy of matrix numerical solutions to linear systems of equations
- Apply numerical solutions to differential equations to build numerical models of civil engineering systems

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: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No:07 CE 7409 Course Title: Numerical Methods (L-T-P : 3-0-0) Credits:3		
Modules	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 Solution of algebraic and transcendental equations- Review and comparison of various iterative methods, convergence- Generalized Newton- Raphson method for multiple roots.	**7**	**15**
MODULE 2 Higher order methods- Newton's method for non-linear systems. 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	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 Interpolation- Newton's divided difference, Lagrange, Aitken, Hermite and Spline techniques – Inverse interpolation –Error estimates-Double interpolation-Trigonometric interpolation.	**7**	**15**
MODULE 4 Curve fitting-method of least squares – non-linear relationships – Correlation and Regression – Linear Correlation – Measure of correlation – Standard error of estimate – Coefficient of correlation – Multiple linear regressions.	**7**	**15**
SECOND INTERNAL TEST		

MODULE 5 Numerical differentiation-Numerical integration-Newton–Cote's integration formula-Gauss quadrature –Error estimates-Double integration. Solution of ordinary differential equations-Single step & multi step methods- Euler method, Modified Euler, Ranga- Kutta method. stability solution – simultaneous first order differential equations - higher order difference equations. Numerical solution of integral equations.	**7**	**20**
MODULE 6 Partial differential equations – classification – Laplace equation, ID wave equation, ID heat equation – Finite difference method – Relaxation methods. Stability and convergence of solution.	**7**	**20**

Course No:07 CE 7413

Course Title: SOFT COMPUTING TECHNIQUES

Credit: 3-0-0:3 Year :2015

Prerequisites : Nil

Course Objectives:

- To acquaint the students with soft computing methodologies such as neural networks, fuzzy logic, genetic algorithms and hybrid algorithms
- To enable the students to implement real time intelligent and adaptive systems.

Syllabus

Artificial neural network Basic concepts-Types of Neural network Architectures- learning rules-Learning paradigmsBack Propagation networks- efficiency and accuracy of BPN. Other pattern mapping algorithms - Recurrent Networks –Auto associative and bidirectional associative networks-Hopfield network- Kohonen Self organizing maps-counter propagation network and Adaptive resonance theory. Introduction to Fuzzy logic: Fuzzy sets- Fuzzy set operations- Fuzzy relations-Fuzzification- Defuzzification- Fuzzy logic controller(Block Diagram). **Fundamentals of genetic algorithms:** Basic concepts- working principle – Crossover -mutation-convergence of genetic algorithm. **Hybrid systems:**–Neuro fuzzy hybrids- neuro genetic hybrids-Fuzzy genetic hybrids-Genetic algorithm based back propagation network- Fuzzy back propagation networks.

Course Outcomes:

- Apply various neural network architectures to solve problems in Engineering in general and water resources in particular
- Distinguish between crisp and fuzzy system and develop application
- Develop genetic algorithm solution for Water resources engineering problems
- Apply combinations of these technologies for building application

Text Book

1. Sivanandan,S.N. and S.N.Deepa, *Principles of Soft Computing*, Wiley India.
2. S.Rajasekharan, G.A.Vijayalakshmi Pai, *Neural Network, Fuzzy Logic and Genetic Algorithms Synthesis and Applications*, Prentice Hall India.

References

1. S.Haykins, *Neural Networks a Comprehensive foundation*, Pearson Education.
2. Timothy J Ross, *Fuzzy logic with Engineering Applications*, McGraw Hill, New York.
3. D.E.Goldberg, *Genetic Algorithms in Search Optimisation and Machine Learning*, Pearson Education.

Internal continuous assessment: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks

ii) Tutorials/Assignments having 10 marks

End Semester Examination: 60 marks

Course Plan:

Course No:07 CE 7413 **Course Title: Soft Computing Techniques** **(L-T-P : 3-0-0) Credits:3**		
MODULES	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 **Artificial Neural Networks**: Basic concepts-Types of Neural Network Architectures-Single layer feed forward network-Multilayer feed forward network-Characteristics of Neural Networks-learning rules-Error correction and Hebbian learning. Learning paradigms- unsupervised, supervised and reinforcement learning. Perceptron networks-Back Propagation networks-sigmoidal non-linearity-learning rate momentum factor. Stopping criteria. Other factors controlling the efficiency and accuracy of BPN	**7**	**15**
MODULE 2 Other pattern mapping algorithms -Radial basis function network and Cascade correlation network. Comparison of BPN with Radial basis function-Recurrent Networks - Auto associative and bidirectional associative networks- Hopfield network- Kohonen Self organizing maps-counter propagation network and Adaptive resonance theory	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 **Introduction to Fuzzy logic**: Fuzzy sets- Fuzzy set operations- Fuzzy relations-Cardinality of Fuzzy relations-Operations on Fuzzy relations-Properties of Fuzzy relations-Membership Functions-Features of Membership functions- Fuzzification-Methods of Membership value Assignments-	**7**	**15**

MODULE 4 Fuzzy arithmetic fuzzy ordering and fuzzy measures. Fuzzy Rule Base- Fuzzy inference system-Fuzzy decision making-Fuzzy logic controller (Block Diagram)- Application of FLC system	**7**	**15**
SECOND INTERNAL TEST		
MODULE 5 **Fundamentals of genetic algorithms:** Basic concepts- working princ – encoding – different methods – fitness function – reproduction-differe methods. Genetic modelling- inheritance- Crossover mutation-converge of genetic algorithm.	**7**	**20**
MODULE 6 **Hybrid systems:** Neuro fuzzy hybrids- neuro genetic hybrids-Fuzzy genetic hybrids-Genetic algorithm based back propagation network-Fuzzy back propagation networks. Case studies: (A group of 3 or 4 students will take up an application in one of the topics related to water resources and hydroinformatics and present this case study)	**7**	**20**

Course No:07 CE 7415
Course Title: SPATIAL ANALYSIS IN WATERSHED MANAGEMENT

Credit: 3-0-0:3 Year :2015

Pre-requisites: Nil

Course Objective: To introduce advanced GIS technologies for watershed management

Syllabus

Spatial Analysis: Understanding spatial analysis - operators and functions –local, focal, zonal, global and application functions – surface analysis: slope, hill shade, contour and hydrologic analysis – mapping distance: shortest path – mapping density – cell statistics – neighbourhood statistics – reclassification. **Creating Surface models:** creating raster surface from points – interpolating a raster surface – creating TIN surface from vector data – building TIN – creating a TIN from a raster – creating a raster from a TIN. **Analysing Surfaces**: Understanding the shape of a surface – calculating slope, mapping contours - deriving contour lines from a surf ace – calculating area and volume. **Application of GIS in water resources** -Hydro networks- Flow direction-Flow Accumulation- river addressing-Drainage systems-watersheds-Drainage analysis using DEM-Watershed Delineation-Watershed Analysis-Flood plain delineation-River modelling-Digital Terrain Models-Time series. **Integrating GIS with Hydrologic Modelling**- Basic elements of GIS modelling -Classification of GIS modelling- modelling process- Integration of GIS with hydrologic modelling -binary models-index models- Regression models-process models- Building of raster and vector based binary and index models

Course Outcomes:

- Understand the basic concepts and operation of GIS for water resources Data models,
- Demonstrate ability to create digital data models of water resources in GIS: from existing data source
- Conduct hydrologic calculations using map algebra on raster grids
- Analyze a digital elevation model of land surface terrain to derive watersheds and stream networks
- Have an ability to use geospatial technologies to gain a significant advantage in the information technology field

References:

1. Burrough P. A. Principles of Geographical Information Systems for Land Resource Assessment. Oxford University Press Inc., New York, 1986
2. David R. Maidment, Arc Hydro GIS for Water Resources, ESRI Press, Redlands, California, 2002
3. Heywood, Cornellius and Carver, An Introduction to Geographical Information Systems, Pearson Education (Singapore) Pvt. Ltd., Delhi – 110 092, 2001
3. Mitchell A., The ESRI Guide to GIS Analysis Volume 1: Geographical Patterns and Relationships, Environmental Systems Research Institute, California.
4. Mitchell A., Booth Bob and Crosier Scott, 2002, Getting Started with Arc GIS. Environmental Systems Research Institute, Inc., Red Lands, California.

5. Mitchell, A., Booth Bob and Crosier Scott, 2002, Arc GIS Spatial Analyst Environmental Systems Research Institute, Inc., Red Lands, California.
6. Tsung Chang – Kang, 2002, Introduction to Geographic Information Systems, Tata McGraw - Hill Publishing Comp any Limited, New Delhi.
8. VenTe Chow, Handbook of Applied Hydrology, McGraw-Hill, New York, 1964.
9. Keith P.B., Thompson et. al., Remote Sensing and Water Resources Management, American Water Resources Association, Urbana Illinois, 1973.

Internal continuous assessment: 40 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 two tests per subject.

i) Two internal tests, each having 15 marks
ii) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan: **Course No:07 CE 7415** **Course Title: Spatial Analysis in Watershed Management** **(L-T-P : 3-0-0) Credits:3**		
MODULES	**Contact Hours**	**Sem. Exam marks %**
MODULE 1 Spatial Analysis: Understanding spatial analysis - operators and functions –local, focal, zonal, global and application functions – surface analysis: slope, hill shade, contour and hydrologic analysis – mapping distance: shortest path – mapping density – cell statistics – neighbourhood statistics – reclassification.	**7**	**15**
MODULE 2 Creating Surface models: creating raster surface from points – interpolating a raster surface – creating TIN surface from vector data – building TIN – creating a TIN from a raster – creating a raster from a TIN.	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 Analysing Surfaces: Understanding the shape of a surface – calculating slope, mapping contours - deriving contour lines from a surf ace – calculating area and volume	**7**	**15**
MODULE 4 Application of GIS in water resources -Hydro networks- Flow direction-Flow Accumulation- river addressing-Drainage systems-watersheds-Drainage analysis using DEM-Watershed Delineation.	**7**	**15**
SECOND INTERNAL TEST		
MODULE 5 Watershed Analysis-Flood plain delineation-River modelling-Digital Terrain Models-Time seriesIntegrating GIS with Hydrologic Modelling-Basic elements of GIS modelling	**7**	**20**

MODULE 6 Classification of GIS modelling- modelling process- Integration of GIS with hydraulic modelling -binary models-index models- Regression models-process models- Building of raster and vector based binary and index models	**7**	**20**

Course No:07 CE 7417

Course Title: ARTIFICIAL NEURAL NETWORKS

Credit: 3-0-0:3 Year :2015

Course Objective:

- To give a comprehensive treatise on the various neural network models and their respective field of applications

Syllabus:

Introduction to Neural Networks: Biological and artificial Neurons -Neural Networks- Learning rules. LMS algorithm- Back-Propagation algorithms-Radial Basis Function Networks- Applications of Multi-layer perceptrons. Basic learning models: Associative Learning, Competitive Networks, Winner-take-all networks, Adaptive Resonance Theory (ART), neural networks as associative memories, Hopfield network, BAM, Self Organizing Maps: Fundamentals, Algorithms and Applications. Learning Vector Quantization, Optimization problems solving using neural networks, stochastic neural networks, Boltzmann machine Applications of artificial neural networks: Application areas like system identification and control, decision making, pattern recognition, pattern mapping and sequence recognition.

Course Outcomes:

- To understand the broad concept of artificial intelligence and artificial neural networks.
- To know the possible applications of artificial neural networks (ANN).
- To relate biological neural networks to ANN.
- To understand the capabilities and limitations of ANN and to Determine under which circumstances neural networks are useful in real applications

References

1. Simon Haykin, *"Neural Networks"*, second edition, Prentice Hall, 1999
2. Christopher M. Bishop, *Neural Networks for Pattern Recognition* by Oxford University Press, 1995
3. Rumelhart, D.E., and J.L. McClelland (eds.) *Parallel distributed processing: explorations in micro structure of cognition*, Vol. I, Cambridge, MA: MIT Press, 1986.
4. Martin T. Hagan, Howard B. Demuth, Mark Beale, *Neural Network Design,*Vikas Thomson learning
5. Freeman, J.A. and D.M. Skapura, N*eural networks: algorithms, applications and programming techniques*. Addison Wesley Publishing Company, New York, 1991.
6. Yegnanarayana, B. (1994) Artificial neural networks for pattern recognition. *Sadhana*, 19(2), 189-238

Internal continuous assessment: 40 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 two tests per subject.

iii) Two internal tests, each having 15 marks

iv) Tutorials/Assignments having 10 marks

End semester Examination: 60 marks

Course Plan

Course No:07 CE 7417 **Course Title: Artificial Neural Networks** **(L-T-P : 3-0-0) Credits:3**		
MODULES	**Contact Hours**	**Sem. Exam Marks %**
MODULE 1 Introduction to Neural Networks: Biological Neurons and Neural Networks, Networks of Artificial Neurons. Single Layer Perceptron, Learning and Generalization in Single Layer Perceptrons, Hebbian Learning, Gradient Descent Learning, learning rates, Widrow-Hoff Learning , The Generalized Delta Rule, Practical Consideration	**7**	**15**
MODULE 2 Basic neural network models: ADALINE networks, LMS algorithm, Learning in Multi-Layer Perceptrons, Derivation of the Back-Propagation algorithms, sigmoidal non-linearity-learning rate momentum factor. Stopping criteria. Other factors controlling the efficiency and accuracy of BPN.	**7**	**15**
FIRST INTERNAL TEST		
MODULE 3 Radial Basis Function Networks: Fundamentals, Algorithms and Applications, Learning with Momentum, Conjugate Gradient Learning, Bias and Variance. Under-Fitting and Over-Fitting. Applications of Multi-layer Perceptrons.	**7**	**15**
MODULE 4 Basic learning models: Associative Learning, Competitive Networks, Winner-take-all networks, Adaptive Resonance Theory (ART), neural networks as associative memories, Hopfield network,	**7**	**15**
SECOND INTERNAL TEST		

MODULE 5	BAM, Self Organizing Maps: Fundamentals, Algorith and Applications. Learning Vector Quantization, Optimization problems solving using neural networks stochastic neural networks, Boltzmann machine	**7**	**20**
MODULE 6	Applications of artificial neural networks: Application areas like system identification and control, decision making, pattern recognition, pattern mapping and sequence recognition. Case studies: (A group of 3 or 4 students will take up application in any one of the topics related to water resources and hydroinformatics and present this case study)	**7**	**20**

SEMESTER III Course No:07 CE 7101: SEMINAR

(L-T-P : 0-2-0) CREDITS: 2 Year: 2015

Course Objective:

To assess the debating capability of the student to present a technical topic.

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.

Students have to register for the seminar and select a topic in consultation with any faculty member offering courses for the programme. The seminar shall be of 30 minutes. A detailed write-up on the topic of the seminar is to be prepared in the prescribed format given by the Department. 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 department library.

A committee constituted within the department shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee/students.

Course outcome :

- To face the audience with confidence and self esteem
- Enhance the debating capability and presentation skills in a technical topic of his interest.
- Develop the knowledge about contemporary issues and research opportunities
- Enhance the capability to communicate effectively and professionally in both verbal and written forms
- Capability for self education and lifelong learning

Internal continuous assessment: 100 marks

Faculty member in charge of the seminar and another faculty member in the department nominated by the Head of the Department are the evaluators for the seminar. Distribution of marks for the seminar is as follows.

Marks for the report	: 30%
Presentation	: 40%
Ability to answer questions on the topic	: 30%

SEMESTER –III **Course No:07 CE 7103: PROJECT PHASE 1**

Credits: 6

Hours per week: 12

Course 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.

The project work can be a design project/experimental project and or computer simulation project on any of the topics in ENVIRONMENTAL ENGINEERING or related topics. The project work is allotted individually on different topics. As far as possible the students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute subject to the conditions given in M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The student is required to undertake the masters research project phase 1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least three faculty members of which internal guide and another expert. Project work is to be evaluated both in the third and the fourth semesters. Based on these evaluations the grade is finalised in the fourth semester.

Total marks In the 3rd Semester: - Marks: 50

Project Progress evaluation:

Progress evaluation by the Project Supervisor : 20 Marks

Presentation and evaluation by the committee : 30 Marks

SEMESTER 4

Course No: 07 CE 7104: PROJECT PHASE 2

Credits: 12

Hours per week: 21

Course 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.

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. Final evaluation of the project will be taken up only on completion of the project in the fourth semester. This shall be done by a committee constituted for the purpose by the principal of the college

Total marks in the 4^{th} Semester: - 100

Project evaluation by the supervisor/s	: 30 Marks
Evaluation by the External expert	: 30 Marks
Presentation & evaluation by the Committee	: 40 Marks