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

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

SEMESTER – I

Subject: Applied Mathematics

Subject Code	18CWM11	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 various concepts on mathematical models and applications in Environmental Engg. field.
- Gain the knowledge on Optimization techniques and application.
- Study on Statistical operational system using mathematical models.

Modules	**Teaching Hours**
Module -1	
Numerical Methods: Partial differential equation, Newton Raphson Method, Finite Difference, Finite element, method of characteristics, different methods, successive over relaxation method. **Optimization:** Classification and Importance in Environmental studies. Single and multivariable optimization without and with constraints.	**10 Hours**
Module – 2	
Linear Programming: Different methods, linear approximation of non-linear optimization. **Statistics:** Significance test, Frequency distribution, characteristics of distribution, Method of least squares and regression, Multiple regression.	**10 Hours**
Module – 3	
Applied Partial Differential Equations: Classification of second order partial differential equations, Canonical forms - Hyperbolic, Parabolic, Elliptical Equations. **Laplace Transform Method:** Transforms of derivatives, Differential equations and simultaneous equations. Transform of Dirac Delta function, Inverse Transform - examples. **Fourier Transform Method:** Properties of Fourier Transforms, Sine and Cosine 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 functions - illustrations.	**10 Hours**

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 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:

- Ross S.M.,(1987) "**Introduction to Probability and Statistics for Engineers and Scientists"**, John Wiley Publications.3rd Edition,Academic press.
- Kreyszig Erwin(2006),9th Edition" **Advanced Engineering Mathematics"**, Wiley Eastern Publications.
- Berthouex P M.,and Brown L. C.(1994), "**Statistics for Environmental Engineers"**, Lishe publication, 2nd Edition.

Reference Books:

- Rao. S.S.(1979) Optimization: Theory & Applications Techniques, Wiley Eastern Ltd, New Delhi.
- Taha H.A.,(2007), "Optimization Research":An introduction, Pear son Prentice Hall, 8th Edition.
- Shanthakumar M.S., Numerical Methods and Analysis, Tata McGrawHill Publications.

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

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

SEMESTER – I

Subject: Advanced Water Treatment Technology

Subject Code	18CWM12	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 Water and its significance, importance of its quality and Standards for usage as per WHO guidelines.
- To 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. Sources of water and their characteristics. Micro-organisms in natural water purification system. Drinking water quality requirements as per BIS & WHO guidelines. Sources of Water Pollution, Diseases and Control. Public Health Significance. Flow Diagram on overall water supply Project. Unit diagrams and flow charts on Water Treatment System. Suitability of Intake Structures and types.	**10 Hours**
Module – 2	
Treatment Operations and Engineering Systems for Water Purification – Typical treatment for ground water containing Hardness and Turbid surface water contaminated with organisms. Water Aeration process, Importance and limitations. Gas Transfer two film model: Water in Air system and Air in water system. Estimation of Solubility of Air in water with Henry's Law. Significance of DO in Water. Principles of Sedimentation Process and Separation of Solids. Design Criteria and design of Sedimentation tank. Type-I and Type-II Settling pattern in the removal of Discrete particles.	**10 Hours**
Module – 3	
Coagulation and Flocculation Process – Theory of Coagulation and Principle. Types of Coagulants used and their characteristics, Chemical reaction with water. Alkalinity Coagulation relationship. Coagulant Aids, Chemical feeding devises. Determination of Optimum Coagulant Dosage. Numerical design problems on estimation of Coagulants.	**10 Hours**

Module – 4	
Water Treatment by Filtration Process – Theory of Filtration and basic Principles. Classification of Filters used in treatment of water. Filters washing Technique/back wash. Operational troubles and trouble shooting. Design criteria used and Design of Slow and Rapid Sand Filters required for water treatment plant.	**10 Hours**
Module – 5	
Water Disinfection Process – Disinfection methodologies and their suitability. Theory of Disinfection and characteristics of good disinfectant. Forms of Chlorination, Chemical reactions, Break point Chlorination. Measurement of Chlorine Demand and residual Chlorine. Estimation of quantity of Chlorine and Bleaching powder required for treatment of water. **Water Softening** - Hardness removal techniques, numerical problems on determination of Hardness in water sample and Studies on effects of hardness. Fluoridation and Defluoridation techniques in affected areas.	**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 Various diseases in a Community.
- By knowing the Objectives and importance of treatment process, one can judge the standards of water before used and supplying to a community.
- To understand the Dynamics of Water Purification and type of treatment required with respect to water characteristics.
- Gaining the knowledge on water softening process and Fluoridation &Defluoridation techniques.

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:

- Fair, G.M., Geyer J.C and Okun, (1969) "**Water and Waste water Engineering**" Vol II, John Wiley Publications.
- Weber W.J., (1975) "**Physico - Chemical Processes for Water Quality Control**".
- AWWA, (1971), "**Water Quality and Treatment** "McGraw Hill.
- CPHEEO Manual, (1991), "**Water Supply and Treatment",** GOI-Publications, New Delhi.

Reference Books:

- Peavy, H.S., Rowe and Tchobonoglous,G., (1985), **"Environmental Engineering**", McGraw Hill.
- ViessmanJr, Hammer J. M, Perez, E.M, and Chadik, P. A, **Water Supply and Pollution Control**, PHI Learning, New Delhi, 2009.
- Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, **Environmental Engineering**, McGraw Hill., 1984

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 Technology

Subject Code	18CWM13	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 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:

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

Reference Books:

- Fair G.M., Geyer J.G and Okun, "Water-wastewater Engineering".
- 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	18CWM14	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, animals and humans.	**10 Hours**
Module – 2	
Water Pollution: Sources of water and their contamination, causes and effects. 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 soil, 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.	**10 Hours**

Heavy Metal Pollution: Sources of heavy metals, Accumulation of heavy metals in abiotic environment and biotic components, Bioaccumulation, Bio-magnification, Toxic effects (Lead, Mercury, Arsenic). Control measures.	
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, sources of oil pollution, 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.	
Question paper 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. 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 Science and Environmental Sanitation

Subject Code	18CWM15	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 Health Science, Communicable diseases& its Control in rural and urban areas.
- Understand the objectives and maintenance of Environmental Sanitation, waste management and concern to Transmission/Dynamics of Diseases.
- To know about the principles of Epidemiology, prevention of Communicable diseases and Risk Approach.

Modules	**Teaching Hours**
Module -1	
Concept of Health and Disease: Concept of Health, Dimensions of Health, Determinants of Health, Indicators of health, Communicable & non- Communicable Diseases and their sources. Classifications, Methods of communication and control of diseases. **Community Health and Sanitation:** Importance of Community Health, Environmental Sanitation, Rural and urban Sanitation, Classifications of Health as per WHO guidelines, Physical, Mental, Social Health Science.	**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 Diseases and Prevention:** Concept of prevention and Levels. Preventive and Social medicine. Screening for diseases, Concept of screening and uses.	**10 Hours**
Module – 3	
Dynamics of Disease Transmission: Dynamics and Sources of diseases and Reservoirs of Human, Animal and non-living things. Routes of Disease Transmission. **Classifications of Respiratory infections;** Small pox and Chicken pox and their differences. **Intestinal infections**; measles and rubella.	**10 Hours**
Module – 4	
Prevention and Control of Diseases: Source of Infection, Routes of disease Transmission; Malaria, Dengue fever, Chicken Gunya fever, Cholera, Typhoid and Yellow Fever.	**10 Hours**

Disinfection and Types. **Insect Control:** Mosquito and House fly; study on their Life cycle, Transmission of diseases and control measures.	
Module – 5	
Nutrition and Health: Food Poisoning, Types and sources. Prevention and Control. Milk products, Milk Sanitation, Essentials for milk sanitation and Test for milk quality, Pasteurization, Cattle Born Diseases. **Occupational Health:** Health of worker, Occupational Environment, Hazards and Diseases.	**10 Hours**

Course Outcomes:

During this course, students will be trained :

- To understand the roll and importance of Waste management and Transmission of Various diseases in Urban and Rural Community.
- To understand the Dynamics of Disease Transmission.
- Control and remedial measures to maintain good Sanitation.
- Knowledge about water, wastewater and Solid waste management and Environmental administration.

Question paper 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:

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

Reference Books:

- **K. Park,** Preventive and Social medicine, M/S. Banarsidas Bhanot Publications, 22nd Edition,2013.
- **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	18CWML16	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 students to;

- Know the main objective and significance of testing water and waste waters from various sources.
- Basic knowledge on various chemical solutions required for testing of samples and their preparation.
- Gaining knowledge in handling the field study projects on waste management.

Experiments	**Teaching Hours**
* Methodology used for Sampling and Preservation of water and waste water from various sources. Preparation of Standard chemical solutions in the laboratory. • Determination of Solids in wastewater : Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids. • Determination of pH, Electrical Conductivity and TDS. • Determination of Acidity and Alkalinity. • Determination of Calcium, Magnesium and Total Hardness. • Determination of Dissolved Oxygen. • Determination of Chlorides in saline water samples. • Determination of percentage of Chlorine available in a • Sample of Bleaching powder and determination of residual • Chlorine and Chlorine Demand for water and waste water. • Determination of Turbidity by Nephelometer. • Determination of Optimum Coagulant dosage using Flocculator apparatus.	**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.

Question paper 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:

- Manual of Water and Wastewater Analysis – NEERI Publication.
- Standard Methods for Examination of Water and Wastewater, American Public Health Association, Water Pollution Control Federation, American Water Works Association, Washington DC.- latest edition.

Reference Books:

- Sawyer C.N. and McCarty, P.L ., (2003), "**Chemistry for Environmental Engineering and Science**", 5th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- APHA, (2002), "**Standard Methods for Examination of Water and Wastewater**"; 21st Edition.

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

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SEMESTER – I

Subject: Research Methodology and IPR

Subject Code	**18CWM17**	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:	

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SEMESTER – II

Subject: Transport Modelling of Aquatic Systems

Subject Code	18CWM21	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.
- Observe and understand about data collection and analysis.
- To impart the knowledge of mixing zones in a river.
- Observe and understand the Eutrophication.
- Know the importance of ocean disposal of wastewater.

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 Modeling.	**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 modeling, Mass balances, 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, Nutrient loading criteria, Numerical problems. **Ocean disposal of wastewater -** Silting of outfalls.	**10 Hours**
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 will have ten questions. • Each full question consists of 16 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. 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

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

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SEMESTER – II

Subject: Industrial Effluent Treatment and Engineering

Subject Code	**18CWM22**	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	
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. **Effluent standards and receiving water quality standards**. Different aspects and choices of various disposal alternatives.	**10 Hours**
Module – 2	
Industrial Waste survey-Process flow charts, condition of waste stream. Material balance, Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Bio-monitoring.	**10 Hours**
Module – 3	
Pre-treatment of Industrial Wastewater–Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids.	**10 Hours**

Module – 4	
Wastewater Treatment for specific industries: Distillery, Sugar Industry, Pulp and paper, Cement Industry, Textile, Dairy Industry, Fertilizer, Pesticides and Pharmaceutical industries.	**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** of contaminated soils.	**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 will have ten questions.
- Each full question consists of 16 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:

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

Reference Books:

- Nemerow N.N., (1971) – "**Liquid Waste of industry theories,** "Practices and Treatment. Addison Willey New York.
- "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: Occupational Safety and Health Management

Subject Code	**18CWM23**	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 Occupational Health 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,	**10 Hours**

Anthracosis, Bagassosis, Byssinosis, Tobacossis. **Health Screening Measures –** Stages of medical examination, occupational history, Pulmonary Function Test (PFT), Noise Induced Hearing Losses (NIHL). Audiometry.	
Module – 4	
Basics of Preventive Techniques – Accident analysis, monitoring of hazards, reporting and investigation of accidents, prevention and control of accidents, ensuring safety measures, PPE.	**10 Hours**
Module – 5	
Occupational health and safety legislations in India – overview of existing OHS legislations 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 questions.
- Each full question consists of 16 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: Integrated Solid Waste Management

Subject Code	**18CWM241**	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 insight into the collection, transfer, and transport of municipal solid waste.
- Understand the design and operation of a municipal solid waste landfill.
- Understand the design and operation of a resource recovery facility.
- Understand the design and operation of a waste-to-energy facility.

Modules	**Teaching Hours**
Module -1	
Introduction: Day-day solid waste management and social issues, scope and importance of solid waste management, classification and magnitude of the problem, functional elements. Impact of solid waste management. **Solid Waste:** Sources of generation, classifications, characterization and quantification, municipal industrial and bio-medical waste, estimation of moisture content and density of a solid waste, design examples.	**10 Hours**
Module – 2	
Transfer and Transport: Collection services and collections systems, collection equipment, transfer stations, collection route optimization. **Processing Techniques:** Processing methodologies and waste minimization, recovery, recycle and reuse (3R) of materials from solid waste, volume and size reduction, biological processing.	**10 Hours**

Module – 3	
Treatment Methodologies : Composing techniques; aerobic and anaerobic process, incineration, Pyrolysis and energy recovery. **Ultimate Disposal:** Significance of refuse disposal and management, impact of open land dumping site selection, sanitary land, filing process, design criteria and design examples. Leachate and gas collection system leachate movement and treatment.	**10 Hours**
Module – 4	
Hazardous waste: Identification of Hazardous waste, classification, treatment and disposal techniques – biomedical, radioactive and chemical industries.	**10 Hours**
Module – 5	
Recent Developments and Role of Various Organizations: Power generation, energy recovery, blending with construction materials, governmental, non-governmental activities and roles under solid waste management. Important conditions in the planning process.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- Apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges.
- Adopt the role on policy driver's play in stakeholders' response to the waste and resource management challenge within a circular economy.
- Know the principles of existing and emerging technologies for the treatment of waste and recovery of value from wastes.

Question paper 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:

- Tchobanoglous G., Theissen H., and Samual A Vigil.(2014), **"Integrated Solid Waste management Engineering Principles and Management Issues**",McGraw Hill, New York.
- Peavy, Rowe and Tchobanoglous (1985), "**Environmental Engineering**", McGraw Hill Co. 4th Edition
- CPHEEO, Manual on **Municipal Solid waste management**, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.

Reference Books:

- **Waste Treatment and Disposal** 2nd edition Paul T Williams, Wiley, 2005
- **Integrated Solid Waste Management** - Engineering Principles and Management Issues, Tchobanoglous/Theisen/Vigil, McGraw Hill (1993)
- 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: Remote Sensing and GIS in Environmental Engineering

Subject Code	**18CWM242**	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 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, Spectral reflectance 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

Question paper 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:

- 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: Aquatic Chemistry and Microbiology

Subject Code	18CWM243	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
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 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. 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. Pelczar M.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	**18CWM251**	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: The Need for EIA, Indian Policies Requiring EIA , The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions. **Components of EIA:** Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.	**10 Hours**
Module – 2	
Identifying The Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements.	**10 Hours**

Wastes and Emissions: Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio- Economic Impacts, Ecological Impacts, Global Environmental Issues.	
Module – 3	
EIA Methodologies: Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods. **Environmental index** using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS	**10 Hours**
Module – 4	
Reviewing The EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality. **Socio-economic Impacts:** Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System, Integrated Impact Assessment.	**10 Hours**
Module – 5	
Review of EMP and Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal. **Case Studies:** Preparation of EIA for developmental projects-Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.	**10 Hours**

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**.**

Question paper 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	**18CWM252**	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,	**10 Hours**

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 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.	**10 Hours**

Ground vibration and air blast, Environmental and health effects; strategic control and abatement measures	
Module – 5	
CASE STUDIES Industrial manufacturing process description, wastewater characteristics and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Petroleum Refining – Chemical industries – Sugar and Distilleries –Dairy –Iron and steel – fertilizers- Industrial clusters and Industrial Estates	**10 Hours**

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

Question paper 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:

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

Reference Books:

- Mahajan (1984) –” **Pollution control in Process industries”**. TMH, New Delhi.
- 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: Renewable Energy & Alternative Fuels

Subject Code	**18CWM253**	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	
Question paper 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.Yogi Goswami (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: Water and Waste Water Analysis Lab - II

Subject Code	**18CWML26**	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 students to

- The objective of this course is to make students to learn principles and design of experiments.
- To determine the performance and efficiency of various Effluent & Treatment plants.

Contents of Lab	**Teaching Hours**
• Determination of Dissolved Oxygen and its Importance in Environmental Engg. • Determination of Biochemical Oxygen Demand for an industrial waste water. • Determination of Chemical Oxygen Demand. • Determination Fluoride for water and wastewater. • Determination Nitrites and Nitrates for water and wastewater. • Determination of Potassium, Sodium for water and Wastewater. • Determination of Oil and grease substance from Waste water. • Determination of Chlorides and Sulphates from waste water.	**42 Hours**

Course outcomes:

- Achieve Knowledge of Design and development of experimental skills.
- Understand the principles of design of experiments.

Questionpaper pattern:

- Individual experiments can be set as single experiment.
- All questions are to be framed such that they should relate to field.

Text Books:

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

Reference Books:

- **BIS Standards :** 2490-1974, 3360-1974, 3307-1974.
- **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	**18CWM31**	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 Air Pollution from industries and its Effects.
- Study on Meteorological factors used to measure air Pollutants.
- Selection of Site for Industrial Zones in urban areas.
- To 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 Equipment 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 Secondary Pollutants. 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 and Control methods. Heat Island Effect in Urban areas.	**10 Hours**
Module – 3	
Effect of Air Pollution from major Industries – Study on 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 Equipment- Air pollution control equipments for particulate matter. Working principle and field applications on; Gravity Settling Chambers, Centrifugal Collectors, Wet Collectors, Fabric filters and Electrostatic precipitators (ESP). Control methods for Gaseous Pollutants-Adsorption, Absorption and Combustion Process.	**10 Hours**
Module – 5	
Noise Pollution and Control in Industries - Sources, Effects and Occupational hazards. Noise measuring devises, Standards, Noise mapping, Control measures in Industrial establishments-Administrative controls, Engineering Controls and Personnel protections.	**10 Hours**

Course outcomes:

During this course, students will be trained :

- To understand the role and importance of Air pollution and its control technology in the present environmental system.
- Understand the basics on Meteorology and importance of wind.
- Learn to Control 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.

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:

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

Reference Books:

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

Subject Code	**18CWM321**	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;

- Energy and environment management in building.
- Know the new Technologies for low energy buildings.

Modules	**Teaching Hours**
Module -1	
Introduction: Global Energy System, environmental resources necessity and Energy crises, Energy use pattern in India: Energy consumption needs, Energy/sources renewable and non renewable and availability. **Fossil Fuels:** Fossil Fuels classification, composition, physic-chemical characteristics, Energy content of coal. Petroleum and natural Gas formation, exploration, mining and uses of coal, oil and natural gas. Environmental problems associated with exploration, mining, processing, transportation and uses	**10 Hours**
Module – 2	
Bio-Energy: Bio-Mass composition and types, conversion process Pyrolysis charcoal production, compression, classification and liquefaction. Biogas production and uses, Anaerobic digestion classification of Bio-gas plants. Energy from solid waste sources types, energy production.	**10 Hours**
Module – 3	
Solar Energy: Physical Principles of conservation of Solar radiation harnessing of Solar Energy, solar collectors, Solar thermal Energy, Solar Electricity Generation, Solar Heaters, Dryers and cookers, photo voltaic	**10 Hours**
Module – 4	
Tidal Energy: OTPC (Ocean Thermal Electric Conversion), methods of ocean thermal electric power generation, site selection. Energy from tides-basic principles of tidal power, components of tidal plant.	**10 Hours**
Module – 5	
Nuclear Energy: Nuclear Fuels-Mining & processing of Uranium. Fission and fusion concepts of necessity, general component of nuclear reactors, different types of rectors, breading rector's location of NPP, disposal ofNuclear waste	**10 Hours**

environmental effects	

Course outcomes:

During this course, students will be trained :

- Analyse the data obtained from the field
- Develop an appropriate methods to solve logically and optimize the test or field results

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. 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, Renewable and Conventional**", 2nd Edition, Khanna Publishers.

3. 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 Lecture Hours	50	Exam Hours	03

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.

Question paper 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.

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[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 Lecture Hours	50	Exam Hours	03

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.

Question paper 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	**18CWM331**	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 sufficient knowledge on need and principles of risk assessment, management, methodologies and tools.
- Provide detailed design aspects of the treatment, disposal and analytical methods of Hazardous wastes.

Modules	**Teaching Hours**
Module -1	
Introduction: Terminologies used; Ignitability, Corrosivity, Reactivity, Toxicity. Sources & Classification -Regulations for Hazardous Waste Management, case study – String fellow site, kepone Disaster, manifest system, Cradle to grave concept. **Hazardous Waste Characterization** - Designated Hazardous Wastes – Specific hazardous wastes and mixed wastes. Sampling and analysis of hazardous waste.	**10 Hours**
Module – 2	
Waste Minimization and Resource Recovery – Approaches, priorities in HWM, Development of a Waste Tracking System, Selection of waste minimization Process, Case Studies.	**10 Hours**
Module – 3	
Transportation of Hazardous Waste – requirements, containers, bulk and non-bulk transport, State and local regulations, Hazardous Substances, Emergency Response.	**10 Hours**
Module – 4	
Physico-chemical characteristics: Chemical and Biological Treatment of hazardous waste. **Thermal treatment –** Incineration process Design, Chemistry, Stoichiometry and types of Incinerators. Pyrolysis.	**10 Hours**
Module – 5	
Disposal facilities: Sanitary Landfill**,** Design approach, Leachate and Gaseous collection system. Facility siting and Process, selection for treatment, Storage, Disposal facility (TSDF). **Soil contamination:** Site remediation, Bioremediation processes, monitoring & Selection of disposal sites.	**10 Hours**

Course outcomes:

During this course, students will be trained :

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

Question paper 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. 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 Lecture Hours	50	Exam Hours	03

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	**10 Hours**

crystallography, Bio-informatics tools, Bio-assay of pharmaceutical products, online & off line measurement systems, micro processor based control systems.	

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

Question paper 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 Book Company, Inc. 1975.

Reference Books:

1. Fundamental of molecules spectroscopy. Banwell CN, McGraw Hill, NY, 1990.
2. Chemistry for Environment Engineering. Sawyer and Mc Carty.
3. Standard Methods for Examination of Water and Wastewater,

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

SEMESTER – III

Subject: Environmental Planning and Management

Subject Code	**18CWM332**	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 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	**10 Hours**

(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).	
Module – 3	
Entrepreneurship Meaning of Entrepreneur, Evolution of Concept, Functions of 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.	**10 Hours**
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.