VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

M.Tech

Wastewater Management, Health & Safety Engineering (CWM)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech- Wastewater Management, Health & Safety Engineering (CWM)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20CWM11	Numerical Analysis and Advanced Computational Methods	03	--	02	03	40	60	100	4
2	PCC	20 CWM12	Water Pollution and Treatment Technology	03	--	02	03	40	60	100	4
3	PCC	20 CWM13	Advanced Waste Water Treatment Engineering	03	--	02	03	40	60	100	4
4	PCC	20 CWM14	Environmental Pollution and Control Management	03	--	02	03	40	60	100	4
5	PCC	20 CWM15	Community Health and Environmental Sanitation	03	--	02	03	40	60	100	4
6	PCC	20 CWM L16	Water and Wastewater Analysis Lab - I	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	01	--	02	03	40	60	100	2
			TOTAL	**17**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Skill development activities:
Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.
The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.
The students shall
(1) Gain confidence in modelling of systems and algorithms.
(2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
(3) Handle advanced instruments to enhance technical talent.
(4) Involve in case studies and field visits/ field work.
(5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.
All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters

and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.
Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process. (ii) Three credit courses are designed for 40 hours Teaching – Learning process. (iii) Two credit courses are designed for 25 hours Teaching – Learning process.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech- Wastewater Management, Health & Safety Engineering (CWM)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Skill Development Activities	Duration in hours	CIE Marks		Total Marks	
				L	P	SDA					
1	PCC	20CWM21	Transport Modelling of Aquatic Systems	03	--	02	03	40	60	100	4
2	PCC	20 CWM22	Industrial Effluent Treatment and	03	--	02	03	40	60	100	4
3	PCC	20 CWM23	Integrated Solid Waste Management	03	--	02	03	40	60	100	4
4	PEC	20 CWM 24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20 CWM 25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20 CWM L26	Water and Waste Water Analysis Lab - II	--	04	--	03	40	60	100	2
7	PCC	20 CWM27	Technical Seminar	--	02	--	--	100	--	100	2
TOTAL				**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		**Professional Elective 2**	
Course Code under 20XXX24X	**Course title**	**Course Code under 20XXX25X**	**Course title**
20CWM241	Occupational Safety and Health Management	20CWM251	Environmental Impact Assessment
20CWM242	Renewable Energy & Alternative Fuels	20CWM252	Industrial Waste Pollution and Control
20CWM243	Aquatic Chemistry and Microbiology	20CWM253	Remote Sensing and GIS in Environmental Engineering

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini–Project/ Internship	Skill Development activities	Duration in hours	CIE Marks		Total Marks	
				L	P	SDA					
1	PCC	20CWM31	Atmospheric Air Pollution and Control	03	--	02	03	40	60	100	4
2	PEC	20CWM32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20CWM33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20CWM34	Project Work phase -1	--	02	--	--	100	--	100	2
5	PCC	20CWM35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20CWMI36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
TOTAL				**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		**Professional elective 4**	
Course Code under 20XXX32X	**Course title**	**Course Code under 20XXX33X**	**Course title**
20CWM321	Energy and Environmental Resources	20CWM331	Hazardous Waste Management
20CWM322	Human Impact on Marine and Costal Environment	20CWM332	Instrumentation Techniques in Environmental Engineering
20CWM323	Hydraulics of Water and Waste Water Systems	20CWM333	Environmental Planning and Management

Note:

1. Project Work Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

SEE (University examination) shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

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IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	20CWM41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Work Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

SYLLABUS FOR M. Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject: Numerical Analysis and Advanced Computational Methods

Subject Code	20CWM11	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to;

- Study various concepts on mathematical models and applications in Environmental Engg. field.
- Gain the knowledge on Optimization techniques and application.
- Concepts on Statistical operational system using mathematical models.

Modules	Teaching Hours
Module -1	
Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. **Mathematical modelling and engineering problem solving**: Simple mathematical model, Conservation Laws of Engineering. (RBT Levels: L2 & L3)	**10 Hours**
Module – 2	
Numerical Methods: Partial Differential equation, Newton Raphson method, Finite Difference, Finite Element, method of Characteristics, Different methods, S O R method. **Optimization:** Classification and Importance in Environmental Studies, single and multivariate optimization without and with constraints.	**10 Hours**
Module – 3	
Applied Partial Differential Equations: Classification of second order PDE's, Canonical forms-Hyperbolic, parabolic and Elliptic Equations. **Laplace Transformation method**: Transforms of Derivatives, Differential equations and simultaneous equations, Transform of Dirac Delta function, Inverse Transform examples. **Fourier Transform Method**: Properties, sine and cosine of Fourier Transforms.	**10 Hours**
Module – 4	
Probability Theory: Review of basic probability theory,Definition of random variables and probability distribution, Probability mass and density function, expaction, moments, central moments, characteristic functions, probability generating and moment generating	**10 Hours**

functions – illustrations,Binomial, Poisson, Exponential, Gaussian and Rayleigh distribution examples.	
Module – 5	
Joint Probability Distribution: Definition and properties of CDF, PDF, PMF, conditional distributions. Expection, covariance and Correlation. Independent Random variables, statement of central limit theorem - illustrative examples. Random Process: Classification, stationary and ergodic random process. Auto correlation function properties, Gaussian random process.	**10 Hours**
Course Outcomes: During this course, students will be trained : • To understand the role and importance of mathematical modelling. • Knowledge about applications of evaluated results from projects. • Significance of Statistical and Numerical analysis.	
Questionpaper pattern: • The question paper is of 100 marks, it will have Ten full questions. • Each full question consists of 20 marks. • From each module, there will be 2 full questions with a maximum of two or three sub questions. • Each full question is covering all the topics under that module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Ross S.M.,(1987) "**Introduction to Probability and Statistics for Engineers and Scientists"**, John Wiley Publications.3rd Edition,Academic press. 2. KreyszigErwin(2006),9th Edition" **Advanced Engineering Mathematics"**, Wiley Eastern Publications. **3.** Berthouex P M.,and Brown L. C.(1994), "**Statistics for Environmental Engineers"**, Lishe publication, 2nd Edition.	
Reference Books: 1. Rao. S.S.(1979) Optimization: Theory & Applications Techniques, Wiley Eastern Ltd, New Delhi. 2. TahaH.A.,(2007), "Optimization Research":An introduction, Pear son Prentice Hall, 8th Edition. 3. Shanthakumar M.S., Numerical Methods and Analysis, Tata McGrawHill Publications.	

SYLLABUS FORM.Tech. - WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject: Water Pollution and Treatment Technology

Subject Code	20CWM12	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to;

- Gain the Knowledge on significance of water, quality and standards for usage.
- Understand about objectives of water treatment.
- Understand the Design and operation of Water Treatment Process.
- Understand about the Purification process like, Sedimentation, Coagulation, Filtration, Disinfection, Fluoridation & De-fluoridation and softening methodologies involved before supplying to Public.

Modules	**Teaching Hours**
Module -1	
Introduction: Objectives and necessity for Treatment of water. Water pollution, Sources of water pollution and control methods. Point and non-point sources of water pollution. Ground water pollution and its characteristics. Water Borne diseases and control. Characteristics of water. **Analysis for quality of water:**Drinking water quality standards as per BIS & WHO guidelines. Importance of Bacteriological examination of water, Plate Count Test and MPN Test. Problems on determination of E-coli using MPN equation.	**10 Hours**
Module – 2	
Water Purification System: Flow Diagram on overall water supply Project. Various types of Unit flow diagrams used on Water Treatment System. Water Intake Structures and their classifications. **Purification of water:**Water Aeration, Importance and limitations. Gas Transfer two film model; Water in Air system and Air in Water system with their types. Significance of Dissolved Oxygen in Water. Principles of Sedimentation Process and Separation of Solids.Design Criteria and design of Sedimentation tank in the removal of Discrete particles.	**10 Hours**
Module – 3	
Coagulation and Flocculation: Coagulation and Flocculation process of water.Theory of Coagulation and Principle. Types of Coagulants used with their merits and demerits.Coagulants chemical reaction with water.Coagulant Aids, Chemical feeding system. determination of Optimum Coagulant Dosage using Flocculator. Numerical design problems on estimation of Coagulants.	**10 Hours**

Module – 4	
Water Filtration Process– Basic principles and theory on Filtration. Classification of sand filters used in treatment of water. Operational system and Operational troubles and troubleshooting method used in SSF and RSF in treatment of water. Design criteria used and Design of Slow and Rapid Sand Filters required for water treatment plant.	**10 Hours**
Module – 5	
Water Disinfection Process – Sterilization and Disinfection.Methods of disinfection and their suitability. Theory of Disinfection, characteristics of a good disinfectant. Forms of Chlorination, Chemical reactions, Break point Chlorination. Determination of Chlorine Demand of water. Estimation of quantity of Chlorine and Bleaching powder required for treatment of water. **Miscellaneous Treatment of water-** Hardness of water and significance. Numerical problems on determination of Hardness in water sample and Studies on effect of hardness. Fluoridation and Defluoridation techniques.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To understand the roll and importance of drinking water quality and control of water borne diseases.
- Transmission of diseases in a Community.
- To know the Objectives and importance of treatment process and can judge the standards of water before supply to a community.
- To understand the Dynamics of Water Purification and type of treatment required with respect to quality.
- To gain the knowledge on water softening process and Fluoridation &Defluoridation techniques.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Fair, G.M., Geyer J.C and Okun, (1969),**Water supply Engineering** Vol- I, John Wiley Publications.
2. Weber W.J., (1975) **Physico - Chemical Processes for Water Quality Control**.
3. CPHEEO Manual, (2003), **Water Supply and Treatment Engineering,** GOI- Publications, New Delhi.

Reference Books:

1. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), **"EnvironmentalEngineering**", McGraw Hill.
2. ViessmanJr, Hammer J. M, Perez, E.M, and Chadik, P. A, **Water Supply and Pollution Control**, PHI Learning, New Delhi, 2009.
3. Clair N. Sawyer, Perry L. McCarty and Gene F. Parkin, **Chemistry for Environmental Engineering and Science,** McGraw Hill Education Pvt. Ltd, New Delhi, 2014.

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject: Advanced Waste Water Treatment Engineering

Subject Code	20CWM13	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- To understand the basic characteristics of wastewater.
- Understanding the kinetics of biological system.
- Understand the design and working principle of various treatment methods.
- Understand magnitude and influence of hazardous content.

Modules	**Teaching Hours**
Module -1	
Introduction – Objectivesof wastewater treatment system,Need for sanitation, classification of sewerage systems, dry weather and wet weather flow, factors affecting dry weather flow and wet weather flow, Design of sewers. Characteristics of waste water and flowvariations. Types of reactors and reactors analysis.	**10 Hours**
Module – 2	
PrimaryTreatmentof wastewater- Flow chart on Community waste water treatment system, screenings, grit chamber, Oil and Grease removal,Aeration, Equalization basin, primary and secondary settling tanks and design. **Bio-kinetic coefficients**– Definition, Significance in Biological treatment and their determination.	**10 Hours**
Module – 3	
Wastewater Treatment – Aerobic and Anaerobic treatment methods. **Theoretical principles and design considerations**;**suspended growth system**- Conventional activated sludge process and its modifications. **Attached growth system**– Trickling filters, Bio-towers and Rotating Biological contactors.	**10 Hours**
Module – 4	
Sludge Processing – Separation - sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic.Principles and design of stabilization ponds. Nitrification and De-nitrification Processes, Phosphorous removal. Wastewater disinfection.	**10 Hours**

Module – 5	
Role of microorganisms in wastewater treatment - Degradation of Carbonaceous and Nitrogenous matter, high concentrated toxic pollutants. **Rural wastewater systems** – Septic tanks, two-pit latrines, Eco-toilet, soak pits.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To know the basic characteristics of wastewater and the kinetics of biological system.
- Understand the design and working principle of various treatment methods.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Wastewater Treatment Concepts and Design Approach, Karia G.L., and Christian R.A., (2001), Prentice Hall of India Pvt. Ltd., New Delhi.

Reference Books:

1. Fair G.M., Geyer J.G and Okun, "Water-wastewater Engineering".
2. Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject:Environmental Pollution and Control Management

Subject Code	20CWM14	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students;

- To understand the various types of Environmental pollutions & Control techniques.
- To understand the Impact of Pollution on Environmental System.
- To understand the monitoring and assessing the impact of Pollutants through Air, Water and Soil.
- To know the concept of Radioactive pollution, Thermal Pollution, Heavy metal interference and Oil Pollution and their effects.

Modules	Teaching Hours
Module -1	
Introduction: Environmental Pollution and Sources, types of pollution and their Global, regional and local environmental effects. **Air Pollution:** Classifications and sources of air pollutants. Secondary pollutants and formation of Photo-chemical Smog, PAN, PBN, Acid rain; Atmospheric Diffusion and Plume Behaviour, Effects of air pollutants on plants.	**10 Hours**
Module – 2	
Water Pollution: Sources of water and their contamination, Types of pollutants, Industrial effluents- pulp and paper mills, Sugar, Distillery, Domestic wastes, Effluents from water treatment plants. Eutrophication – causes, effects and control measures. **Soil pollution:** Plants as soil pollution indicators, Formation of salts in soils,Causes of soil pollution, Effects of Fungicides and weedicides on soil components and pollution. Different kinds of synthetic fertilizers (N, P, K), their toxicity and Environmental effects, control of soil pollution.	**10 Hours**
Module – 3	
Radioactive Pollution: Types of radiations (Alpha, Beta, Gamma), Units of radioactivity, Sources of radioactive material in environment, Biological impact and health hazards associated with radiation, control of Radioactive pollution. Fate and movement of radioactive material in environment. **Heavy Metal Pollution:** Sources of heavy metals, Accumulation of heavy metals in abiotic environment and	**10 Hours**

biotic components, Bioaccumulation, Bio-magnification, Toxic effects (Lead, Mercury, Arsenic).	
Module – 4	
Noise Pollution: Basic properties of sound, Units, Sources of Noise Pollution, Effects of noise pollution, Measurement of sound. Measures to control noise pollution in industries - automotive type silencers, vibration isolation, damping, lagging. Protection of personnel – ear plugs, ear muffs, helmets, isolation. **Thermal pollution:** Definition and Sources, effects of thermal pollution – physical, chemical, biological, control of thermal pollution.	**10 Hours**
Module – 5	
Oil pollution: introduction, major oil spills in the world, fate and movement of oil after spillage - spreading, evaporation, emulsification, dispersion, dissolution, sedimentation, biodegradation. Effects and control of oil pollution, Remote sensing in water quality monitoring.	**10 Hours**
Course outcomes: During this course, students will be trained : • Estimate amount of pollutant by different agencies in different medium.	
Questionpaper pattern: • The question paper is of 100 marks, it will have Ten full questions. • Each full question consists of 20 marks. • From each module, there will be 2 full questions with a maximum of two or three sub questions. • Each full question is covering all the topics under that module. • The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. S.S.Dara, **Environmental Chemistry and Pollution Control**, S. Chand and Co Ltd., New Delhi. 2. Environmental. Protection and **Pollution Control Manual** – Karnataka State Pollution Central Board. 3. B.K. Sharma, and H. Kaur, **Environmental Chemistry**.	
Reference Books: 1. Handbook of **Environmental Health and Safety** – principle and practices , Vol. II.	

SYLLABUS FOR M Tech .- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject: Community Health and Environmental Sanitation

Subject Code	20CWM15	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to;

- Know the concept of medicine to words Community health.
- Know the concept of health and disease.
- Communicable diseases, Control & prevention in rural and urban area.
- To know the principles of Epidemiology, prevention of Communicable diseases and Risk Approach.
- To know about the nutrition of health.
- Understand the objectives and maintenance of Environmental Sanitation.

Modules	Teaching Hours
Module -1	
Introduction: Concept of Health,medicine to words health, dawn of scientific medicine in antiquity, modern medicine and modern health care. **Community Health and disease:**Classifications of Health as per WHO guidelines, changing concepts of health, dimensions of health, determinants of health concept of well being. Communicable & non- CommunicableDiseases and sources. Disease control and prevention.	**10 Hours**
Module – 2	
Principles of Epidemiology: Epidemiology and Aims of Epidemiology, Basic measurements, Common Sources of Epidemics and Control measures, Uses of Epidemiology. **Concept of DiseaseTransmissionand Prevention**: Dynamics of Disease Transmission**,** modes ofDisease Transmission, concept of screening, types & uses of screening.	**10 Hours**
Module – 3	
Epidemiology of communicable diseases and control: Small pox& chicken pox and their differences. Measles, rubella, influenza, yellow fever, chicken gunya, Cholera,Typhoidand their control. **Global Epidemic Diseases**: Bird flu, Swine flu, Ebola, Zika and Corona virus. Insect Control:House fly and Mosquito-study on their Life cycle.	**10 Hours**
Module – 4	
Food and Milk Sanitation: Food Poisoning,Types and sources. Prevention and Control.Essentials for milk	**10 Hours**

sanitation and Test for milk quality, Pasteurization,Cattle Born Diseases. **Nutrition of health:** Nutrients, proteins, fats and carbohydrates. Nutritional problems in public health and surveillance.	
Module – 5	
Environmental sanitation: Environmental sanitation, Rural and Urban sanitation. Importance of safe drinking water, safe excreta and methods of waste disposal. **Occupational health and Safety:** Occupational health hazards and diseases, health of worker and safety measures.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To understand the roll and important concepts of health.
- To understand the Dynamics of Disease Transmission and control measures.
- To know about the principles of epidemiology.
- To know about food sanitation and nutrients.
- Control and remedial measures to maintain good Sanitation.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

- Joseph .A. Salvato, by Environmental Sanitation.
- E.W. Steel , Water Supply and Sanitary Engineering,

Reference Books:

- **J.E. Park and K. Park,** Preventive and Social medicine, M/S. BanarsidasBhanot Publications.
- **Baljeeth s kapoor,**Environmental sanitation, S Chand & Co.
- **P.K. Goel,** Water Pollution Causes, Effects and Control, New Age International (Pvt.) Ltd

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject: Water and Wastewater Analysis Lab - I

Subject Code	20CWML16	IA Marks	40
Number of Lecture Hours/Week	03	Exam Marks	60
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable the students to;

- Know the main objective and significance of water testing and waste waters from various sources.
- Getting basic knowledge on preparation of various chemical solutions required for testing of water and waste water samples.
- Gaining basic knowledge of analysis for small projects on water and waste water Engg.

Name of the Experiments	**Teaching Hours**
• Sampling and preservation of water and waste water. Preparation of Standard chemical solutions. 1. Determination of Solids in waste water samples. 2. Determination of pH, Electrical Conductivity and TDS. 3. Determination of Acidity and Alkalinity. 4.Determination of Calcium, Magnesium and Total Hardness. 5. Determination of Dissolved Oxygen. 6. Determination of Chlorides. 7. Determination of percentage of Chlorine available in a sample of Bleaching powder and determination of residual Chlorine. 8. Chlorine Demand for a given sample of water and waste water. 9. Determination of Turbidity by Nephelometer. 10. Determination of Optimum Coagulant Dosage using Flocculator.	**42 Hours**

Course outcomes:

- Achieve the Knowledge of development of experimental skills.

- Understand the principles of design of experiments.
- Knowing the Objectives and principles to carry out experimental Projects.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

- Manual of Water and Wastewater Analysis – **NEERI Publications**.
- Standard Methods for Examination of Water and Wastewater, American Publication Health Association (APHA), Water Pollution Control Federation, American Water WorksAssociation (AWWA), Washington DC.- latest edition.

Reference Books:

- BIS Standards and WHO Guidelines.
- Chemistry for Environmental Engineering by Sawyer and Mc. Carty.

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject: Research Methodology and IPR

Subject Code	20RMI17	IA Marks	40
Number of Lecture Hours/Week	02	Exam Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to;

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Modules	Teaching Hours
Module -1	
	8 Hours
Module – 2	
	8 Hours
Module – 3	
	8 Hours
Module – 4	
	8 Hours

Module – 5	
	8 Hours
Course outcomes: During this course, students will be trained :	
Questionpaper pattern:	
Text Books:	
Reference Books:	

SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Transport Modelling of Aquatic Systems

Subject Code	20CWM21	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to;

- The course introduces both ecology and transport modelling of aquatic systems for students.
- It explains different ecosystems and their interactions through symbiotic and synergic relationships, reviews ecological indices and modes.
- It describes tropic levels of lakes, influence of nutrient loading and control measures for Eutrophication.
- Know the Importance of modelling in wastewater engineering.

Modules	Teaching Hours
Module -1	
Ecology -Classification of Ecosystems, Structure and Function of Ecosystems, Energy flow in Ecosystems, Ecological Niche and succession, Biogeochemical cycles, Ecological Pyramids. System ecology and Ecosystem Modelling.	**10 Hours**
Module – 2	
Aquatic and Terrestrial Ecosystems - Diversity and dominance Indices, Ecosystem Models. Lake Ecosystem, Trophic levels, nutrient loading, nutrient enrichment, Leibig's Law, control of Eutrophication.	**10 Hours**
Module – 3	
Modelling –Introduction, Scope of modelling, Mass balance, waste load allocation, applications in environmental management. Model calibration and verification. Nature of inputs. Advection, Diffusion, Dispersion. Numerical examples of waste load allocation.	**10 Hours**
Module – 4	
Steady-state water quality modelling - models for conservative and non-conservative substances, Numerical examples. **Data collection and analysis** - specialized water quality surveys, estimation of decay andreaeration rates. Numerical examples based on decay and reaeration rates. Streeter-Phelps equation derivation and numerical problems..	**10 Hours**
Module – 5	
Mixing zones in rivers –types of outfalls and mixing regimes. Dissolved oxygen models for lakes under completely mixed and stratified conditions. **Eutrophication models** – Stoichiometry, Phosphorus as limiting nutrient, Mass Balance on total phosphorus in lakes,	**10 Hours**

Nutrient loading criteria, Numerical problems. **Ocean disposal of wastewater -** Silting of outfalls.	

Course Outcomes:

During this course, students will be trained :

- Student will be able to Classify and discuss the structure and function of ecosystems.
- Describe symbiotic and synergic relationships.
- Illustrate the need for bio- geo- cycles. Apply ecosystem models.
- Describe the importance of modelling and its applications.
- To evaluate the data collection and analysis.
- Achieve knowledge mixing zones in rivers, Eutrophication.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Odum E.P. & Barret G.W., (2005), "**Fundamentals of Ecology**", 5th Edition, Cengage Learning.
2. Schnoor J.L., "**Environmental Modelling – Fate and Transport of Pollutants in Water, Air and Soil**", John Wiley and Sons.
3. Thomann R.V., and Mueller J.A., "**Principles of Water Quality Management and Control**", Harper & Row Publications.

Reference Books:

1. Adam M. Neville and John B. Kennedy, "**Basic Statistical Methods for Engineers and Scientists**", International Text Book Company

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – II

Subject: Industrial Effluent Treatment and Engineering

Subject Code	20CWM22	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to;

- Understanding the Industrial effluent characteristics and their effects on environment.
- Understand treatment and disposal alternatives of the industrial wastewater.

Modules	**Teaching Hours**
Module -1	
Industrial Effluent Significance of industrial effluent treatment, Effects of Industrial Wastes on sewerage system and sewage treatment plants and receiving water bodies. Effects of waste additions on physical and chemical properties of soil. **Disposal Standards** Effluent standards and receiving water quality standards – differences, steps for implementation. Disposal alternatives – methods, operating procedures, recommended standards.	**10 Hours**
Module – 2	
Industrial Waste Survey - Process flow charts for manufacturing of Sugar, Distillery, Paper & Pulp, Dairy industries, condition of waste stream, Material balance – procedure & significance, Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Bio-monitoring.	**10 Hours**
Module – 3	
Pre-treatment of Industrial Wastewater–Volume reduction – methods and its significance, Strength reduction – methods and its significance, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids.	**10 Hours**
Module – 4	
Effluent Treatment for industries: Distillery, Sugar Industry, Pulp and paper, Cement Industry, Textile, Dairy Industry, Fertilizer, Pesticides and Pharmaceutical industries – flowchart with significance of each treatment unit.	**10 Hours**
Module – 5	
Design of complete treatment system & disposal of Effluents: Distillery, Diary, Sugar Paper and Pulp mill to meet PCB standards. **Treatment of Radio Active Wastes** - Low activity and high activity radiation, application of radioactive techniques for wastewater treatment. **Bio-Remediation**.	**10 Hours**
Course outcomes:	

During this course, students will be trained :

- To understand the role and importance of industrial wastewater management.
- Understand the basics of treatment methodologies.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

4. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. "Wastewater Treatment Concepts and Design Approach", Karia G.L., and Christian R.A., (2001), Prentice Hall of India Pvt. Ltd., New Delhi.
6. "Wastewater Treatment", Rao M.N., Datta A.K., (2008), 3rd edition, Oxford & IBH Publishing Co. New Delhi.

Reference Books:

1. Nemerow N.N., (1971) – "**Liquid Waste of industry theories,** "Practices and Treatment. Addison Willey New York.
2. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

SYLLABUS FOR M Tech. WASTE WATER MANAGEMENT, HEALTH &SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Integrated Solid Waste Management			
Subject Code	20CWM23	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to;

- Gain knowledge on collection, transfer, and transport of municipal solid waste.
- Understand the methods on processing and operation of solid waste under land filling process.
- Understand the strategies for collecting the recyclable materials and resource recovery.
- Understand the methods of solid waste disposal techniques.
- Understand the recent developments on solid waste management.

Modules	**Teaching Hours**
Module -1	
Introduction: solid waste, solid waste management, types of solid waste, sources of solid waste, properties of solid waste.Estimation of moisture content and density of a solid waste, materials flow in society, functional elements and impact of solid waste management. **System for solid waste management:**solid waste generation, factors affecting generation rates, on site storage collection services, types of collection services, collection routes, transfer stations.	**10 Hours**
Module – 2	
Processing Techniques: Processing methodologies and waste minimization, recovery, recycle and reuse (3R) of materials from solid waste, mechanical volume reduction and thermal volume reduction, manual component separation. **Land filling process of solid waste:**factors considered in selection of site for potential landfill sites, land filling methods and operations, occurrence of gases and Leachate in Landfills. Control of gas movement, control of leachate movement.	**10 Hours**
Module – 3	
Treatment Methodologies : Composting- aerobic and aerobic process, use of compost, factors affecting composting process, Vermi-composting process. Incineration, Pyrolysis and Energy recovery. **Refuse Disposal:** Significance of refuse disposal and management, impact of open land dumping site selection, sanitary land filling, design criteria.	**10 Hours**
Module – 4	
Recycling of solid waste: introduction, developing	**10 Hours**

strategies for collecting recyclable materials, ways to collect recyclables and reuse of recyclable materials. **Hazardous waste:**Introduction,identification of Hazardous waste from solid waste, classification, treatment and disposal techniques of; Biomedical, radioactive and waste from chemical industries.	
Module – 5	
Recent Developments on: solid waste management of Bio-medical waste, Plastic and E-waste. **Bio-medical waste:** introduction, sources and generation of bio-medical waste. Bio-medical waste management. **Plastic waste:**Environmental effects of plastic waste, recycling of plastic waste, disposal of plastic waste. **E-Waste:**Introduction, Health hazards, E-waste management.	**10 Hours**

Course outcomes:

During this course, students will be trained to:

- Apply the basic principles behind solid waste management, for solving practical problems.
- To know the roll and importance of solid waste management in a society.
- Know the methods required for the treatment of waste and recovery of materials.
- To understand the recent developments on solid waste management and its importance.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Tchobanoglous G., Theissen H., and EIiassenR.(1991), **"Solid Waste Engineering Principles and Management Issues**",McGraw Hill, New York.
2. Peavy, Rowe and Tchobanoglous (1985), "**Environmental Engineering**", McGraw Hill Co. 4th Edition
3. CPHEEO, Manual on **Municipal Solid waste management**, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
4. K. Shashi Kumar, **Solid waste management,** PHI Publications.

Reference Books:

1. **Waste Treatment and Disposal** 2nd edition Paul T Williams, Wiley, 2005
2. **Integrated Solid Waste Management** - Engineering Principles and Management Issues, Tchobanoglous/Theisen/Vigil, McGraw Hill (1993)
3. Mantell C.L., (1975), "**Solid Waste Management**", John Wiley.

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Occupational Safety and Health Management

Subject Code	20CWM241	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to;

- Know the Importance of Sector specific safety and risks.
- Observe and understand about biological and physical health hazards.
- To impart the knowledge of women safety, child labour.
- Observe and understand the Asbestosis, NIHL PFT.
- Know the importance of legislations in India, ESI Act.

Modules	**Teaching Hours**
Module -1	
Sector Specific Occupational Health and Safety Issues – Health and safety risks in mining,Health hazards in electronics industry, food processing industry, textile industry, construction industry, wastewater treatment plants, solid waste landfills.	**10 Hours**
Module – 2	
Health hazards and risk assessment - Hazard and risk, biological, chemical, physical and psychological health hazards, health risk assessment and management. **Soico-Economic Aspects of Occupational Health and Safety –** women and OccupationalHealth and Safety, child labour. Occupational Health, health problems in unorganised sectors**.**	**10 Hours**
Module – 3	
Occupational Diseases, Health problems and Preventions: - Asbestosis, Silicosis, Farmer's lung, Pneumoconiosis, Anthracosis, Bagassosis, Byssinosis, Tobacossis. **Health Screening Measures –** Stages of medical examination, occupational history,Pulmonary Function Test (PFT), Noise Induced Hearing Losses (NIHL). Audiometry.	**10 Hours**
Module – 4	
Basics of Preventive Techniques – Accident analysis, monitoring of hazards, reporting andinvestigation of	**10 Hours**

accidents, prevention and control of accidents, ensuring safety measures, PPE.	
Module – 5	
Occupational health and safety legislations in India – overview of existing OHSlegislations in India, Factories act, Mining act, Workmen's compensation act, Employee's state insurance act, Present state of OHS legislation in India. Inadequacy of OHS Legislation in India.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To understand the role and importance of Safety in various sectors.
- Understand the basics of health hazards.
- Learn the safety measures for women in unorganised sectors.
- To evaluate the occupation diseases like asbestosis, silicosis.
- Achieve knowledge about various legislation in India.

Question paper pattern:

- The question paper will have ten full questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Goetsch D.L., (1999), "**Occupational Safety and Health for Technologists**", Engineers and Managers", Prentice Hall.

2. Heinrich H.W., **"Industrial Accident Prevention",** McGraw Hill Publication ,Newyork.

3. Colling D.A., "**Industrial Safety Management and Technology**", Prentice Hall, New Delhi.

Reference Books:

1. National Safety Council and Associate (Data) Publishers Pvt. Ltd. (1991), "**Industrial Safety and Pollution Control Handbook**".

SYLLABUS FOR M Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Renewable Energy & Alternative Fuels

Subject Code	20CWM242	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Create awareness in students about problems related to fossil fuels and familiarity about alternative fuels.
- Teach combustion and emission characteristics of various gaseous and liquid alternative flues.
- Understand adaptability of engines to alternative fuels.

Modules	**Teaching Hours**
Module -1	
Introduction to energy and resources – Renewable energy sources - Availability of solar energy – Sun-earth relationships - - Solar radiation measurement – Flat plate collectors – Solar water heating systems – Evacuated Tubular Concentrators - Solar air heating systems and applications – Concepts on solar drying, cooking, desalination, solar ponds and solar cooling - Passive heating and cooling of buildings – Basics of solar concentrators and types Solar thermal power generation.	**10 Hours**
Module – 2	
Biomass to energy conversion processes – Anaerobic digestion, process parameters, biogas composition, digester types, high rate anaerobic conversion systems – Alcohol from biomass – Biodiesel: preparation, characteristics and application - Biomass combustion and power generation – Briquetting – Gasification: Process, types of gasifiers, applications – Waste to energy technologies.	**10 Hours**
Module – 3	
Power in the wind - Types of wind mills – WEG components, Power curves and energy estimation– Indian wind potential. Small Hydro Power: Types, site identification, head and flow measurement, discharge curve, estimation of power potential and system components. Technologies for harnessing renewable energy sources like geothermal, wave, tidal and ocean thermal energy.	**10 Hours**
Module – 4	

Fossil fuels and their availability - Potential alternative liquid and gaseous fuels - Merits and demerits of various alternative fuels - Engine requirements Methods of production - Properties - Blends of gasoline and alcohol - Performance in SI engines – Adaptability - Combustion and emission characteristics - Performance in CI engines - Emission characteristics - Properties of alcohol esters Production and properties of CNG, LPG, hydrogen gas, biogas and producer gas - Performance and Storage, distribution and safety aspects.	**10 Hours**
Module – 5	
Various vegetables oils - Properties - Esterification - Performance and emission characteristics - Bio-diesel: Feed stock, characteristics, preparation (lab and commercial), storage, applications, environmental impacts, economics, policy.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- Learn need for alternative fuels
- Learn sources of various alternative flues
- An understanding limitation of fossil fuels and combustion characteristics fuels

Questionpaper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of two or three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

- Frank Kreith and D.YogiGoswami (2007), Handbook of Energy Efficiency and Renewable Energy, CRC Press.
- John Twidell and Tony Weir (2006), Renewable Energy Resources, 2nd Edition, Taylor & Francis, USA.
- John A. Duffie and William A. Beckman (2006),

Reference Books:

- Solar Engineering of Thermal Process, 3rd Edition, John Wiley & Sons.
- Gilbert M. Masters (2004), Renewable and Efficient Electric Power Systems, Wiley Interscience. Osamu Hirao and Richard Pefley (1988),

Present and Future Automotive Fuels, Wiley Interscience Publication, New York
- Alcohols and Motor Fuels: Progress in Technology - Series No. 19 - SAE Publication USA

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Aquatic Chemistry and Microbiology

Subject Code	20CWM243	IA Marks	40
Number of Lecture	04	Exam Marks	60

Hours/Week			
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to Know the Importance of Microorganisms in environment and their role.

- Observe and understand about microscopy, Bacteria, Algae, Fungi.
- To impart the knowledge of Control and Measurement of microorganism.
- Observe and understand the fundamentals of Physical Chemistry, Trace contaminants and their Analysis
- Know the importance of pH, Colorimetry, water softening, DO.

Modules	Teaching Hours
Module -1	
Microbiology - Importance of Microorganisms in air, water and soil environment. Difference between Prokaryotic and Eukaryotic cells. Principles and applications of microscopy – Bright field, Dark field, Fluoresce, TEM, SEM. Metabolism and metabolic pathways (Meaning and Importance).	**10 Hours**
Module – 2	
Bacteria – Morphology, typical growth curve and generation time, classification and their importance. **Algae -** Morphology, classification and their importance. **Fungi -** Morphology, classification and their importance. **Protozoa** - Morphology, classification and their importance. **Enzymes** - classification, factors influencing enzyme reaction, Derivation of Michaelis – Menten equation.	**10 Hours**
Module – 3	
Control & Measurement of Microorganisms – Physical agents, chemicals agents (Types and Importance in brief). Measurement Techniques - APC, MPN, MFT. Microbiology of Domestic water and wastewater. Eutrophication of lakes. Bioconcentration, Biomagnification and Bioaccumulation.	**10 Hours**
Module – 4	
Introduction to Fundamental Chemistry - Importance of environmental Chemistry. Toxic chemicals, Heavy metals and effects, Electrochemistry and its applications. **pH** – Principle, Measurement, Numerical Examples, Buffers and Buffer index.	**10 Hours**

Colourimetry – Principles and applications. **Dissolved Oxygen** – Environmental Significance, methods of determining DO, DO membrane probes, problems.	
Module – 5	
Water Softening – Methods, Causes and Sources of hardness, types of hardness, methods of determination, public health significance, problems. **Instrumental methods of analysis of pollutants** – Working principles using Infrared Spectroscopy, Atomic Emission Spectroscopy, Atomic Absorption Spectroscopy, Fluorimetry, Gas Chromatography, HPLC.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To understand the role and importance of microorganisms in environment.
- Understand the basics of microscopy, Bacteria, Algae, Fungi.
- Learn the Control and Measurement of microorganism.
- To evaluate the effects of toxic chemicals, heavy metals etc.
- Achieve knowledge about pH, Colorimetry, water softening, DO.

Questionpaper pattern:

- The question paper will have ten full questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Sawyer C.N. and McCarty, P.L ., (2003), "**Chemistry for Environmental Engineering and Science**", 5th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. PelczarM.J ,Chan ECS, Krieg, NR(1998) "**Textbook of Microbiology**" 5th edition Tata McGraw Hill Publishing Co.
3. McKinney R.E.(1962) "**Microbiology for Sanitary Engineers**", Newyork McGraw Hill.

Reference Books:

1. APHA, (2002), "**Standard Methods for Examination of Water and Wastewater**"; 21st Edition.
2. Gaudy and Gaudy (1980), "**Microbiology for Environmental Scientists and Engineers**", McGraw Hill.
3. L.M. Prescott, Harley, Klein, (2002), "**Microbiology**" 5th edition, McGraw-Hill Higher Education.

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING [As per Choice Based Credit System (CBCS) scheme] **SEMESTER – II**			
Subject: Environmental Impact Assessment			
Subject Code	20CWM251	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60

Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to;

- Identify environmental attributes for the EIA study.
- Identify methodology and prepare EIA reports.
- Specify methods for prediction of the impacts.
- Formulate environmental management plans.

Modules	**Teaching Hours**
Module -1	
Introduction:salient features of EIA, EIA procedure, analytical functions associated with EIA, identification of impacts on the environment by preliminary overview, classification and prediction of impacts. **EIA as planning tool:** introduction, preparation of environmental base map (EBM), formation of EIA study team, preparation of EIA report, Environmental monitoring and management plan.	**10 Hours**
Module – 2	
EIA methodologies: criteria for selection of EIA methodology, EIA methods, application of rapid assessment procedure in EIA models and modelling. **Assessment of impacts on soil and ground water environment:** methodology for the prediction and assessment of impact on soil and ground water, environmental impact on soil and ground water for road construction project.	**10 Hours**
Module – 3	
Assessment of impact on surface water environment: introduction, projects which create impact concerns for the surface water environment, methods for evaluation of impacts on surface water environment. **Assessment of impact on Biological Environment:** introduction, methodology for assessment of impacts on biological environment, systematic approach for evaluating biological impacts, assessment of impacts of road development on flora and fauna.	**10 Hours**
Module – 4	
Assessment of impact on Air Environment: introduction, approach for assessment of Air pollution impact.	**10 Hours**

Assessment of Impact of Noise on the Environment: introduction, basic information of noise, noise measurement, effects of noise on people, methodology for assessing environmental impacts of noise.	
Module – 5	
Environmental Risk Assessment (ERA): introduction, Environmental risk assessment, risk assessment and treatment of uncertainty key steps in performing an ERA, advantages and limitations of ERA. **EIA Case Studies:** Environmental impact of industrial development, human use values, quality of life values, factors to be considered in making assessment decisions, preparations of EIA of Land clearing projects.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To know about the salient features of EIA procedure required to predict project descriptions.
- To know about the knowledge on Environmental clearance before establishing mini projects.
- To know the impact identification and impact assessment.

Questionpaper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of two or three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

- Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., 1997
- David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003
- Hosetti, B. B., Kumar A, Eds, Environmental Impact Assessment & Management, Daya Publishing House, 1998

Reference Books:

- UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987.
- Anjaneyulu.Y., and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
- Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING [As per Choice Based Credit System (CBCS) scheme] **SEMESTER – II**			
Subject: Industrial Waste Pollution and Control			
Subject Code	20CWM252	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60

Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to

- Understand the industrial process, water utilization and waste water generation
- Characteristics of industrial waste water and treatment options of industrial waste water
- Characteristics of industrial noise pollution

Modules	**Teaching Hours**
Module -1	
INTRODUCTION Industrial scenario – Uses of Water by industry – Sources and types of industrial wastewater – Industrial wastewater disposal and environmental impacts – Reasons for treatment of industrial wastewater – Regulatory requirements – Industrial waste survey – Industrial wastewater generation rates, characterization and variables – Population equivalent – Toxicity of industrial effluents and Bioassay tests – Preventing and minimizing wastes at the source – Individual and Common Effluent Treatment Plants – Joint treatment of industrial wastewater.	**10 Hours**
Module – 2	
INDUSTRIAL WATER POLLUTION CONTROL AND TREATMENT Sources and characteristics of industrial wastewater, effects on environment. Standards related to industrial wastewater. Waste volume reduction, waste strength reduction, neutralization, equalization and proportioning. Advanced wastewater treatment. Industry specific wastewater treatment for chloro- alkali, electroplating, distillery, tannery, pulp and paper, fertilizer, etc. Treatment technology of coal washery and coke oven effluents. Acid mine drainage: occurrence, effects and treatment technologies. Equalization – Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal – Refractory organics separation by adsorption – Aerobic and	**10 Hours**

anaerobic biological treatment – Sequencing batch reactors – High Rate reactors. Chemical oxidation – Ozonation – Photo-catalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal – Land Treatment.	
Module – 3	
AIR POLLUTION CONTROL SYSTEM DESIGNE Review of general principles of air pollution control. Design and operation of gravity settling chambers. Design and operation of cyclones. Design and operation of wet dust scrubbers – column scrubbers, jet scrubbers, vortex scrubbers, rotating disc scrubbers, and venturi scrubbers. Design and operation of fabric filters. Design and operation of electrostatic precipitators design and operation of mist separators baffled mist separators, pressure separators. Dust control and abatement measures in mines; role of green belts. Control devices for gaseous pollutants with special emphasis on adsorption, absorption, mass transfer, condensation, and combustion. Control of motor vehicle emissions. Indoor air pollution control.	**10 Hours**
Module – 4	
NOISE CONTROL ENGINEERING Noise measurement techniques and analysis: Worksite, ambient and road transport. Noise prediction and modelling, noise impact assessment: Scultz Fractional Impact method; Value function curves. Noise abatement measures - Sound absorption, Acoustic barrier, Vibration Isolation, Vibration damping, Muffling, personal protector and green belt--principles and design considerations. Noise pollution and management in Mines, Washeries, Power plants, Fertilizer plants, Cement plants, etc. Human Vibrationwhole body vibration problems in opencast mines, health effects and control measures. Ground vibration and air blast, Environmental and health effects;strategic control and abatement measures	**10 Hours**
Module – 5	
CASE STUDIES Industrial manufacturing process description,wastewater characteristics and waste treatment	**10 Hours**

flow sheet forTextiles – Tanneries – Pulp and paper – metal finishing – PetroleumRefining – Chemical industries – Sugar and Distilleries –Dairy –Iron and steel – fertilizers-Industrial clusters and IndustrialEstates	

Course outcomes:

During this course, students will be trained :

- Analyze the waste water from different industries
- Design suitable units for industrial waste water treatment
- Select the suitable residue disposal options
- Select a suitable method for reducing the noise pollution

Questionpaper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of two or three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Eckenfelder, W.W., (1999) "Industrial Water Pollution Control", Mc-Graw Hill.
2. Arceivala, S.J., (1998) "Wastewater Treatment for Poll. Control", Tata McGraw Hill.
3. World Bank Group (1998)"Pollution Prevention and Abatement Handbook –Towards Cleaner Production ", World Bank and UNEP, Washington D.C

Reference Books:

1. Mahajan (1984) –" **Pollution control in Process industries"**. TMH, New Delhi.
2. Eckenfelder(2000)- "**Industrial Water pollution Control"-** McGraw hill Company, New Delhi.

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Remote Sensing and GIS in Environmental Engineering

Subject Code	20CWM253	IA Marks	40
Number of Lecture	04	Exam Marks	60

Hours/Week			
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Understand the fundamentals of remote sensing
- observe and process the GPS data
- use the image processing for the outburst of diseases.

Modules	Teaching Hours
Module -1	
Fundamentals of Remote Sensing: Definition, Physics of remote Sensing, Electromagnetic.Radiation and its interactions with atmosphere, Spectralreflectance of earth features, Resolution Spectral, Temporal and Radiometric.	**10 Hours**
Module – 2	
Platforms Sensors and Image Processing: Aerial Photographs, Active and passive sensors, Data products, Various satellites in orbit and their sensors, Image Processing-Visual and digital image, Interpretation, Interrelation keys, Methodology, Training sets, Ground truth verification, Image analysis, Image enhancement, Rectification, Classification methods, Users accuracy, Producers accuracy and overall accuracy.	**10 Hours**
Module – 3	
Introduction to GIS: Data entry, storage and maintenances, Data outputs. Data analysis, Hardware and Software	**10 Hours**
Module – 4	
Application of Remote Sensing and GIS: Applications of remotely sensed data for identifying solid waste disposal, forest fire mapping, EIA studies etc, Optimal routing if solid waste using GIS-Case study, Environmental sitting of industries and zoning atlas development.	**10 Hours**
Module – 5	

Remodeling of water distribution system using GIS, Environmental degradation assessment using RS and GIS.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- analyze the data and model the distribution network
- analyze the satellite images for epidemic studies

Questionpaper pattern:

- The question paper will have ten full questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

- Manual of Remote sensing - Ed: Robert G Reeves.
- Theory of pattern recognition and modern forecasting - V.Karpin and Wright Pattern
- Digital Remote Sensing - Pritivish Nag M Kudrat ; Concept publication
- Principles of GIS for land and resources assessment, Burrough, P.A., 1986, Oxford.

Reference Books:

- Geographical information systems Vol 1 & 2. Edited by: Paul A.Longley, Michael F.Goodchild, David J. Maguire & David W.Rhind.
- Geographical information systems and digital image processing – Muralikrishna1999. Allied Publication

SYLLABUS FOR M.Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Water and Waste Water Analysis Lab - II

Subject Code	20CWML26	IA Marks	40
Number of Lecture	03	Exam Marks	60

Hours/Week			
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to;

- Create awareness for analysis of water and waste water.
- know about the objectives of testing water and waste water in the laboratory.
- The objective of this course is to make students to learn principles of conducting experiments.
- understand the analysis methodology on water and waste water.

Modules	**Teaching Hours**
Module -1	
1. Determination of Dissolved Oxygen present in a given sample of water and waste and its importance in environmental engg. 2. Determination of Bio-chemical Oxygen demand (BOD) present in a given sample of water and waste. Dilution factor for high strength waste waters. 3. Determination of Chemical Oxygen Demand (COD) for a given sample of water and waste water. 4. Determination Nitrates and Nitrites in a given sample of water and waste water using by spectrophotometer. 5. Determination Fluoride in a given sample of water. 6. Determination of Oil and Grease substances in a given sample of waste water . 7. Determination of Chlorides and Sulphates in a given sample of waste water. 8. Determination of Potassium and Sodium in a given sample of water and waste water using Flame photometer.	**42 Hours**

Course outcomes:

During this course, students will be trained :

- To understand the roll and importance of analysis of water and waste water contaminants.
- To know about the existing quality and status of water and waste water.
- To know the Objectives and importance of analysis of water and waste

water there by knowing the treatment process required before its disposal with respect to standards.

- Achieve Knowledge of Doing and development of experimental skills.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Two questions.
- Two experiments will be given.
- The students will have to answer on one question for conduction of experiment and one question for write up of that experiment.

Text Books:

1. **Manual on Water and Wastewater Analysis** – NEERI Publication.
2. **Standard Methods for Examination of Water and Wastewater**, American Publication: AWWA, APHA. Association, Water Pollution Control Federation, American Water Works Association.

Reference Books:

1. **BIS Standards :**2490-1974, 3360-1974, 3307-1974.
2. **Chemistry for Environment Engineering**. Sawyer and Mc Carty.

SYLLABUS FOR M.Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject: Atmospheric Air Pollution and Control

Subject Code	20CWM31	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of	50	Exam Hours	03

Lecture Hours			

CREDITS – 04

Course objectives: This course will enable students to;

- Know the Importance of Air Pollutionfrom industries and Effects.
- Study on Meteorological factors used to measure air Pollutants.
- Know the Industrial plant location during city planning.
- To impart the knowledge on effect of Air pollution from major Industries.
- Study on impact of Air pollution and to know the Economic losses.
- Study on Air pollution control Equipments to control Particulate matter and Gaseous pollutants.
- Know the importance of Noise pollution from Industries and its control.

Modules	Teaching Hours
Module -1	
Introduction: Air Pollution, Characterisation of Atmospheric Air Pollutants, Primary and SecondaryPollutants. Major Air Pollution Disasters of Environmental importance, Bhopal Gas Tragedy. **Meteorology:**Measurement of Meteorological factors in dispersion of Air pollutants, Solar Radiation, Atmospheric Lapse Rates, Wind speed and direction recording devices, Construction of Wind Rose diagram for industrial stacks. Maximum Mixing Depth (MMD), Temperature Inversions.	**10 Hours**
Module – 2	
Industrial Plant Location and City Planning: Selection of site for Industrial Plant Location. Industrial Stack Emissions and Plume behaviour, measurement of Smoke Density from Industrial Stacks using Ringelmann chart and Control methods. Heat Island Effect in Urban areas. Study on typical industries producing specific pollutants. Dust control in Thermal power plants, cement industry and stone crusher industry.	**10 Hours**
Module – 3	
Effect of Air Pollution from major Industries: Study on effect of air pollution from major industries: cement Industry,stone crushers and Petroleum Refineries. Health effects, Effect on plants and Economical Losses. Green House Effect, Acid Rain, Global Worming, Photo-chemical Smog, Indoor Air Pollution, Occupational diseases.	**10 Hours**
Module – 4	
Air Pollution Control Equipments: Air pollution control equipments for particulate matter. Working principle and field applications of; Gravity Settling Chambers, Centrifugal Collectors, Wet Collectors, Fabric filters and Electrostatic precipitators (ESP). Control methods for Gaseous Pollutants- Adsorption, Absorption and Combustion Proc	**10 Hours**
Module – 5	
Noise Pollution and Control in Industries: Sources, Effects	**10 Hours**

and Occupational hazards.Noise measuring devises, Standards, Noise mapping, noise control measures in Industrial establishments-Administrative controls, Engineering Controls and Personnel protections.	

Course outcomes:

During this course, students will be trained :

- To understand the role and importance of Air pollution and its control methods.
- Understand the basics on Meteorology and importance of atmosphere.
- Learn to know use of controlling devices and measurement of Air pollutants using Specific devices.
- To evaluate the effect of Air pollutants on Health and Economical losses.
- Achieve knowledge about Global Warming, Acid rain, etc., from major industrial activities in urban areas including Noise Pollution.

Question paper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Colls, J., **Air Pollution: Measurement, Modeling and Mitigation**, CRC Press, 2009.
2. Noel, D. N., **Air Pollution Control Engineering**, Tata McGraw Hill Publishers,1999.
3. Stern, A.C., **Fundamentals of Air Pollution**, Academic Press, 1984.

Reference Books:

1. Wark K., Warner C.F., and Davis W.T., (1998), "**Air Pollution - Its Origin and Control**", Harper & Row Publishers, New York.
2. Lee C.C., and Lin S.D., (1999), **"Handbook of Environmental Engineering Calculations**", McGraw Hill, New York.
3. Perkins H.C.(1974), "**Air Pollution**", McGraw Hill.
4. Crawford M.,(1976) "**Air Pollution Control Theory**", TATA McGraw Hill.
5. Stern A.C., "**Air Pollution**", Vol I, II, III.
6. Seinfeld N.J., (1975), "**Air Pollution",** McGraw Hill.
7. Stern A.C.(1968), Vol. V, "**Air Quality Management**".

SYLLABUS FOR M Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject: Energy and Environmental Resources

Subject Code	20CWM321	IA Marks	40
Number of Lecture	04	Exam Marks	60

Hours/Week			
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to;

- Gain the Knowledge on conventional and non conventional energy resources.
- understand the various types of energy resources and their significance.
- Understand about the Bio-mass, bio energy, biogas plants with their functions.
- Understand about solar radiation, power generation and its utilization.
- Understand about geothermal energy and tidal energy generation and utilization.
- understand about the nuclear power generation, utilization and nuclear waste disposal methods.

Modules	Teaching Hours
Module -1	
Introduction:sources of energy, primaryenergy resources and secondary energy resources, world renewable energy resources and energy strategies. Renewable and non-renewable energy sources and availability. Conventional and non-conventional energy sources. use of various sources of energy consumption in the world. **Fossil Fuels:** classification of fossil fuels, composition, physico-chemical characteristics, natural Gasformation, exploration, mining and uses of coal oil and natural gas.	**10 Hours**
Module – 2	
Bio-Energy: Bio-Mass energy, benefits of using Biomass for digestion and sources, bio-fuels, bio-power, bio-products. Biogas production and uses. Classification of biogas plants. Indian floating gas digester (KVIC), Chinese fixed dome type digester. Advantages and disadvantages. problems involved with biogas production. Factors affecting generation of Biogas.	**10 Hours**
Module – 3	
Solar Energy: Introduction, solar radiation at earth's surface, Beam and Diffuse solar radiation. Measurement of solar radiation. Solar energy collectors-concentrating and non-concentrating collectors, advantages and disadvantages. Physical principles of conservation of solar radiation into heat energy. **Solar Electricity generation:**Solar Photo-voltaic, solar distillation, solar furnace and solar cooking, advantages and disadvantages.	**10 Hours**
Module – 4	
Geo-thermal Energy:introduction on energy from Earth,	**10 Hours**

geo-thermal resources, hydro-thermal resources, geo-pressured resources, petro-thermal resources, Magma resources. Advantages and disadvantages over other energy forms. **Tidal Energy:**introduction, Ocean Thermal Energy Conversion (OTEC), open cycle and closed cycle system for OTEC, Energy from tides-basic principles of tidal power generation, components of tidal power plants, advantages and limitations of tidal power generation.	
Module – 5	
Nuclear Energy:introduction,Nuclear energy, advantages and disadvantages of nuclear power plants, Nuclear fission and nuclear fusion concepts and necessity, general components of nuclear reactors. classification of nuclear reactors, types of nuclear reactors, PWR and BWR. Location of nuclear power plant, types of nuclear waste and methods of disposal of nuclear waste.	**10 Hours**

Course outcomes:

During this course, students will be trained to;

- Understand the various resources of energy and its utilization.
- to know about conventional and non conventional energy resourses.
- to know about Bio-fuels, bio-energy and bio-gas plants.
- to know about solar energy, Geothermal energy, Tidal energy and nuclear energy with their merits and demerits.

Question paper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Mathur, A.N., and Rathore, N.S., "Renewable Energy and Environment" –Proceedings of the National Solar Energy, Himanshu Publications, Udaipur.
2. Rao and Parulekar B.B., (1977), "Energy Technology–Non-conventional,
3. Renewable and Conventional", 2nd Edition, Khanna Publishers.
4. Rai, G.D , "Non-conventional Energy Sources", Khanna Publications.

Reference Books:

1. Saha, H., Saha, S.K., and Mukherjee, M.K., (1990), "**Integrated Renewable Energy for Rural Development",** Proceedings of the National Solar Energy Convention, Calcutta, India,
2. Wilber, L.C., (1989), "**Handbook of Energy Systems Engineering",** Wiley and Sons.
3. The Energy Research Institute (TERI) Publications, New Delhi.
4. Ministry of Environment and Forests, Government of India, Annual

Reports.

SYLLABUS FOR M Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING [As per Choice Based Credit System (CBCS) scheme] **SEMESTER – III**			
Subject: Human Impact on Marine and Costal Environment			
Subject Code	18CWM322	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of	50	Exam Hours	03

Lecture Hours			
CREDITS – 04			

Course objectives: This course will enable students to;

- To provide students understanding of the materials and processes associated with the major natural geo-hazards: floods, earthquakes, volcanic activity, landslides, and coastal hazards.

Modules	Teaching Hours
Module -1	
Estuaries and Saltwater Marshes; Adaptations of Estuarine and Saltwater Organisms – Sea-grass Ecosystem – Mangrove Ecosystem – Barrier Islands, Biogeography – Coral **Reefs and Atolls** – Open Ocean – Marine Benthos and Tidal Communities – Human Impact on the Marine Environment.	**10 Hours**
Module – 2	
Coastal Hazard: Coastal Hazard; Natural vs. Man-made hazard - Cyclones, Coastal Erosion, Tsunami, Flood, Storm surges, Sea Level Rise and Others – Impacts on Natural and Human environment.	**10 Hours**
Module – 3	
The Human Coast The Human Coast - Governance of the Coast: Institutions, Policy and Jurisdictions – Technological Hazards - Biological and Anthropogenic Coastal Hazards - Hazards and Disasters; Definition, Causes, Effects, Differences and their relationship to each other.	**10 Hours**
Module – 4	
Case Studies Examples – Case Studies – Lessons Learnt – Preparing for the Future growth.	**10 Hours**
Module – 5	
Coastal Hazard Management Ethical Dimensions - Competing Values - Growth Management: tools, plans, principles – Mitigation: Definition, approaches, types and examples - Coastal Hazards Management Framework - Hazard Mitigation Planning.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To be able to discuss the ability to predict and manage these hazards based on case studies to demonstrate the intensity and management options for all the natural hazards under consideration.

Questionpaper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of two or three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

- Barnes, R.S.K. and Hughes, R.N.. Introduction to Marine Ecology, 3rd ed., Blackwell Publishing, 1999.
- Beatley, T., David, J.B. and Anna, K.S. An Introduction to Coastal Zone Management, Island Press, Washington D.C., 2002.
- Bryant, E., Natural Hazards, Cambridge University Press, New York, 2006.
- Burby, R.J., ed., Cooperating With Nature: Confronting Natural Hazards With Land-Use Planning for Sustainable Communities, Joseph Henry Press, Washington D.C. 1998.)

Reference Books:

- Godschalk, D.R., et al., , Natural Hazard Mitigation: Recasting Disaster Policy and Planning, Island Press, Washington D.C,1999.
- NC Division of Emergency Management, Hazard Mitigation Section, Risk Assessment and Planning Branch, Keeping Natural Hazards From Becoming Disasters: A Mitigation Planning Guidebook for Local Governments, 2003.

SYLLABUS FOR M Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject: Hydraulics of Water and Waste Water Systems

Subject Code	18CWM323	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of	50	Exam Hours	03

Lecture Hours			
CREDITS – 04			

Course objectives: This course will enable students to;

- Formulate momentum, energy and mass transport models
- Solve diffusion-dispersion equations
- Apply basic flow equations for steady and unsteady flows in open channels

Modules	Teaching Hours
Module -1	
Introduction: Water Supply System-types of systems, population forecasting methods, water demands, pressure, design period, Pipe materials and roughness coefficient. **Storage Reservoirs –** Site selection**,** Need, different types, capacity determination and evaluation of pumping system. **Pipe Networks** – Peak factors for intermittent and continuous distribution system. Branch and Grid Iron systems. Design Layouts of distribution systems, Evaluation of distribution system.	**10 Hours**
Module – 2	
Basic concepts of open channel flows; conservation laws, continuity equation, momentum equation, Application of momentum and energy equations. Critical flow, its properties and application; location of critical flow and its computation **Uniform flow;** flow resistance, equations of flow resistance, computation of normal depth, Gradually varied flow, governing equations classification of water surface profiles.	**10 Hours**
Module – 3	
Hydrologic processes; Hydrologic cycle and its interaction with human activity, Hydrologic analysis, Hydrologic statistics. Transport processes. **Diffusion system-** phenomena, Flicks' First and second Laws of diffusion, Advection diffusion equation, Turbulent diffusion and dispersion mixing phenomenon in rivers, Contaminant transport system, Saltwater intrusion into aquifers, Non aqueous phase liquid (NAPL) in groundwater,	**10 Hours**
Module – 4	
Water Quality in Distribution System – Factors affecting water quality, predictive tools and intermediate disinfection. **Wastewater Collection System** – Separate and Combined Sewer Systems, relevant equations for flow conditions, Pipe materials and roughness coefficient, design guidelines and examples. Sewer Appurtenances.	**10 Hours**
Module – 5	

Sewer Network – Estimation of Nodal Flows, Pumping Stations, Evaluation of Different Network Options. **Storm Sewers** – Flooding and water quality problems, run-off calculations, storm water inlets, open drains and sewer pipes and design for different conditions of flow of storm sewage.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- solve basic equations of flow through porous medium
- formulate forecast models for operation of hydrologic systems.

Questionpaper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of two or three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

- Sincero A.P., and Sincero G.A., (1999), "**Environmental Engineering –A Design Approach",** Prentice Hall of India Pvt. Ltd., New Delhi.
- Hammer M.J., and Hammer Jr. M.J., (2008), **"Water and Wastewater Technology**", Prentice Hall of India Pvt. Ltd., New Delhi.
- Walski T.M., (1987), "**Analysis of Water Distribution Systems**", CBS Publications, New Delhi."

Reference Books:

- Kundu and Cohen, Fluid Mechanics, Academic Press, 2012
- Cussler, E. L, Diffusion: Mass transfer in fluid systems, 3rd Ed., Cambridge
- University Press, 2007.
- Chow, V.T. , Open channel flows, McGraw Hill, 2010
- Chow, V.T. , Applied Hydrology, McGraw Hill, 2010

SYLLABUS FOR M Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject: Hazardous Waste Management

Subject Code	20CWM331	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to;

• have knowledge on need and principles of Hazardous waste management. • risk assessment, management and methodologies to handle safely the hazardous waste. • Provide detailed aspects on the treatment and disposal methods of Hazardous wastes.	
Modules	**Teaching Hours**
Module -1	
Introduction: Hazardous waste management, Ignitability, Corrosivity, Reactivity, Toxicity. Sources & Classification of hazardous waste, Legislation conditions of hazardous waste Management, case study – String fellow site chemicals, life styles and the environment public and Government awareness of hazardous waste. **Toxicity and risk management:** health of people exposed to toxic chemicals, relationship of toxicology to hazardous waste management. Case study-risk assessment of Leukemia from human exposure to Benzene.	**10 Hours**
Module – 2	
Environmental Legislation and Regulations: Rivers and Harbours Act, Atomic energy act of 1984, the national environmental pollution act, occupational safety and health act. The calm air ct, motor vehicles emissions. Toxic pollutants, toxic substances control act.	**10 Hours**
Module – 3	
EPA designated hazardous waste: mixed waste sampling and analysis, case study-the vanishing zero aor analytical chemistry. **Pollution prevention and waste minimization:** governmental policy on waste reduction, benefits of hazardous waste pollution prevention and reduction approaches to hazardous waste pollution prevention and reduction. waste flow diagram, selection of waste minimization process	**10 Hours**
Module – 4	
Physico-chemical Treatment: physicaltreatment-screening, sedimentation, clarification, cyclone separation, flotation, filtration, adsorption, absorption, evaporation, distillation and condensation reverse osmosis. **Chemical treatment:** solubility, neutralization, coagulation and flocculation, jar and extender tests, oxidation and reduction, disinfection, ion exchange, stabilization and fixation systems.	**10 Hours**
Module – 5	
Treatment process: Selecting the process, case study- the electireness of treatment technologies for organic hazardous	**10 Hours**

waste. **Transportation and storage of hazardous waste**: Transportation of hazardous waste, POT and EPA coordination, EPA regions. The nuclear regulations commission. Containers for hazardous waste material, Bulk transport. **Thermal process:** Incineration process, types,Advantages and disadvantages of incineration, the chemistry of incineration**.**	

Course outcomes:

During this course, students will be trained to;

- Identify the sources and describe characteristics of hazardous wastes.
- Review of case studies with respect to risk identification, assessment and emergency preparedness.
- Enumerate on waste minimization and resource recovery techniques.
- Prepare the transportation protocol for safe transport of hazardous wastes.

Questionpaper pattern:

- The question paper is of 100 marks, it will have Ten full questions.
- Each full question consists of 20 marks.
- From each module, there will be 2 full questions with a maximum of two or three sub questions.
- Each full question is covering all the topics under that module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Lehman, (1983), **"Hazardous Waste Disposal"**, Plenum Press.
2. Lagrega M.D., Buckingham P.L., and Evans J.C., (1994), **"Hazardous Waste Management**", McGraw Hill International Edition.
3. Wentz C.A., (1989), "**Hazardous Waste Management**", McGraw Hill.
4. Dawson and Mercer, (1981), **"Hazardous Waste Management**", John Wiley.

Reference Books:

1. Fawcett, (1984), "**Hazardous and Toxic Materials: Safe Handling and Disposal"**, John Wiley.
2. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "**Industrial Safety and Pollution Control Handbook"**

SYLLABUS FOR M Tech., WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject: Instrumentation Techniques in Environmental Engineering

Subject Code	18CWM332	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of	50	Exam Hours	03

Lecture Hours			

CREDITS – 04

Course objectives: This course will enable students to

- To analyse the quality standards.
- To use the appropriate instruments and minimize the errors.

Modules	Teaching Hours
Module -1	
Treatment of Data in Quantitative Analysis - Accuracy, Precision, Standard deviation, Types of errors, Minimization of errors. Significant figures, Criteria for rejection of data, Principles of instrumentation.	**10 Hours**
Module – 2	
Spectrophotometric Methods - Principles, applications, advantages & limitations of the following Spectrophotometric methods: Colorimetry& Spectrophotometry, FTIR, NMR, Atomic absorption spectrophotometry, Flame photometry, Fluorimetry, Nephelometry and Turbidimetry, Inductively coupled plasma spectroscopy & Mass spectroscopy.	**10 Hours**
Module – 3	
Electrochemical Methods - Principles, applications, advantages & limitations of following electrochemical methods: Polarography, Pulse polarography, Ionselective electrode oscilloscopic polarography, cyclic voltametry& anode stripping voltametry	**10 Hours**
Module – 4	
Chromatography - Principles, applications, advantages & limitations of following chromatographic methods: Adsorption, Partition, Column chromatography, Paper chromatography, Thin layer chromatography, Gas chromatography, High Performance Liquid Chromatography (HPLC), Ion-chromatography & size exclusion chromatography	**10 Hours**
Module – 5	
Physical and Biological Methods - Analytical methods in Biotechnology & bio-process control, Electrophoresis, X-ray crystallography, Bio-informatics tools, Bio-assay of pharmaceutical products, online & off line measurement systems, micro processor based control systems.	**10 Hours**

Course outcomes:

During this course, students will be trained:

- To measure the pollution level in waste water
- To understand the effect of level of micro-organisms present in the waste water

- To evaluate the hazardousness of the polluted medium

Questionpaper pattern:

- The question paper will have ten questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with a maximum of two or three sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Instrumental Methods of analysis, Willard H H& Dean LL, John Willey, (1976).
2. Modern Methods of chemical analysis Recsok RL, & Shields LD, John Willey & sons, Inc(1990).
3. Instrumental Methods of chemical analysis, Ewing GW, McGrw Hill BookCompany, Inc. (1975).

Reference Books:

1. Fundamental of molecules spectroscopy. Banwell CN, McGraw Hill, NY,Chemistry for Environment Engineering. Sawyer and Mc Carty.
2. Standard Methods for Examination of Water and Wastewater,

SYLLABUS FOR M Tech.- WASTE WATER MANAGEMENT, HEALTH & SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject: Environmental Planning and Management

Subject Code	20CWM333	IA Marks	40
Number of Lecture Hours/Week	04	Exam Marks	60
Total Number of	50	Exam Hours	03

Lecture Hours			

CREDITS – 04

Course objectives: This course will enable students to

- Understand the management and to apply the skills of the management when they become an entrepreneur

Modules	Teaching Hours
Module -1	
Management Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management– Management as a science, art or profession – Management & Administration – Roles of Management, Levels of Management, Development of Management Thought – early management approaches – Modern management approaches PlanningNature, importance and purpose of planning process – objectives – Types of plans (Meaning only) – Decision making – Importance of planning – steps in planning & planning premises – Hierarchy of plans.	**10 Hours**
Module – 2	
Organizing and Staffing Nature and purpose of organization – principles of organization – Types of organization – Departmentation – Committees – Centralization Vs Decentralization of authority and responsibility – Span of control – MBO and MBE (Meaning only) Nature and importance of Staffing – Process of Selection & Recruitment (in brief). **Directing & Controlling -**Meaning and nature of directing – Leadership styles, Motivation Theories, Communication – Meaning and importance – Coordination, meaning and importance and Techniques of Coordination. Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief).	**10 Hours**
Module – 3	
Entrepreneurship Meaning of Entrepreneur, Evolution of Concept, Functions of	**10 Hours**

Entrepreneur, Types of Entrepreneur, Entrepreneur – an emerging class. Concept of Entrepreneurship – Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of Entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.	
Module – 4	
Small Scale Industry Definition; Characteristics; Need and rationale : Objectives, Scope, role of SSI in Economic Development. Advantages of SSI. Steps to start an SSI – Government policy towards SSI, Different Policies of SSI., Government Support on SSI., during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO / GATT Supporting Agencies of Government for SSI Meaning. Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only).	**10 Hours**
Module – 5	
Preparation of Project**,** Meaning of Project, Project Identification, Project Selection, Project Report, Need and significance of Project, Contents, formulation, Guidelines by Planning Commission for Project Report, Network Analysis, Errors of Project Report, Project Appraisal. Identification of Business Opportunities. Market Feasibility Study : Technical Feasibility Study, Financial Feasibility Study & Social Feasibility Study	**10 Hours**
Course outcomes: During this course, students will be trained : • Identify, select a suitable Project • Write a Project Report, with formulation and understand the Guidelines by Planning Commission for Project Report. • Become a Entrepreneur	
Questionpaper pattern: • The question paper will have ten questions. • Each full question consists of 20 marks. • There will be 2 full questions (with a maximum of two or three sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full	

question from each module.

Text Books:

- Principles of Management – P.C. Tripathi, P.N. Reddy, Tata McGraw Hill,
- Dynamics of Entrepreneurial Development & Management – Vasant Desai, Himalaya Publishing House.
- Entrepreneurship Development – Small Business Enterprises – Poornima M. Charantimath – Pearson Education – 2006 (2&4).

Reference Books:

- Management Fundamentals – Concepts, Application, Skill Development – Robert Lusier – Thomson .
- Entrepreneurship Development – SS Khanka – S Chand & Co.
- Management – Stephen Robbins – Pearson Education / PHI – 17th Edition, 2003.