Prof. Ram Meghe Institute Of Technology And Research Badnera -444701

An Autonomus College Affiliated to Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

PROGRAMME SCHEME & SYLLABI

2023-2024

M. Tech.

(Environmental Engineering)

Published By
Dr. G.R. Bamnote
Principal
Prof. Ram Meghe Institute Of Technology And Research, Badnera - Amravati.

Department Vision :

To become a pace-setting center of excellence acclaimed across the region & imitated as a role model by its peers

Department Mission :

1. To elevate technical, entrepreneurial and communication skills of students so as to scale up their employability potential and encourage the spirits of enterprise

2. To elevate moral ethics and values in students so as to help them in shaping their attitude and belief towards varied aspect of life and provide them with unique prospective.

Program Educational Objectives :

1. **Preparation:** To strive for overall personality development of students so as to nurture not only quintessential technocrats but also responsible citizens.
2. **Core Competence:** To make the students apply the necessary problem-solving, design, and application skills for successful careers in Civil Engineering.
3. **Breadth:** To provide the educational foundation and communication skills that prepare the students for diverse career paths.
4. **Professionalism:** To inculcate the value systems & ethics, leadership and team work skills, bring holistic development of personality and to promote entrepreneurial thinking among students.
5. **Learning environment:** To provide students with an environment that develops confidence andstimulates innovative thinking for successful professional career.

Program Outcomes :

- **Engineering Graduate will be able to :**

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identity, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for and have the preparation and ability to Engage in independent and life- long learning in the broadest context of technological Change.

Program Specific Outcomes :

1. **Computer Based Civil and Structural Engineering Design:** Design Civil end Structural engineering systems using contemporary software used by design and analysis firms.

2. **Entrepreneurial spirit:** Demonstrate ability to organize activities, work with and lead teams, understand prevalent trade practices, understand site culture.

Prof. Ram Meghe Institute of Technology and Research, Badnera-Amravati
(An Autonomous Institute)
Two Year Post Graduate Degree Program in Master of Technology
Choice Based Credit System (Semester Pattern)
Branch : Environmental Engineering

SEMESTER: I

Sr. No.	Subject Code	Subject	Teaching Scheme					Examination Scheme										
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL			
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal Marks		Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
										Max. Marks MSE/ MSIE	Max. Marks TA				Int.	Ext.		
Theory																		
01	1SMTCE01	Environmental Microbiology	3	..	..	3	3	3	60	30	10	100	24	50				
02	1SMTCE02	Environmental Sciences and Chemistry	3	..	..	3	3	3	60	30	10	100	24	50				
03	1SMTCE03	Air Pollution & Control	3	..	..	3	3	3	60	30	10	100	24	50				
04	1SMTCE04	Professional Elective 1	3	..	..	3	3	3	60	30	10	100	24	50				
05	1SMTCE05	Professional Elective 2	3	..	..	3	3	3	60	30	10	100	24	50				
06	1SMTCE06	Research Methodology	2	..	..	2	2	2	60	30	10	100	24	50				
Practicals																		
07	1SMTCE07	Environmental Microbiology -Lab	..	..	2	2	1	..							25	25	50	25
08	1SMTCE08	Environmental Science & Chemistry-Lab	..	..	2	2	1	..							25	25	50	25
09	1SMTCE09	Air Pollution & Control-Lab	..	..	2	2	1	..							25	25	50	25
		Total	**17**		**6**	**23**						**600**					**150**	
																Total	**750**	

Professional Elective 1: 1) Watershed Management; 2) Environmental Geotechnology; 3) Hazardous Waste Management
Professional Elective II:1) Environmental Impact Assessment and Management; 2) Water Supply and Wastewater Collection Systems;
3) Remote Sensing and GIS in Environmental Engineering

Prof. Ram Meghe Institute of Technology and Research, Badnera-Amravati
(An Autonomous Institute)
Two Year Post Graduate Degree Program in Master of Technology
Choice Based Credit System (Semester Pattern)
Branch : Environmental Engineering

SEMESTER: II																			
Sr. No.	Subject Code	Subject	Teaching Scheme					Examination Scheme											
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL				
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal Marks		Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks	
										Max. Marks MSE/ MSIE	Max. Marks TA				Int.	Ext.			
Theory																			
01	2SMTCE01	Advanced Water Treatment Technology	3	..	..	3	3	3	60	30	10	100	24	50	..	..	..	..	
02	2SMTCE02	Advanced Waste Water Treatment Technology	3	..	..	3	3	3	60	30	10	100	24	50	..	..	..	..	
03	2SMTCE03	Industrial Waste Water Treatment	3	..	..	3	3	3	60	30	10	100	24	50	..	..	..	..	
04	2SMTCE04	Professional Elective III	3	..	..	3	3	3	60	30	10	100	24	50	..	..	..	..	
05	2SMTCE05	Professional Elective IV	3	..	..	3	3	3	60	30	10	100	24	50	..	..	..	..	
Practicals																			
06	2SMTCE06	Industrial Waste Water Treatment-Lab	..	..	2	2	1	..	..	..	..	..	..	..	25	25	50	25	
07	2SMTCE07	Design Problem-Lab	..	..	2	2	1	..	..	..	..	..	..	..	25	25	50	25	
08	2SMTCE08	Software Based Problem -Lab	..	..	2	2	1	..	..	..	..	..	..	..	25	25	50	25	
09	2SMTCE09	Mini- Project & Seminar 1	..	..	4	4	2	..	..	..	..	..	..	..	50	50	100	50	
		Total	**15**		**10**	**25**	**25**					**500**					**250**		
																Total	**750**		

Professional Elective III: 1) Solid and Biomedical Waste Management; 2) Bioremediation: Principles and Application; 3) Soft Computing Skills
Professional Elective IV:1) Business Analytics; 2) Industrial Safety; 3) Operation Research; 4) Cost Management of Engineering Projects; 5) Composite Materials; 6) Waste to Energy
Mini-Project & Seminar 1: Mini-Project shhould be relevant to current technology and must include innovative element, Seminar will be based on Mini project

Prof. Ram Meghe Institute of Technology and Research, Badnera-Amravati
(An Autonomous Institute)
Two Year Post Graduate Degree Program in Master of Technology
Choice Based Credit System (Semester Pattern)
Branch : Environmental Engineering

SEMESTER: III																			
Sr. No.	Subject Code	Subject	Teaching Scheme					Examination Scheme											
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL				
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal Marks		Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks	
										Max. Marks MSE/ MSIE	Max. Marks TA				Int.	Ext.			
Practicals																			
01	3SMTCE01	Compulsary Internship Two Months (After Compliton of 1st Year)	..	..	..	..	6	..							..	200	200	100	
02	3SMTCE02	Seminar & Dissertation Phase - I		8	..	8	4	..							100	..	100	50	
		Total		**8**		**8**	**10**										**300**		

Prof. Ram Meghe Institute of Technology and Research, Badnera-Amravati
(An Autonomous Institute)
Two Year Post Graduate Degree Program in Master of Technology
Choice Based Credit System (Semester Pattern)
Branch : Environmental Engineering

SEMESTER: IV																			
Sr. No.	Subject Code	Subject	Teaching Scheme					Examination Scheme											
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL				
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal Marks		Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks	
										Max. Marks MSE/ MSIE	Max. Marks TA				Int.	Ext.			
Practicals																			
01	4SMTCE01	Seminar & Dissertation Phase - II		..	20	20	10	..							100	200	300	150	
Total					**20**	**20**	**10**										**300**		
																Total	**300**		

Summary of Marks & Credits					
Year	**Semester**	**Sem Marks**	**Yearly Marks**	**Sem Credits**	**Yrly Credits**
First Year	**I**	750	1500	20	40
	II	750		20	
Secound Year	**III**	300	600	10	20
	IV	300		10	
Total		2100		60	

Exit Option after complition of First Year: Student has to complete 10 credit online courses (NPTEL/MOOCS/SWAYAM) suitable for Environmental Engineering to qualify for the post graduate Diploma in Environmental Engineering

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

Prof. Ram Meghe Institute of Technology and Research, Badnera-Amravati (An Autonomous Institute)

Two Year Post Graduate Degree Program in Master of Technology,

Branch: Environmental Engineering

Syllabus of Semester-I

1SMTCE01 Environmental Microbiology

Lectures/week: 03 **Credits: 03**

Tutorials: Nil **Course Prerequisites: Nil**

Course Objectives:

1. The main objective is to know and understand the role of microbes in biogeochemical processes in different ecosystems.
2. The students will learn the basic microbiological principles, the methods in microbial ecology and theoretical and practical use.
3. To create a base for understanding processes and changes in the environment.

Course Outcomes:

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

1. Acquire basic knowledge regarding preparation and perform sampling and microbial analysis.
2. Study the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.
3. To determine the growth rate and micro-community composition with the basic environmental parameters.
4. Use the knowledge to prevent infections to human and environmental health.
5. Know various Culture media and their applications and also understand various physical and chemical means of sterilization
6. Comprehend the different biological treatment technologies adopted for the treatment, airborne diseases and their control.

SECTION –A

Unit I: Introduction to Microbiology

Classification of microorganisms, prokaryotic cells, and eukaryotic cells. Characterization of microorganisms, and its importance. Distribution of biological forms, interrelationship application in the field of Environmental Engineering.

Unit II: Bacteria

Distribution, cytology, forms size, morphology and file structure of bacteria, nutritional requirements, metabolism, growth of bacteria, growth patterns, food microorganism relationship, Aerobic, Anaerobic growth. Factor affecting growth, generation time.

Bacteriology of water

Pathogens and indicators of pollution, method of isolation, enumeration and differentiation. Presumptive, confirmative and completed test for E-coli, most probable number, Membrane filter technique, indicators of pollution, sampling method, frequency, and precautions.

Unit III: Fresh water Biology

Freshwater Biology: Flora and fauna in rivers, distribution, limnology, biological cycles, oxygen concentration, nutrient concentration, oxygen depletion, oxygen sag reaeration, Lake eutrophication and its prevention.

SECTION - B

Unit IV: Algae, Fungi Protozoa

General, introduction to these groups, their role in environmental Engineering and their classification, identification, observation nutrition, reproductions, their control.

Unit V: Bacterial culture

Isolation of microorganisms, staining procedures, pure and mixed cultures, culture characteristics, different media, selective methods, interference, gram-positive and negative bacteria laboratory culturing techniques, equipment used, microscope, autoclave, incubator, test chamber. Microbiology of wastewater treatment: Microorganisms, fundamental theory, theory of operations, oxygen requirements an environmental factor associated with following waste treatment methods.

· Activated sludge process

· Trickling filter

· Oxidation pond

· Sludge digestion

Unit VI: Air Microbiology:

Types of microorganisms, Air borne diseases, sampling of air, microbial content of air, control of airborne diseases.

Control of microorganisms: Death of bacteria, Pattern of death, the effect of temp pH, toxic substances on the growth of bacteria, Antagonism and synergism. Control of microorganisms by physical age Control of microorganisms by chemical agents.

Text Books:

1. Environmental Biology, Mukherjee, Tata McGraw Hill Publishing. Co. Ltd,1996.
2. Microbiology of Water and Sewage, P. L. Gainey., Prentice Hall Inc., 1952.

Reference Books:

1. Microbiology for Environmental Scientist and Engineers, Anthony Gaudy, Elizabeth Gaudy, McGraw Hill Int. Book Co., 1980.
2. Microbiology for Sanitary Engineers, R. E. Mckinney, McGraw Hill Int. Book Co., 1967.
3. Microbiology, M. J Pelczar., E. C. S. Chan, Tata McGraw Hill, 1986.

1SMTCE02 Environmental Science & Chemistry

Lectures/week: 03 **Credits: 03**

Tutorials: Nil **Course Prerequisites: Nil**

Course Objectives:

1. Understanding the concept and importance of environmental problems. Climatology & meteorology, Ecology and global atmospheric change.

2. To provide an in-depth knowledge of the basics of chemistry, a variety of reactions and introduce equilibrium chemistry.

3. To lay the foundation of electrochemistry, colloidal and surface chemistry to know instrumental methods of analysis.

Course Outcomes:

1. Explain the environmental problems and climates
2. Explain ecology & global atmospheric change
3. Explain chemical reactions and their importance. Physical chemistry. potential.
4. Classify organic and biochemistry. Formulate enzymatic relationships using kinetics.
5. Perform different techniques for measuring wastewater quality parameters. colloids, discuss their properties and their environmental significance.
6. Apply the knowledge of chemistry for water treatment processes like coagulation, softening etc.

SECTION A

UNIT I: The Nature and Scope of Environmental Problems

Interaction of systems, Environmental disturbances, public awareness and action, Quantification of Environmental problems.

Climatology and Meteorology: Basic atmospheric properties, Energy outputs and inputs, wind stability and turbulence, water in the atmosphere, climate.

UNIT II: Ecology

Introduction, Energy flow in Ecosystems, food chain and trophic level, elements of limnology, Eutrophication.

Global Atmospheric Change: The greenhouse effect and stratosphere ozone depletion, Global temperature, the greenhouse effect, carbon dioxide, chlorofluorocarbons, the greenhouse gases, and changes in stratospheric ozone.

UNIT III: General and Physical Chemistry

General Chemistry: Law of mass action, Stoichiometry, Gas Laws.

Physical Chemistry: Types of the solution, electrical conductivity and aqueous solution, ionic theory, electrical dissociation, Buffer solutions, Indicators, Solubility products, Common ion effect, Amphoteric hydroxides, chemical equilibrium and ways of shifting it.

SECTION B

UNIT IV: Organic Chemistry and Biochemistry 1

Organic compounds of interest to environmental engineers. General preparation of the functional groups of organic compounds. Enzymes, classification,Enzyme carbolized reactions.

UNIT V: Organic Chemistry and Biochemistry 2

Break down and synthesis of carbohydrates, fats, and protein under aerobic and anaerobic reactions. CNP cycle under aerobic and anaerobic reactions. Concept of B.O.D., C.O.D., T.O.C. Colloids, Dispersion of Colloids, General and electrokinetic properties of colloids, colloidal solutions and mixtures.

UNIT VI: Environmental Chemistry

Water structure and anomalous behavior of water, Chemistry involved in water treatment processes like coagulation, disinfection, softening, fluoridation, defluorination, Iron and its control. Composition and characterization of sewage, sewage sludge and gas analysis.

Chromatography: Principles and uses in Environmental Engineering.

Text Books:

1) Introduction to Environmental Engg. and Science By Gilbert M Masters.

2) Environmental Science By Alam Singh, Vol-I, II, III.

Reference Books:

3) Environmental Science & Engg. By Henry.

4) Fair G M, Geyr J C, Okun D A, Water and Wastewater Engineering, Vol, I &II, John Wiley& Sons, New York.

5) Chemistry for Environmental Engineering By Sawyer & McCarty

---

1SMTCE03 Air Pollution and Control

Lectures/week: 03 **Credits: 03**

Tutorials: Nil **Course Prerequisites: Nil**

Course Objectives:

1. Understanding of basic concepts of air pollution.
2. Study of air pollution episodes.
3. Study of sampling types and methods for ambient air and stack.
4. Study of macro and micro meteorology for understanding the dispersion of pollutants.
5. Simple and complex modeling for a point source, line source and area source.
6. Study of pollution control methods, mechanisms and devices.

Course Outcomes:

At the end of the subject, the students will be able to:

1. Classify and identify the sources of air pollutants and predict the effects of air pollutants on human health and environment.
2. Apply and relate the significance of various air pollution dispersion models.

3. Recognize various environmental transformation processes of pollutants under extreme weather conditions.
4. Interpret meteorological data and develop the capability to the assessment of the project proposals, and air quality pollution index for any region.
5. Justify the use of pollution control equipment and their design.
6. Design of emission control devices and control of gaseous emission.

SECTION – A

Unit I: Elements of Air Pollution

History of air pollution, Definitions, sources and classification of air pollution, Natural versus polluted atmosphere, Primary and secondary air pollutants, Stationary and mobile sources. Photochemical Smog.

Unit II: Effects of air pollution

Effect on human health, on vegetation, on animals and on materials. Global effects: Global Warming, Acid Rain, Ozone layer depletion, Air pollution episodes. Economic effects.

Unit III: Meteorology and Air Pollution

Meteorological factors influencing air pollution, Plume behavior, Wind rose, Air pollution modellings-Box model, Gaussian plume model, Stack height and problems on determination of Stack height.

SECTION – B

Unit IV: Sampling procedures

Classification of sampling, Sampling methods, Sampling Suspended Particulates by High Volume Sampler, Determination of Mass Concentration and Problems, Stack sampling, Gaseous Samplings.

Unit V : Regulatory Control of Air Pollution

Air quality criteria & standards, Elements of Regulatory Control, Air Pollution Index.

Unit VI : Engineering Control of Air Pollution

Engineering Control concept, control device & systems, Control of stationery sources, Control of mobile sources, source sampling & monitoring.

Text Books:

1. Air Pollution – M.N. Rao & H.V.N. Rao.
2. Fundamentals of Air Pollution – Stern, Wohlers, Bouble, Lower.

Reference Books:

1. Air Pollution, Vol. I To IV – A. C. Stern.
2. Air Pollution & Control – P. P. Mowli& N. Venkata Subbayya.
3. Air Pollution Sienfeld J. H.
4. Air Pollution – Perkins.
5. Air Quality Monitoring – A Course Manual By NEERI, 19981.

Professional Elective-I

1SMTCE04 - 1 Watershed Management

Lectures/week:03 **Credits: 03**

Tutorials: Nil **Course Prerequisites: Nil**

Course Objectives:

1. To understand the concept of hydrology and hydrological cycle.
2. To study the hydrology of groundwater.
3. To provide knowledge regarding watershed development and management.

Course Outcomes:

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

1. Explain the concept of the hydrological cycle in detail.
2. Develop control and mitigation techniques for watershed problems
3. Understand the hydrology of groundwater.
4. To apply knowledge of watershed development and management.
5. Assess the impact of watershed planning through case studies.
6. Analyze public policies and practices of watershed planning

SECTION A

UNIT I: Introduction to Watershed Management

The hydrological cycle, storage, the concept of storage, the watershed Water and Energy: Energy movement, quality of energy, the geometry of energy, the energy budget.

UNIT II: Processes in Water

Water in Vegetation Processes, interception, Transpiration, Evapotranspiration, calculations by using water budget, Evapotranspiration, models, storage.

UNIT III: Hydrology and Hydrograph

Hydrology in water resources development, statistical analysis of rainfall and runoff, different distribution methods, Estimation of Unit Hydrograph-flood flow formulae, Storm hydrograph, Storage and regulation of runoff-safe yield of streams, Estimate of storage requirements.

SECTION B

UNIT IV: Hydrology of Groundwater Common Aquifers

Exploration for Boundary conditions, Unconfined and Confined, steady and unsteady flow into wells and infiltration galleries – Evaluation of formulation constant interference, Method of images – Types, design, construction and maintenance of wells and infiltration galleries, Development of wells – well strainer – functions and selections.

UNIT V: Watershed Development and Management

Watershed Development and Management: Definition, Need and scope, characterization of watershed criteria survey, Basic data collection and interpretation, Establishment of watershed research stations. Watershed resource evaluation and management. Irrigation technology. Integrated farming system. Project formulation and economic analysis.

UNIT VI: Practice of Watershed Management

Rehabilitation, Protection and Enhancement. Non-Point Sources of Pollution: The legal basis, the process of non-point source pollution control, Best management practices principles, Best management practices on wetlands. Rainwater Harvesting: Necessity, Methods of rainwater harvesting, Requirements for the design of the project, community participation, Role NGO's, Government and Municipal Corporations, Limitations, quality assurance of stored water.

Text Books:

1. Watershed Management by J V S Murthy, New Age International Publishers.
2. Watershed Planning & Management by Dr. R. Suresh, Standard Publishers Distributors.
3. Watershed Management in India by M. Dinesh Kumar.

Reference Books:

1. Watershed Hydrology by Peter E. Black.
2. Water Resources Systems, Planning and Management by R. N.Chaturvedi.

Professional Elective-I

1SMTCE04 - 2 Environmental Geotechnology

Lectures/week: 03 **Credits: 03**

Tutorials: Nil **Course Prerequisites**: Nil

Course Objectives:

1. To study the concept of contamination and contamination of solid waste in landfills.
2. To study the different containment systems using Geo-membrane.
3. To provide knowledge regarding contaminants of slurry wastes.

Course Outcomes:

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

1. Understand the concept of contamination in detail.
2. Apply knowledge regarding different containment systems.
3. Make geotechnical reuse of Waste material.
4. Understand vertical barriers for environment.
5. To gain knowledge about contaminants of slurry wastes.
6. To acquire knowledge about engineering properties of wastes.

SECTION A

UNIT I: Contamination

Surface & subsurface contamination, Sources and effects of subsurface contamination, Physical, Chemical and biological characteristics of solid waste, Identification, Characterization and regulatory requirements for disposal of hazardous, non-hazardous and domestic waste Soil-waste interaction, Effect of pollutants on soil properties

UNIT II: Contaminants of solid waste in landfills

Characteristics of solid wastes, Disposal of solid waste, Stabilization and solidification of solid waste, Waste containment, Solid waste Landfills and its components, Shape and size of landfills, Types of landfills, Site selection Impervious barriers for liners and Covers, Liner systems and cover systems, , Landfill construction and operation, Leachate generation, Leachate collection and detection system , Closure and post-closure care, Sustainable waste management, Ground water contamination associated with leachate transfer

UNIT III: Containment systems using Geo-membrane

Advantages of using composite barrier for Liners and Covers, Single composite liner system for MSW landfill, Double composite liner system for HW landfill, Stability of landfills.

SECTION B

UNIT IV: Contaminants of slurry wastes

Slurry transported waste, Slurry Ponds and their operation, Embankment construction methods for ponds, Design aspects, Environmental impact and control,

UNIT V: Vertical barriers for containment

Contaminated sites, Types of vertical barriers, - Soil bentonite slurry trench walls, and Cement-Bentonite slurry trench walls -construction and design aspects

UNIT VI: Geotechnical reuse of Waste material

Waste reduction, Use of waste in Geotechnical construction, Waste characteristics for soil replacement, Transportation consideration, Engineering properties of waste, Waste material in embankments and fills Reclamation of contaminated site, various methods.

Text Books:

1. Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.

2. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and 8. Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

Reference Books:

1. Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005.

2. Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press,1997.

3. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.

4. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.

5. Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.

Professional Elective-I

1SMTCE04 - 3 Hazardous Waste Management

Lectures/week: 03 **Credits: 03**

Tutorials: Nil **Course Prerequisites: Nil**

Course Objectives:

1. To provide knowledge regarding hazardous wastes.
2. To characterize Hazardous Wastes and be able to apply different site treatments.
3. To provide information regarding Basic Disaster Management Aspects and long-term measures.

Course Outcomes:

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

1. Understand the concept of hazardous wastes.
2. Do the assessment of hazardous sites for waste minimization and resource recovery.
3. Implement long-term measures for the prevention of hazardous wastes.
4. Characterize hazardous waste.
5. Suggest suitable treatment for the waste.
6. Suggest the long term measures to prevent the development of waste.

SECTION A

UNIT I: Introduction to Hazardous Waste

Definition, Problems, general awareness, Industry and Government's perspective. Risk Assessments, Environmental legislation.

UNIT II: Hazardous Waste Characterization and Site Treatment

Introduction, study of characterization, Assessment of Hazardous sites, waste minimization and Resource Recovery, chemical, physical and biological treatment to Hazardous waste, Thermal process.

UNIT III: Transportation of Hazardous Wastes

Container for Hazardous waste, bulk transport, Nonbulk transport. Hazardous Wastes (Handling, Storage & Management) Rules, 1989 of MoEF. Introduction.

SCETION B

UNIT IV: Groundwater Contamination

Effect on human health, Historical uses and abuses, hydrology, Detection, Control and Mitigation of groundwater contamination. Process Techniques and Disposal: Selecting the process, siting the facility, integrating landfill systems as Disposal sites, developing a new facility, and operating a landfill.

UNIT V: Basic Disaster Management Aspects

The significance of Disaster, the Disaster threat, National Disaster Management policy, major Requirements for coping with the Disaster Management cycle, Disaster and National Development, Disaster legislation, and counter-disaster resources. International Disaster Organization, utilization of Resources.

UNIT VI: Long-Term Measures

Prevention, Mitigation. Major factors for occurrence of Disaster impact: - Response to Disaster impact: - Major post impact factors, Disaster management support requirements.

Text Books:

1. Hazardous Waste Management: Charles A. Wentz., McGraw-Hill, New York,1989

2. Hazardous Waste Minimization, Harry M. Preeman, McGraw-Hill, 1989

Reference Books:

1. Hazardous Waste Chemistry, Toxicology and Treatment, Stanly E. Manahan, 1st edition, CRC-Press, 1990)

2. Disaster Management: A Disaster Manager's Hand Book, W. Nick Carter, ADB Publ., Manila,1991

3. Hazardous Waste Management, Wentz, Charles A., McGraw-Hill, 1989

4. Hazardous Waste Management, LaGrega, Michael D. Buckingham, Philip L. Evans and Jeffrey C., McGraw-Hill, 1989

Professional Elective-II

1SMTCE05 - 1 Environmental Impact Assessment & Management

Lectures/week: 03 **Credits: 03**

Tutorials: Nil **Course Prerequisites: Nil**

Course Objectives:

1. Explain the necessity of Environmental Impact Assessments.

2. To provide a detailed insight into the Indian environmental legislation aspects including National Environmental Policy, legal framework, and various Acts related to environmental pollution, Prevention and control.

4. Explain the process of impact assessment and deal with various methodologies.

5. Explain the scope of EIA and the positive aspects related to the same.

Course Outcomes:

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

1. Explain the National Environmental Policy and Legal framework related to environmental aspects.

2. List and identify various Indian Environmental Acts in vogue, amendments, modifications and notifications and describe the Role of the Tribunal.

3. Discuss the concept of Carrying Capacity; Environmental Impact Assessment studies for various developmental activities and also defines objectives, types and limitations of EIA.

4. Describe the scope of EIA along with the framework and propose the need for public participation in EIA.

5. Collect data and prepare ElA reports.

6. Illustrate various Environmental management techniques.

SECTION A

UNIT I: Introduction to EIA

Development and Environment, need for EIA, the concept of EIA, elements of EIA, nature of impacts – primary, secondary, tertiary, short-term, long-term, local and regional, reversible & irreversible impacts.

UNIT II: Impacts and Technical Terms Related to EIA

Overview of impacts – directly & indirectly measurable impacts w.r.to air, noise & water. Screening and scoping in EIA, terms of reference for conducting EIA, methodologies of EIA checklists, cost-benefit analysis, & networks.

UNIT III: Framework of EIA

Scope of EIA, baseline data collection, prediction of impacts, evaluation of impacts, Battelle environmental evaluation system, environmental quality monitoring.

SECTION B

UNIT IV: Environmental legislation

Basic concepts, critical issues, civil liability, various enactment and their provisions – Water Act (1974,1988), Air Act (1981, 1988), Environmental Protection Act 1986, Role of State & Central boards of pollution control, local Govt., social action groups.

UNIT V: Environmental Audit

Definition, the concept of EA, types of environmental audit, benefits of environmental audit, scope & objectives, environmental statement, procedural aspects of conducting an environmental audit, pre-audit phase, on-site audit phase & post-audit phase. Sustainable development & environmental management, Environmental Management in India.

UNIT VI: Resource Management

Types of resources - terrestrial (soil) resources, minerals, plants & animals (biotic) resources, marine, freshwater, air & bioenergy resources, resource utilization-renewable and nonrenewable resources, optimal use of resources, depletion of resources – causes & effect.

Text Books:

1. Environmental Impact Assessment: Rau & Woofes.

2. Environmental Impact Assessment: W.F. Canter, McGraw Hill.

Reference Books:

1. Proceedings of Indo-British Workshop on EIA of Petrochemical. Industries and Environmental Audit, Jan. 1994, IAEM, Nagpur.

2. Handbook on Pollution Control Acts, Central Pollution Control Board, New Delhi.

3. The New Environmental Age by R. K. Sapra, S. Bhardwaj, Ashish Pub. House, New Delhi.

Professional Elective-II

1SMTCE05 - 2 Water Supply and Waste Water Collection Systems.

Lectures/week: 03 **Credits: 03**

Tutorials: Nil **Course Prerequisites**: Nil

Course Objectives:

1. To study the Water transmission systems and water distribution systems.
2. To provide knowledge regarding the Design of rising mains.
3. To study the different types of sewer systems.
4. To study Optimization Techniques and Analytical solutions using different methods.

Course Outcomes:

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

1. Analyse the flow in closed and open pipe networks using various methods.
2. Acquire knowledge regarding the requisites for sewerage system design.
3. Find out the solutions by Calculus, Lagrange Multiplier method, Linear programming Optimization of water distribution systems including branching, water hammer, causes and prevention.
4. Carry out the Cost analysis and optimization of the sewer system.
5. To design and analyze water supply system.
6. To design pumping mains.

SECTION A

UNIT I: Hydraulics of water mains

Water transmission systems and water distribution systems, analysis, different methods Relaxation methods, method of section, Equivalent pipe method, Maintenance of distribution systems.

UNIT II: Design and Analysis of Water Supply System

Design of rising mains, Analysis of flow in closed and open pipe networks using various methods, Hardy Cross Method, Newton Raphson Method, Linear Method, CPM method, Distribution network, Pumps and Pumping station. Design of pump and pumping station.

UNIT III: Types of sewer system

Types of sewer system, requisites for sewerage system design, Flow through sewers Hydraulics of sewers, Self-cleansing velocity, Sewer shape-their usefulness, sewer invert drop, Design of sewerage networks.

SECTION B

UNIT IV: Pumps and pumping station

Requirement analysis of pumps, Design of pumping mains.

UNIT V: Optimization Techniques

Optimization Techniques Analytical solutions by Calculus, Lagrange Multiplier method, Linear programming Optimization of water distribution systems including branching, water hammer, causes and prevention.

UNIT VI: Cost analysis of Sewer System

Cost analysis and optimization of sewer system, Principles of Reliability analysis.

Tex Books:

1. Watershed Hydrology, Peter E. Black, Prentice Hall, 1991.

2. Water Resources Systems, Planning and Management, R.N. Chaturvedi, New Delhi : Tata McGrawHill, 1987

Reference Books:

1. Bhave P. R. And Gupta R, Analysis of Water Distribution Networks, Narosa Publishing Co., New Delhi (2006).

2. Bhave P.R, Optimal design of water distribution networks, Narosa Publishing Co., New Delhi (2003).

3. Engineering Optimization: Theory and Practice Book by S. S. Rao

---

Professional Elective-II

1SMTCE05 - 3 Remote Sensing and GIS in Environmental Engineering

Lectures/week: 03 **Credits: 03**

Tutorials: Nil

Course Objectives:

1. To provide information about Surface-Water Hydrologic Data, Spatial techniques for Surface-Water Hydrology Modelling.

2. To study the Geospatial techniques for planning and design of Water-Supply.

3. To provide knowledge regarding Applications of Geoinformatics for spatial management of resources.

4. To study the integrated applications using various technologies within Geoinformatics.

Course Outcomes:

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

1. Design GIS-Based Wastewater Collection System Design.

2. Design GIS-Based Decision-Support Systems for Wastewater and Storm Water Systems.

3. Gain knowledge regarding Geospatial Technologies for Water Resources Monitoring and Forecasting.

4. Explain the Applications of Remote Sensing and Geographic Information Systems in Wildlife Mapping and Modelling.

5. Acquire knowledge regarding applications of geoinformatics for spatial management of resources.

6. Acquire knowledge regarding the taxonomy of environmental models in the spatial sciences.

SECTION A

UNIT I: Introduction to Subject. Surface

Water Hydrologic Data, Spatial techniques for Surface-Water Hydrology Modeling, Surface-Water Hydrology Models, ArcSWAT model and its applications; Groundwater Data, Groundwater Models and spatial techniques for Groundwater Modeling and Visualization, The ArcHydro Data Model.

UNIT II: Geospatial techniques for planning and design of Water

Supply. Geospatial techniques for planning and design of solid waste collection and Irrigation Systems, Spatial Database Development for Wastewater and Stormwater Systems, GIS-Based Wastewater Collection System Design and Management Applications, GIS-Based Decision-Support Systems for Wastewater and Stormwater Systems

UNIT III: Geospatial Technologies for Water Resources Monitoring and Forecasting

Spatial Decision Support Systems in River Basin Management; Spatial systems for floodplain mapping and management. Spatial Techniques for Water Quality Monitoring and Modeling, GIS for Water Quality Database Development.

SECTION B

UNIT IV: **Applications of Geoinformatics for spatial management of resources**

Run-off estimations, infiltration characteristics, groundwater potential and recharge characteristics, Watershed management, watershed prioritization, Sediment yield estimation, reservoir capacity studies, transportation design and planning, Spatial analyses for Environment Impact Assessment, Monitoring and feedback, Natural indices, Concept of E-Governance using Geoinformatics, web GIS.

UNIT V: Integrated applications using various technologies

Integrated applications using various technologies within Geoinformatics; methods and approach. Real-time and temporal analysis using Geoinformatics. Multidisciplinary applications of Geoinformatics; integration of various segments. Geoinformatics for resources management and utilities management.

UNIT VI: Taxonomy of Environmental Models in the Spatial Sciences

Geographic Data for Environmental Modeling and Assessment. Applications of Remote Sensing and Geographic Information Systems in Wildlife Mapping and Modeling. Land Use Planning and Environmental Impact Assessment Using Geographic Information Systems.

Text Books:

1. Lynn E. Johnson, Geographic Information Systems in Water Resources Engineering, CRC Press, 2008.

2. Praveen Kumar, Mike Folk, Momcilo Markus and Jay C. Alameda, Hydroinformatics: Data Integrative Approaches in Computation, Analysis, and Modeling, CRC Press, 2005.

Reference Books:

3.Allan Brimicombe, GIS, Environmental Modeling and Engineering, Second Edition, CRC Press, 2009.

4. Andrew Skidmore (Editor, Environmental Modelling with GIS and Remote Sensing, CRC Press), 2002.

1SMTCE06 Research Methodology

Lectures/week: 02 **Credits: 02**

Course Objectives:

1. To provide knowledge regarding effective literature studies, approaches, analysis, plagiarism and research ethics.
2. To provide information regarding patent rights and new development in IPR.
3. To enrich research quality.

Course Outcomes:

1. Apply effective technical writing skills for research work.
2. Understand research problem formulation.
3. Analyze research-related information.
4. Follow research ethics.
5. Understanding that when IPR would take such an important place in the growth of individuals & nations, it is needless to emphasize the need for information about Intellectual Property Rights to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to the creation of new and better products, and in turn brings about, economic growth and social benefits.

SECTION A

UNIT I: Understanding Research

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for the research problem, data collection, analysis, interpretation, and Necessary instrumentations.

UNIT II: A literature survey

Effective literature studies approaches, analysis Plagiarism, and Research ethics.

UNIT III: Research Proposal writing

Effective technical writing, how to write the report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

SECTION B

UNIT IV: Intellectual property right

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International Cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V: Procedure for Patenting

Patent Rights, Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT VI: New Developments in IPR

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books:

1. C.R. Kothari and Gaurav Garg, "Research methodology: methods and techniques".
2. Dr. N.W. Ingole & Dr. M.V.Mohod "Research methodology".

Reference Books:

3. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
4. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
6. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
7. Mayall, "Industrial Design", McGraw Hill, 1992.
8. Niebel, "Product Design", McGraw Hill, 1974.
9. Asimov, "Introduction to Design", Prentice Hall, 1962.
10. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
11. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

1SMTCE07 Environmental Microbiology-Lab

Practical: 02 Hours/Week **Credits: 01**

Course Objectives:

1. Understand the role of microorganisms as agents of environmental change
2. Understand microbial processes aimed to solve environmental problems.
3. Study of instruments related with Environmental Microbiology practical.
4. To carry the bacteriological examination

Course Outcomes:

On completion of this Subject/Course the student shall be able to:

1. Recognise and use the properties of microorganisms, principally bacteria, to remedy problems of contamination and other environmental impacts.
2. Identify the significance to conduct experiments on bacteriological analysis.
3. Explain current environmental issues through laboratory experiments.
4. Apply the metabolic processes of microorganisms, principally bacteria, to industrial processes related to the environment.
5. Develop problem solving and laboratory skills using modern instrumentation.
6. Identify the pollutional strength of wastewater.

A minimum of eight experiments/ practicals are to be performed.

1. Sampling procedure for bacteriological examination.
2. Study of instruments
3. Heterotrophic plate count
4. Preparation of differential media
5. Isolation of bacteria by various methods
6. Staining of bacteria
7. Enumeration of bacteria by various methods
8. M.F. technique, Control of microorganisms.
9. Study of Effect of pH on growth of bacteria.
10. Study of Effect of Temperature on growth of bacteria.
11. Study of Effect of Salt Concentration on growth of bacteria.

1SMTCE08 Environmental Science & Chemistry-Lab

Practicals: 02 Hours/Week **Credits: 01**

Course Objectives:

1.To study various characteristics of wastewater.

2.To carry out various tests on wastewater

3.To understand the transformation and degradation of organic pollutants in the environment.

Course Outcomes:

On completion of this Subject/Course the student shall be able to:

1. Gain knowledge in various parameters of water.
2. Identify the significance to conduct experiments on water purity.
3. Explain current environmental issues through laboratory experiments.
4. Prepare the students to excel in the experiment research Programme or to succeed in industry
5. Develop problem solving and laboratory skills using modern instrumentation.
6. To acquire analytical skills in assessing environmental impacts through a multidisciplinary approach.

A minimum of eight experiments/ practicals are to be performed.

Determination of :-

1. Conductivity
2. pH (pH paper and pH meter)
3. Turbidity
4. Hardness (Calcium and total by EDTA method)

5. Chlorides
6. Chlorine demand and Chlorine residual (Available, Break point dose)
7. DO, BOD
8. COD
9. Iron and Manganese
10. Acidity and Alkalinity
11. Solids (Total, suspended and settleable).

1SMTCE09 Air Pollution & Control-Lab

Practicals: 02 Hours/Week **Credits: 01**

Course Objectives:

1. To Study various instruments and equipment acquired for Air Quality Monitoring
2. To perform Air Quality Monitoring .and perform Statistical Analysis of observed air pollution data.
3. To design Air Quality Monitoring Equipment.
4. To study the fate and transport of air pollutants and its measurement techniques

Course Outcomes:

On completion of this Subject/Course the student shall be able to:

1. Classify and identify the sources of air pollutants and predict the effects of air pollutants on human health and the environment.
2. Apply and relate the significance of various air pollution dispersion models.
3. Carry out Air Quality monitoring for various parameters.
4. Carry out the Statistical Analysis of observed air pollution data.
5. Design various air pollution controlling equipment.
6. To evaluate the use of air pollution controlling equipment.

A minimum of eight experiments/ practicals are to be performed.

1. Study of Air Quality Monitoring Instruments & Equipment.
2. To measure CO % & NO % of the exhaust gases from vehicles or gasoline engines.
3. Determination of SPM or RSPM
4. Determination of Air Quality Index from given data.
5. Determination of SO_2
6. Determination of NO_2
7. Statistical Calculations of observed air pollution data.
8. Design of Bag filter for controlling dust pollution in a particular industry – case study.
9. Design of cyclone separator.

10. Determination of wind velocity, wind direction, temperature, cloud cover, humidity & preparation of wind rose diagram.
11. Correlation analysis of air quality data using software.

2SMTCE01 Advanced Water Treatment Technology

Lectures/week: 03 **Credits: 03**

Course Objectives:

1. To understand the importance of standards of treated water.
2. To learn the various unit operations and processes of water treatment process
3. To study and design various miscellaneous treatment processes such as softening fluoridation/de-fluoridation.
4. To design the conventional water treatment plant.

Course Outcomes:

On successful Completion of the course, students will be able to-

1. Explain the inter-relationship between water quality parameters and plant sizing, hydraulics and layout.
2. Illustrate aeration, sedimentation, coagulation and flocculation and filtration processes.
3. Know the importance and removal of trace organics.
4. Design Water treatment plant, sizing, hydraulics and layout
5. Analyze the chemistry of disinfection and to know the kinetics of disinfection.
6. Understand the adsorption process and apply the knowledge of isotherms.

SECTION A

Unit I : Introduction to Water Treatment

Standards for treated waters. Effects of storage on water quality. Limnology. Water ecology, Thermal stratification. Seasonal Change. Algae, Control measures, quality of underground Waters. Nature and source of impurities. Examination of waters. Requirements of water treatment facilities. Unit operations, Gravity systems, pumping systems. Intake structures.

Unit II : Sedimentation

Principles of sedimentation and floatation. General equations for settling or discrete particulates. Hindered settling, the efficiency of an ideal basin, short-circuiting. Sludge: Sludge moisture content – specific gravity relationship. Up-flow and sludge blanket tanks – mathematical model of the unit processes.

Unit III : Coagulation

Theories of chemical coagulation. Nature of colloids. Zeta potential. Coagulants and their specificity. Design of mechanical flocculators. Mean velocity gradient “G”, “Gt” effect of temperature and other variables. Power consumption. Mathematical Modeling.

SECTION B

Unit IV : Filtration

Theory of filtration. System Parameter and mathematical modeling, size and shape characteristics of granular filtering materials. Preparations of filter sand, Hydraulics of filtration through homogeneous and stratified beds. Performance of slow, rapid, high-rate multiplayer and composite filters. Upflow, two way filter, dual media filter. Pressure filters. Diatomaceous earth filters.

Unit V : Disinfection

Principles of disinfection. Factors affecting disinfection. Halogens: Chlorine, Iodine and Bromine. Aeration: Principles of aeration, System parameters and mathematical model. Types of Aeration Adsorption: Theories of adsorption. Removal of taste and odor by adsorption. Removal of color. Effects of fluorides. Fluoridation. Removal of fluorides.

Unit VI: **Other Treatment Methods**

Boiler feed water. Softening of water. Methods of Iron and Manganese Removal. Use of aeration, oxidation, ion exchange and other methods and their control. Theory of corrosion, and corrosion control. Reuse of water and conservation of water in industry.

Text Books:

1. Water Engineering, Volume - I by B.C. Punmia
2. Water and Wastewater Engineering by Fair Geyer and Okun, JohnWilly and Sons

Reference Books:

1. Water and Wastewater Technology by Mark J. Hammer, John Willyand Sons
2. Water Supply and Sewerage by E. W. Steel and McGhee, McGraw Hill Company.
3. Manual on Water Supply & Treatment, CPHEEO, New Delhi.
4. Physico-Chemical Processes for Water Quality Control by Weber, John Wiley & Sons, 1972

2SMTCE02 Advanced Waste Water Treatment Technology

Lectures/week: 03 **Credits: 03**

Course Objectives:

1. Students should learn the principles of wastewater treatment and management.
2. Students should learn the fundamental concepts in waste water treatment technologies, hazardous waste disposal and management issues related to sludge treatment and disposal.
3. Students should acquire process design skills related to wastewater treatment.

Course Outcomes:

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

1. Students should be able to describe the unit processes associated with the wastewater treatment systems.
2. Explain the principles of wastewater treatment and apply the knowledge in process design.
3. Carry out innovative and creative laboratory exercise related to wastewater treatment.
4. Identify the specific pollution problems.
5. Emphasize the need for sludge separation, thickening and volume reduction. Design the facilities for biological sludge handling and treatment of biological sludge.
6. Understand and apply the design principles and criteria in designing units such as screen, grit chamber, primary settling tank.

SECTION A

UNIT I: Introduction.

Objectives of waste water treatment, Purpose of advanced wastewater treatment, Wastewater quantity and transport and wastewater characteristics. Alternative flowcharts, function and basic principles involved in different units of conventional wastewater treatment plant.

UNIT II: Process Analysis

Reaction and reaction kinetics, Mass balance, Reactors and their hydraulic characteristics, Practical aspects of reactor design.

UNIT III: Physical and Chemical Treatment

Screening, Grit removal, flow equalizations and mixing. Flocculation, sedimentation, flotation. Detailed principles and design aspects of Screening, Grit chamber and Sedimentation tank.

SECTION B

UNIT IV: Principles of Biological Treatment

Kinetics of biological growth, introduction to suspended and fixed film reactors. Concepts of gas transfer and solids separation, Nitrogen and Phosphorus removal from wastewater. Concepts of aerobic and anaerobic treatment of wastewater. Design of Activated Sludge system using biological process dynamics. Complete design details of Activated Sludge Process. Modifications of ASP. Process concepts and design aspects of Trickling Filters, Rotating Biological Contactors (RBC), Fluidized bed reactor/treatment.

UNIT V: Sludge Treatment and Disposal

Aerobic and Anaerobic digestion of sludge, sludge stabilization, dewatering, conditioning and disposal.

UNIT VI: Tertiary Treatment

Principles of tertiary treatment, theory of adsorption and factors affecting adsorption. Concepts and different methods of dissolved solids removal. Basic principles of Reverse Osmosis, Ultra-filtration, Electro dialysis, and Desalination.

Text Books:

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

Reference Books:

1. Wastewater Engineering: Treatment, Disposal & Reuse, By Metcalf & Eddy Inc. Sixth Ed. 2002, McGraw Hill.

2. Introduction to Environmental Engg., By. P.A. Veslind, PWS, Publishing Company, Boston, 1997.

3. Wastewater Treatment and disposal, By S.J. Arceivalla, Marcel Dekker,1981.

4. Wastewater Treatment Plant Planning, Design and Operation, By S.R. Quasim, Holt, Rinehart & Winston N.Y.

5. Activated Sludge Process: Theory and Practices, By N.F Grey, Oxford University Press, 19.

2SMTCE03 Industrial Wastewater Treatment

Lectures/week: 03 **Credits: 03**

Course Objectives:

1. To study the effects of discharge of industrial Wastewater on the environment.
2. To study to minimize the problems of Industrial Wastewater.
3. To study the characteristics and treatments of industrial Wastewaters from different industries.

Course Outcomes:

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

1. Identify the effects of discharge of Industrial Wastewater on land and water bodies.
2. Apply the knowledge to minimize the problems of Industrial Wastewaters.
3. Understand and explain the theories and systems of industrial effluent treatment and disposal.
4. Have an outlook on industrial effluent management with reference to the specific industry.
5. Apply the knowledge for effective and sustainable treatments of industrial Wastewaters from different industries
6. Design ETP for different industries.

SECTION A

Unit I : Problem of Industrial Waste Water

Variation in quality and quantity of industrial wastewater. Effects of discharge of industrial wastewater on streams; land and municipal sewers. Benefits of water pollution control by doing treatment of industrial waste.

Unit II : Indian Standards

Indian standards for discharge of treated wastewater on land, into municipal sewer and natural water courses. Sampling procedure. Experimental evaluation of physicochemical or biological treatment methods for treatment of the wastewater.

Unit III : Approaches to minimization of the problem of industrial wastewater

Good house-keeping, equalization, neutralization, precipitation, mixing of different effluent streams, recycling of effluent streams.

SECTION – B

Unit IV: General approach for handling and treatment of industrial wastewater

The general approach for handling and treatment of industrial wastewater with the following special characteristics: Shock loads, presence of colours, toxic metal/ions, refractory substances, e.g. A B S and other detergents, growth-inhibiting substances such as insecticides, waste rich in nutrients (N.P.K. etc.), waste rich in oil & grease, etc.

Unit V: Process Line Diagrams:

Process line diagrams, characteristics and treatment of industrial waste of: Pulp and paper, textile, tannery, food, Canings, sugar mill, distillery, dairy, etc. industries.

Unit VI: Advanced Industrial Wastewater Treatment:

Principles of tertiary treatment, Reuse and resource recovery. Recent trends in industrial waste management, Cleaner Technologies.

Text Books:

1. Waste Water Treatment, Disposal and Reuse-Mctcalf and Eddy.
2. Pollution Control in Process Industries – S. P. Mahajan.

Reference Books:

1. Liquid Waste of Industry – Theory, Practices and Treatment Nemcrow.
2. Industrial Water Pollution Control- W. W. Eekenfelder.
3. Natural Systems for Waste Management and Treatment – S.C. Reed, E.J. Middlebrooks, R. W. Crites.
4. The Treatment of Industrial Waste – Purse Lievre E.B.
5. Water Quality Management by W.W. Eckenfelder
6. Biological Treatment of Waste Waters: W.W. Enkenfelder

2SMTCE04 Professional Elective - III

(1) Solid and Biomedical Waste Management

Lectures/week: 03 **Credits: 03**

Course Objectives:

1. To provide an overview of waste generation, waste characterization and waste management processes.
2. To impart knowledge on solid waste management with emphasis on municipal solid waste management which includes different waste processing options such as pyrolysis, composting, and incineration; designing and operating sanitary landfill.
3. To enrich knowledge about the characteristics of hazardous wastes and their management.
4. To make learners focus on energy recovery from biomass, agricultural and industrial wastes for the production of biogas, ethanol, methanol and hydrogen.
5. To impart knowledge on industry-specific solid waste management practices.
6. To enrich knowledge about the characteristics of biomedical wastes and their management.

Course Outcomes:

At the end of the subject, the students will be able to:

1. Identify and interpret the criteria for the classification of a substance as a solid waste.
2. Recognize waste minimization and source reduction, assess and describe the procedure for solid and hazardous waste identification and characterization and various waste processing options.
3. Define and elucidate the management, treatment and disposal of hazardous wastes.
4. To assess and develop physical/chemical/biological treatment techniques for the control of hazardous wastes.
5. To address and describe solid waste management including landfill operation.
6. To manage industry-specific solid waste issues.
7. To design and execute land reclamation projects.
8. To explain and interpret the regulations concerning the handling, transportation and disposal of municipal, hazardous, radioactive and biomedical wastes.

SECTION A

Unit I : Introduction

Problems and impacts of solid waste in developing countries; Sources, types and composition of Municipal solid waste, quantity estimation and forecast, Management systems and planning.

Unit II : Characteristics of Solid Waste

Sampling – physical, chemical and biological analysis, Sources, types and composition of industrial hazardous and toxic wastes, Treatment and disposal methods

Unit III : Collection of Solid Waste

On-site handling and processing; Collection systems and service; Analysis of collection systems, collection routes; Management issues and concerns. Transfer and transport, design requirements.

SECTION B

Unit IV: Composting and Sanitary Landfilling

Process microbiology, Aerobic and anaerobic composting, parameters affecting, Design considerations, compost control, engineering design and operations

Sanitary Landfill: Process mechanism, Classification, types, siting considerations, engineering design and operations.

Unit V: Incineration Process details, classification, types, siting considerations, Energy recovery, Pyrolysis, engineering design and operations.

Unit VI: Biomedical waste:

Biomedical waste Treatment and Disposal: Generation, collection, transport, treatment and disposal.

Text Books:

1. Solid waste Management in developing Countries, Bhide A.D and Sudaresan B.B; INSDOC, New Delhi, 1983.
2. Municipal and Rural Sanitation, Ehlens and Steel; Tata McGraw-Hill, 1976.

Reference Books:

1. Solid Waste Engineering – Principles and Management Issues, G. Techbanoglous, H. Theisen and Elliasen, Mc-Graw Hill Inc., 1972.
2. Water Supply for Rural Areas and Small Communities, Wagner E. G. and Lanoik J.N; Geneva, WHO Publication, 1989.
3. Solid waste Engineering, Principles and management issues, G. Techbanoglous, Elliasen; Mc-Graw Hill Book Co.1985.
4. Solid Waste Management, D. Joseph Hagerty, Joseph L. Pavoni& John E. HeerJr.;VanNorstrand ,Van Nostrand Reinhold, New York 1973.
5. Handbook of solid waste Management, Frank Kreith; 2nd edition, Mc-Graw Hill Inc. 2002.
6. Management of Solid Waste in Developing Countries, Frank Flintoff; 2ndEdn, WHO publication, 1984.

2SMTCE04 Professional Elective - III

(2) Bioremediation: Principles and Application

Lectures/week: 03 **Credits: 03**

Course Objectives:

1.To provide knowledge regarding bioremediation and bio remedial practices those are being carried out.

2.To provide knowledge regarding natural and programmed bioremediation.

3. To study different types of bioremediations in detail.

Course Outcomes:

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

1. Acquire detailed knowledge regarding bio-remedial practices.
2. Understand solid and slurry phase bioremediation (composting, land farming, slurry bioreactors and lagoons).
3. Explain Genetic Engineering and Bioremediation.
4. To acquire knowledge of genetic Engineering.
5. To understand the concept of bio simulation.
6. Study the application of biosensors in bioremediation.

SECTION A

Unit I : **Introduction to Biotransformation**

Biodegradation and bioremediation, history of bioremediation, xenobiotics and their structures and persistence in the environment, in situ and ex situ bioremediation technologies and their merits and demerits.

Unit II : **Bio Remedial Practices**

An overview of the current bio remedial practices and its application, factors affecting bioremediation (physical, chemical and biological), bio stimulation and bio augmentation, bio concentration and bio magnifications.

Unit III: Natural and programmed bioremediation

Inducible and degrading enzymes and their roles, Roles of electron donors and acceptors in bioremediation, anaerobic and aerobic bioremediation processes, application of bioinformatics in bioremediation.

SECTION B

Unit IV: Types of Bioremediations

Solid and slurry phase bioremediation (composting, land farming, slurry bioreactors and lagoons), liquid phase bioremediation, bioventing, soil-vapour extraction (SVE) and treatment.

Unit V : Genetic Engineering and Bioremediation

Phytoremediation Concept of phytoremediation, roles of phytochelatins and chemicals secreted by the plant roots, phytoremediation with trangemic plants, fungal and algal bioremediation, merits and demerits of phytoremediation, Types of phytoremediation systems.

Unit VI : Regulations of GM organisms in India Biosensors and their applications in bioremediation.

Reference Books:

1. Baker H. and Herson D.S. Bioremediation, McGraw Hill, 1994

2. Eweis J.B., Ergas S.J., Chang D.P.Y. and Schroeder E.D., Bioremediation Principles, McGraw Hill, 1998.

2SMTCE04 Professional Elective - III

(3) SOFT COMPUTING SKILLS

Lectures/week: 03 **Credits: 03**

Course Objectives:

1. To study the need for soft computing techniques.
2. To Learn Artificial Neural Networks (ANN) and its applications.
3. To study different types of computing techniques and their applications in civil engineering.

Course Outcomes:

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

1. Explain the different components of soft computing.
2. Gain Knowledge regarding fuzzy set operations and fuzzy relations.
4. To apply Evolutionary computing, Genetic algorithms and Hybrid soft computing techniques.
5. Study Genetic algorithm.
6. Apply soft computing techniques in Civil Engineering.

SECTION A

Unit I : Need for soft computing techniques, components of soft computing.

Unit II : Artificial Neural Networks (ANN), Types of ANN, Learning algorithms.

Unit III : Applications of ANN, Information and uncertainty, Chance versus ambiguity.

SECTION B

Unit IV : Classical sets and fuzzy sets, Logic and reasoning, Fuzzy set operations and fuzzy relations.

Unit V : Membership Functions, Fuzzy Systems, Decision Making with Fuzzy Information, Fuzzy Classification and Pattern Recognition, Neuro-Fuzzy Systems.

Unit VI : Evolutionary computing, Genetic algorithm, Hybrid soft computing techniques, Applications in Civil Engineering.

Text Books:

1. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall India, New Delhi, 2008
2. Jang, J.R, Sun Chuen-tsai, and MizutaniEiji, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, PHI Learning, 2009 Rajasekaran, S., and Vijayalakshmi Pai, G.A., Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications, Prentice-Hall India, New Delhi, 2003.

Reference Books:

1. Sivanandam, S N and S N Deepa, Principles of Soft Computing, Wiley India, 2013
2. Karray, Fakhreddin O. and Clarence De Silva, Soft Computing and Intelligent Systems Design – Theory, Tools and Applications, Pearson Education Ltd., 2013

2SMTCE05 Professional Elective-IV

(1) Business Analytics

Lectures/week:03 **Credits: 03**

Course Objectives:

To impart students:

1. To understand the role of business analytics within an organization.

2. To analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.

3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision-making.

4. To become familiar with processes needed to develop, report, and analyze business data.

7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc

Course Outcomes:

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

1. Demonstrate knowledge of data analytics.

2. Demonstrate the ability to think critically in making decisions based on data and deep analytics.

3. Demonstrate the ability to use technical skills in predictive and prescriptive modeling to support business decision-making.

4. Demonstrate the ability to translate data into clear, actionable insights.

5. Use decision-making tools/Operations research techniques.

6. Mange business process using analytical and management tools.

SECTION A

Unit I: Business Analytics

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

Unit II: Statistical Tools

Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit III: Trendiness and Regression Analysis

Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

SECTION B

Unit IV: Organization Structures of Business analytics

Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit V: Forecasting Techniques

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit VI: Decision Analysis

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.

2. Business Analytics by James Evans, persons Education

2SMTCE05 Professional Elective-IV

(2) Industrial Safety

Lectures/week:03 **Credits: 03**

Course Objectives:

To impart students:

1. To provide knowledge regarding industrial safety.

2. To study the fundamentals of maintenance engineering.

3. To study the fundamentals of maintenance engineering and the concept of fault tracing.

Course Outcomes:

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

1. Acquire detailed knowledge regarding accidents, causes, types, results and control, mechanical and electrical hazards in industries.

2. Understand the aim of maintenance engineering and the primary and secondary functions and responsibility of maintenance department.

3. To perform periodic and preventive maintenance of the industries.

SECTION A

Unit I: Industrial safety

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of Factories Act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit II: Fundamentals of maintenance engineering:

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

Unit III: Wear and Corrosion and their prevention

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

SECTION B

Unit IV: Fault tracing

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes

Unit V: Periodic and preventive maintenance1

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

Unit VI: Periodic and Preventive Maintenance 2

Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Text Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.

2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference books:

3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.

4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

2SMTCE05 Professional Elective-IV

(3) Operation Research

Lectures/week:03 **Credits: 03**

Course Objectives:

1. To study Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis and Inventory Control Models.

2. To study Formulation of a LPP and Nonlinear programming problem.

3. To make one understand the scheduling and sequencing of different models.

Course Outcomes:

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

1. Find Graphical solution by revised simplex method - duality theory - dual simplex method - sensitivity analysis parametric programming.

2. Evaluate Kuhn-Tucker conditions min using cost flow problem and max flow problem using CPM/PERT.

3. Schedule and sequence single server and multiple server models and also deterministic inventory models.

4. Determine confidence intervals for parameters of estimation theory.

5. To make statistical decisions using the test of hypothesis for a given sample.

6. Formulate and solve linear as well as nonlinear optimization problems.

Unit 1: Optimization Techniques Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2: Formulation of a LPP Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming

Unit 5: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Text Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.

2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

Reference books:

1. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.

2. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.

3. Pannerselvam, Operations Research: Prentice Hall of India 2010.

4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

2SMTCE05 Professional Elective-IV

(4) Coste Management of Engineering Projects

Lectures/week:03 **Credits: 03**

Course Objectives:

To impart students:

1. To introduce and overview the Strategic Cost Management Process Cost concepts in decision-making.

2. To study the concept of project in detail.

3. To study Cost Behaviour and Profit Planning Cost Behaviour and Profit Planning Marginal Costing.

4. To understand the Quantitative techniques for cost management.

Course Outcomes:

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

1. Understand the Objectives of a Costing System.

2. Explain project execution as a conglomeration of technical and nontechnical activities and detailed engineering activities.

3. Learn Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

4. Develop project formulation skills .

5. Know fundamentals in applied business economics.

6. Apply tools & techniques for cost & profit.

Unit 1: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit II: Project

meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as a conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit III: Cost Behavior and Profit Planning

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of divisional profitability pricing decisions including transfer pricing.

Unit IV: Quantitative techniques for cost management : Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Text Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.

2. Charles T. Horngren and George Foster, Advanced Management Accounting.

Reference books:

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd

---

2SMTCE05 Professional Elective-IV

(5) Composite Material

Lectures/week:03 **Credits: 03**

Course Objectives:

To impart students:

1. To introduce the concept of composite materials.

2. To study reinforcements in detail.

3. To study the Manufacturing of Metal Matrix Composites and Polymer Matrix Composites

Course Outcomes:

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

1. Understand the advantages and application of composite, functional requirements of reinforcement and matrix and effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

2. Acquire knowledge regarding the properties and applications of whiskers, particle reinforcements and the mechanical behavior of composites.

3. Know the Laminar Failure Criteria that including strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, and hydrothermal failure.

4. To understand the concept of Manufacturing of Metal Matrix Composites.

5. acquire knowledge of Manufacturing of Polymer Matrix Composites.

6. To know the characteristics of composite materials.

Unit I: Introduction

Definition, Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit II: Reinforcements

Preparation-layup, curing, properties and applications of glass fibres, carbon fibres, Kevlar fibres and Boron fibres. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit III: Manufacturing of Metal Matrix Composites

Casting, Solid State diffusion technique, Cladding, Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering. Manufacturing of Carbon, Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit IV: Manufacturing of Polymer Matrix Composites

Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method, Filament winding method, Compression molding, Reaction injection molding. Properties and applications.

Unit V: Strength Laminar Failure Criteria

Strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007

Reference Books:

1. Hand Book of Composite Materials-ed-Lubin.

2. Composite Materials – K.K.Chawla.

3. Composite Materials Science and Applications – Deborah D.L. Chung.

4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

2SMTCE05 Professional Elective-IV

(6) Waste To Energy

Lectures/week: 03 **Credits: 03**

Course Objectives:

1. An understanding about the concept of waste to energy and equipment involved.
2. Understand conceptual design of a Gasifier and its operational aspect.
3. Comprehend theoretical design of a biomass Combustor and its operational aspect.
4. Grasp basic design of a Biogas plant and its operational aspect.

Course Outcomes:

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

1. Implement the concept of waste to energy in Industrial and allied areas.
2. Design a Gasifier and understand operational aspect of a typical Gasifier.
3. Design a biomass Combustor.
4. Understand operational aspect of a biomass Combustor.
5. Design a Biogas plant
6. Understand the operational aspect of a Biogas plant

Unit I: Introduction to Energy from Waste

Classification of waste as fuel, Agro based, Forest residue, Industrial Waste, MSW, Incinerators, gasifier, digester. Status of waste to Energy conversion in India.

Unit II: Biomass Pyrolysis

Types of Biomass Pyrolysis, Manufacture of Charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

Unit III: Biomass Gasification

Types of Biomass Gasifiers, Basic design of selected Biomass Gasifiers. Operational aspect of a typical Biomass gasifier, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

Unit IV: Biomass Combustion

Biomass stoves, Improved chullahs, types, some exotic designs, Fixed bed combustors Types of biomass combustors, Basic design of selected biomass combustors, and Operational aspect of a typical biomass combustor.

Unit V: Biogas

Properties of biogas - calorific value and its composition. Types of Biogas plants, Basic design of a biogas plant. Operational aspect of a typical biogas plant.

Text Books:

1. Edgard and Mercier (2009) Energy Recovery, Nova Science Publishers.
2. Worrell and Vesilind (2012) Solid Waste Engineering, Cengage Learning.

Reference books:

1. Tchobanoglous (1993) Integrated Solid Waste Management, Mc Graw Hill.
2. Prabir Basu (2010) Biomass Gasification and Pyrolysis, Academic Press/ElsevierInc.
3. Clark and Deswarte (2015) Introduction to Chemicals from Biomass, John Wiley & Sons.
4. Tabatabaei and Ghanavati (2018) Biogas Fundamentals, Process, & Operation, Springer.
5. Abbasi, Tauseef and Abbasi (2012) Biogas Energy, Springer.
6. Nijaguna (2002) Biogas Technology, New Age International Publishers.

2SMTCE06 Industrial Waste Water Treatment- Lab.

Practical: 2hrs/week **Credits: 01**

Course Objectives:

1.To study various characteristics of Industrial wastewater.

2.To carry out various tests on Industrial wastewater

3.To understand the transformation and degradation of organic pollutants in the environment.

Course Outcomes:

On completion of this Subject/Course the student shall be able to:

1. Gain knowledge in various parameters of Industrial Wastewater.
2. Identify the significance of conducting experiments on Industrial Wastewater purity.
3. Explain current environmental issues through laboratory experiments.
4. Prepare the students to excel in the experiment research Programme or to succeed in industry
5. Develop problem solving and laboratory skills using modern instrumentation.
6. To acquire analytical skills in assessing environmental impacts through a multidisciplinary approach.

List of Experiments: Minimum of 8 practical's out of the given should be performed.

1. Determination of Fixed and Volatile Solids.
2. Determination of Sulphates.
3. Determination of Biochemical Oxygen Demand of Industrial wastewater
4. Determination of Chemical Oxygen Demand of Industrial wastewater.
6. Determination of Oil & Grease.
7. Determination of Phosphates.
8. Determination of SVI of Biological sludge.
9. Metal analysis from Industrial Wastewater any one ((a) Arsenic b) Nickel c) Chromium).
10. Determination of Colour.
11. Determination of Odour.

2SMTCE07 Design Problem-Lab

Practical: 2hrs/week **Credits: 01**

Course Objectives:

1. To design various unis of STP and ETP
2. To study the characteristics and treatment of Wastewater.
3. To design of plumbing for multistory building.

Course Outcomes:

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

1. Design of Water Treatment Processes.
2. Design of Sewage Treatment Processes.
3. Design of plumbing for multistory building.
4. Design of sewerage systems for small town/village.

Design any one of the following:

1. Design of Water Treatment Processes.
2. Design of Sewage Treatment Processes.
3. Design of plumbing for multistory building.
4. Design of sewerage systems for small town/village.

2SMTCE08 Software Based Problem-Lab

Practical: 2hrs/week **Credits: 01**

Course Objectives:

1. To design various unis of STP and ETP using software.
2. To design Air pollution Modelling.
3. To design Environmental Modelling.

Course Outcomes:

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

1. To Acquire knowledge of Environmental Engineering Software
2. Know the Air Pollution Modelling softwares.
3. Acquire the knowledge of Treatment Process Design

Software based practical on treatment process design or modeling for pollution assessment and control.

2SMTCE09 Mini Project and Seminar 1

Practical: 2hrs/week **Credits: 01**

Course Objectives:

1. To study different aspects of Environmental Engineering.
2. To study the different problems related to Environmental Engineering.
3. To provide knowledge regarding different solutions to Environmental problems.

Course Outcomes:

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

1. Apply the knowledge to overcome different problems related to the Environment.
2. To find alternate solution in order to control Environmental degradation.
3. Help and protect the Environment by reducing pollution.
4. To know how to prepare and present research project.
5. Apply experimental or mathematical skill to validate theories to relevant subject.
6. Prepare and present the report with interpretation.

Mini project will be Based on the syllabus of Environmental Engineering.

Syllabus of Semester-III

3SMTCE01 Internship

Practical: **Credits: 06**

Course Prerequisites: First Year Course Completion

Compulsory Internship Two Months (After Completion of 1st Year)

3SMTCE02 Seminar & Dissertation Phase– I

Practical: 8hrs/week **Credits: 04**

Course Prerequisites: Nil

Course Objectives:

1. To identify and define the problem with OBJECTIVES
2. To perform the literature review of past work related to the problem and identify the research gap.
3. To demonstrate the problem with respect to society.
4. To demonstrate understanding, application of relevant methodology techniques and analysis with 40 % of work completion.

Course Outcomes:

On successful Completion of the course, students will be able to

1. Complete the definition of the problem with bridging the research gap.
2. To demonstrate the problem in-depth knowledge and thoughtful application in stating an in-depth analysis of key theories supporting the study.
3. Apply the relevant methodology and technique to solve the problem.
4. To complete 40% study on defined problem through mathematical application or experimentation.

The student has to select a topic for the dissertation, carry out literature review, find the literature gap, carry out 40% or more work on dissertation topic and submit the report and deliver the seminar based on it.

Syllabus of Semester-IV

4SMTCE01 Seminar & Dissertation Phase –II

Practical: 20hrs/week **Credits: 10**

Course Objectives:

1. To record the findings of a study.
2. To co-relate the results with previous work results.
3. To prepare the report on a complete study with clear interpretation and discussion of the results.

Course Outcomes:

On successful Completion of the course, students will be able to

1. Carry out detailed mathematical modelling or experimental validation.
2. Present the report on the complete study with clear interpretation and discussion of the results.
3. Demonstrate the utility of study to the society.
4. Define future scope of study.

Student has to carryout remaining dissertation work on the selected dissertation topic and submit the report. Seminar shall be delivered on the dissertation submitted. Marks shall be based on your work, Seminar and Viva-Voce on dissertation.