

**SHIVAJI UNIVERSITY, KOLHAPUR**  
**S.E. (Environmental Engineering) Part I (Semester III) Revised**

Sr. No.	Subject	Teaching Scheme (Hours)					Paper Marks	Examination Scheme			Total Marks
		L	T	P	Dr	Total		TW	POE	OE	
1	Engineering Mathematics-III	4	1	-	-	5	100	25	-	-	125
2	Environmental Chemistry & Microbiology	4	-	2	-	6	100	50	-	25	175
3	Fluid Mechanics	3	-	2	-	5	100	25	-	25	150
4	Surveying, Remote Sensing & GIS	3	-	2	-	5	100	25	50	-	175
5	Ecology & Environmental Sanitation	3	1	-	-	4	100	25	-	-	125
6	Building Drawing & Services	3	-	-	2	5	-	50	-	-	050
<b>Total (Part –I)</b>		<b>20</b>	<b>02</b>	<b>06</b>	<b>02</b>	<b>30</b>	<b>500</b>	<b>200</b>	<b>50</b>	<b>50</b>	<b>800</b>

**S.E. (Environmental Engineering) Part II (Semester IV) Revised**

Sr. No.	Subject	Teaching Scheme (Hours)					Paper Marks	Examination Scheme			Total Marks
		L	T	P	Dr	Total		TW	POE	OE	
1	Water Resources Engg	4	1	-	-	5	100	50	-	-	150
2	Environmental Geology	3	-	2	-	5	100	50	-	-	150
3	Environmental Hydraulics	3	-	2	-	5	100	50	-	25	175
4	Structural Mechanics –I	3	-	2	-	5	100	25	-	-	125
5	Construction Technology	3	-	2	-	5	100	25	-	25	150
6	Programming Laboratory	2	-	2	-	4	-	50	-	-	050
<b>Total (Part- II)</b>		<b>18</b>	<b>1</b>	<b>10</b>	<b>-</b>	<b>29</b>	<b>500</b>	<b>250</b>	<b>-</b>	<b>50</b>	<b>800</b>
<b>Grand Total of Part I &amp; II</b>											<b>1600</b>

**SHIVAJI UNIVERSITY, KOLHAPUR**

**T.E. (Environmental Engineering) Part I (Semester V) Revised**

Sr. No.	Subject	Teaching Scheme (Hours)					Paper Marks	Examination Scheme			Total Marks
		L	T	P	Dr	Total		TW	POE	OE	
1	Water Supply Engineering	3	-	2	-	5	100	50	-	25	175
2	Engineering Management & Economics	3	1	-	-	4	100	25	-	-	125
3	Transportation Engineering & Town Planning	4	-	2	-	6	100	25	-	-	125
4	Geotechnical Engineering	3	1	2	-	6	100	50	-	25	175
5	Building Planning & Design *	3	-	-	2	5	100 *	25	-	25	150
6	Structural Mechanics – II	2	-	2	-	4	-	50	-	-	050
	<b>Total (Part –I)</b>	<b>18</b>	<b>2</b>	<b>8</b>	<b>2</b>	<b>30</b>	<b>500</b>	<b>225</b>	<b>-</b>	<b>75</b>	<b>800</b>

\* Theory paper of 4 hours duration

**T.E. (Environmental Engineering) Part II (Semester VI) Revised**

Sr. No.	Subject	Teaching Scheme (Hours)					Paper Marks	Examination Scheme			Total Marks
		L	T	P	Dr	Total		TW	POE	OE	
1	Wastewater Engineering	3	-	2	-	5	100	25	-	25	150
2	Air & Noise Pollution	4	-	2	-	6	100	50	-	-	150
3	Solid & Hazardous Waste Management	4	-	2	-	6	100	50	-	-	150
4	Design of Structures I	3	-	2	-	5	100	50	-	-	150
5	Environmental Management	3	1	-	-	4	100	25	-	25	150
6	Design & Drawing of Environmental Systems	2	-	-	2	4	-	50	-	-	050
	<b>Total (Part- II)</b>	<b>19</b>	<b>1</b>	<b>8</b>	<b>2</b>	<b>30</b>	<b>500</b>	<b>250</b>	<b>-</b>	<b>50</b>	<b>800</b>
<b>Grand Total of Part I &amp; II</b>											<b>1600</b>

**Vocational/Industrial Training of 3 to 4 weeks during summer vacation is to be completed.**

**SHIVAJI UNIVERSITY, KOLHAPUR**  
**B.E. (Environmental Engineering) Part I (Semester VII) Revised**

Sr. No.	Subject	Teaching Scheme ( Hours)					Paper Marks	Examination Scheme			Total Marks
		L	T	P	Dr	Total		TW	POE	OE	
1	Air Pollution & Control	3	-	2	-	5	100	25	-	25	150
2	EIA & Environmental Legislations	3	1	-	-	4	100	25	-	-	125
3	Advanced Water & Wastewater Treatment	3	1	2	-	6	100	25	-	25	150
4	Design of Structures II	4	-	2	-	6	100	25	-	25	150
5	Elective I	3	1	-	-	4	100	25	-	-	125
6	Seminar	-	-	2	-	2	-	50	-	-	050
7	Project	-	-	2	-	2	-	25	-	-	025
8	Vocational Training Presentations	-	1	-	-	1	-	25	-	-	025
	<b>Total (Part –I)</b>	16	4	10	-	30	500	225	-	75	800

**B.E. (Environmental Engineering) Part II (Semester VIII) Revised**

Sr. No.	Subject	Teaching Scheme ( Hours)					Paper Marks	Examination Scheme			Total Marks
		L	T	P	Dr	Total		TW	POE	OE	
1	Environmental Management Systems	3	-	2	-	5	100	25	-	-	125
2	Industrial Waste Treatment	3	1	-	-	4	100	25	-	-	125
3	Quantity Surveying & Valuation *	3	-	2	-	5	100	50	-	25	175
4	Industrial Health & Safety	3	-	2	-	5	100	25	-	-	125
5	Elective II	3	1	-	-	4	100	25	-	-	125
6	Project Work	-	-	4	-	4	-	75	-	50	125
	<b>Total (Part- II)</b>	15	2	10	-	27	500	225	-	75	800
<b>Grand Total of Part I &amp; II</b>											1600

\* Theory paper of 4 hours duration

**Elective I**

1. Optimization Techniques
2. Clean Development Mechanism
3. Disaster Planning & Risk Analysis
4. Renewable Energy Engineering
5. Environmental Bio Technology

**Elective II**

1. Managerial Techniques
2. Watershed Management
3. Environmental Modeling & Simulation
4. Operation & Maintenance of Environmental Systems
5. Occupational Health and Safety Assessment

**SHIVAJI UNIVERSITY**  
**B.E. (Environmental Engineering) Part I, Semester-VII (Revised)**

**1. AIR POLLUTION & CONTROL**

**Teaching Schemes**

Lectures: 4 Hours/Week

Practical :2 Hours/Week

**Examination Schemes**

Theory Paper : 100 Marks

Term Work : 25 Marks

Oral : 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Study the various air quality models.
2. Know about design of different air pollution control equipments.
3. Study laws & regulations related with air quality.
4. Learn about air quality monitoring.

**SECTION I: AIR QUALITY MODELING**

**Unit 1: Atmospheric and Air Quality Modeling (10)**

Air Quality modeling and simulation, General characteristics of elevated point sources, line sources,, Air Pollution models for Point source and Line sources - Gaussian Model, Highway Model, Line Model, Street Canyon Model, Box Model, Introduction to CALINE model, RAMS Model,

**Unit 2: Air Quality Monitoring (5)**

Air Quality Instrumentation, Ambient Air Quality Monitoring for SPM & gaseous pollutants, PM 2.5 and PM10, sampling, Stack Gas sampling & Monitoring, Use of Various sensors in Automobile Exhaust Analysis.

**Unit 3: Air Pollution - Standards & Legislation (5)**

Ambient Air, Criteria Pollutants and Trace Gases, Air Pollution Management and Data Analysis, Air Quality Criteria and Standards, EPA Clean Air Act, Air Pollution Control Act 1981, NAAQS, Air Quality Index/Indices, Air Quality Status in India and Abroad, Urban Air Pollution Management

**SECTION II: AIR POLLUTION CONTROL**

**Unit 4: Control measures for Air Pollution (6)**

Necessity of Air Pollution control, Control Equipments, , Definition of collection efficiency and removal efficiency, In plant measures like Modify process, Modify feed stream, Shutdown source, Automobile Exhaust Control Mechanism

**Unit 5: Particulate Contaminant Control (8)**

Particulate Control Mechanisms, Design and operations of Gravitational settling chambers, Centrifugal separators, Wet scrubbers, Fabric filters, Electrostatic precipitators

## **Unit 6: Gaseous Contaminant Control**

**(6)**

Mechanisms of Gaseous pollutant Control, Combustion stoichiometry, Adsorption and Absorption of various gaseous pollutants

**Termwork :** A journal consisting of practicals on following.

1. Determination of Ambient Air Quality
2. Determination of Stack Emission
3. Determination of PM<sub>2.5</sub> & PM<sub>10</sub>
4. Determination of Traffic Exhaust and other meteorological parameters for modeling
5. Assignments based on design of gravitational settling chambers, Centrifugal separators, Wet scrubbers, Fabric filters, Electrostatic precipitators
6. Visit to Industry having Control equipments & report

### **Reference Books :**

1. Air Pollution by Wark and Warner
2. Air Pollution by Stern Vol I, II, III
3. Air Pollution by D. Nevers
4. Air Pollution by Ross

**SHIVAJI UNIVERSITY**  
**B.E. (Environmental Engineering) Part I, Semester-VII (Revised)**

**2. EIA & ENVIRONMENTAL LEGISLATION**

**Teaching Scheme**

Lectures: 3 Hrs/Week

Tutorial : 1 Hrs/Week

**Examination Scheme**

Theory: 100 Marks

Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Study various methods of analysis of impacts on the environment
2. Learn to prepare EIA statement and the various mitigation measures.
3. Study the various legal procedures in India for Environmental Clearance.
4. Learn various terms of Environment Legislation

**SECTION – I**

**Unit 1: (4)**

Introduction : concept of EIA , necessity of EIA , objectives of EIA , Legal provisions for EIA in India, Components of EIA studies, Types of impacts, planning & management of EIA studies,

**Unit 2: (8)**

Methodology: background information, environmental monitoring, interaction matrix methodologies, simple matrix, stepped matrix, summary observations, network methodologies, checklist methodologies, Simple & descriptive checklists, Description of environmental settings: conceptual framework, Environmental indices & indicators: background information, Various indices like WQI, AQI , EQI , etc . Procedure for calculating these indices

**Unit 3: (8)**

Impact Assessment Methodologies : mass balance Approach , box model approach , air quality dispersion modelling , assessment of impact , various mitigation measures , Impact on air , water, noise & biological environment. Public participation in EIA, basic definition, legal requirement, advantages & disadvantages, procedure of public hearing in India, Documentation and Reporting of EIA studies, Environmental Impact Statement, post monitoring of EIA, post impact assessment, Concept of carbon foot prints due to industry.

**SECTION – II**

**Unit 4: (8)**

Historical development of various environmental legislations, USEPA 1969, Clean Air Act, Clean Water Act, NEPA , Water (Prevention & Control of Pollutants act), 1974 and Rules, Water Cess Act and Rules, Air (Prevention & Control of Pollutants act), 1981 and Rules, Indian Forest act and Rules

**Unit 5: (8)**

Environmental Protection Act 1986 and Rules, EIA notification and procedure, Municipal Waste (Management and Handling) Rules, Biomedical Waste (Management and Handling) Rules, Hazardous Waste Rules, Noise Pollution Rules, other rules under EPA, Present status of these rules in India

**Unit 6:****(4)**

Case studies of various landmark judgments in Environmental field Environmental Ethics: Ethical theories and codes of ethics, changing attitudes, Environmental Education, Role of NGO's in Environmental planning and education.

**Term work:**

At least one assignment based on each unit.

**Reference Books:****EIA**

1. Environmental Impact assessment - Canter L.W.; McGraw Hill Publishers
2. Environmental Impact assessment handbook - Rou, Wooten
3. Manual of Environmental Impact Assessment - Govt. of India Publication
4. Handbook of Environmental Impact assessment - Kulkarni V.S, Kaul N, Trivedi R.K. , Scientific Publishers
5. Environmental assessments and statements - Harr and Hagerty

**Env Legislation**

1. Environmental Planning and Management in India - Saxena
2. All Environmental Legislations, amendments, rules Published by Ministry of Environment
3. and Forest, Govt of India
4. Handbook of Environmental Law, Acts, Guidelines, Compliances and Standards Vol. I, II -Trivedi R.K.
5. Environmental Law - Kaur Gurkbal
6. Environmental Law - Jaswal P.S.
7. Environmental Law - Tripathi S.C.
8. Environmental Law - Tiwari H.N.
9. Environmental Law Case book - Leelakrishnan P.
10. Environmental Law in India - Upadhye J.J.R.

# SHIVAJI UNIVERSITY

## B.E. (Environmental Engineering) Part I, Semester-VII (Revised)

### 3. ADVANCED WATER AND WASTEWATER TREATMENT

#### Teaching Scheme

Lectures :3 Hours / Week

Tutorial : 1 Hour / Week

Practical :2 Hours / Week

#### Examination scheme

Theory: 100 Marks

Term Work: 25 Marks

Oral Exam: 25 Marks

#### Course Learning Objectives

At the end of course, the students will

1. Review basics of conventional treatment and understand need for advanced water and wastewater treatment.
2. Understand concepts and design of advanced physico-chemical processes for treatment of water & wastewater.
3. Understand kinetics and design of biological processes for treatment of wastewater.
4. Acquire an understanding of the fundamental scientific concepts and technical details of Wetland and aquatic treatment systems.

### SECTION - I

#### Unit 1: Need & Basics of Advanced Treatment

(4)

Review of conventional water treatment, Need for Advanced water and wastewater treatment, Reclamation and reuse of wastewater, Reactors and Reaction Kinetics: Types of Reactions and Reaction Kinetics, Types of reactors and Principles of Reactor Design

#### Unit 2: Settling & Filtration

(8)

Types of Settling, Hindered and Compression Settling, Filtration: Design and operation of Dual media filter, Head loss calculations in depth filtration

Membrane Filtration: Terminology, Process Classification, Membrane configuration, specific membrane problems such as fouling and its control, application of membranes, Electro dialysis: Theory, Disposal of concentrate waste streams.

#### Unit 3: Ion Exchange, Adsorption & Disinfection

(8)

Ion Exchange: Process, Ion exchange resins, exchange capacity, ion exchange chemistry and reactions, Design of ion exchange units

Adsorption: types of adsorption, adsorption isotherms, activated carbon adsorption kinetics, analysis and design of adsorption column, Disinfection with ozone: Chemistry, UV disinfection: System components.

### SECTION - II

#### Unit 4: Growth Kinetics, Nitrogen & Phosphorous Removal & UASB Design (8)

Modeling suspended and attached growth treatment processes for biological nitrification and denitrification, Nitrogen Removal by Physical and Chemical Processes, Biological phosphorous removal, Chemical precipitation for removal of phosphorous, anaerobic sludge blanket processes, Design considerations for up flow Anaerobic Sludge Blanket process.

#### Unit 5: Chemical Precipitation & Disposal of Contaminants

(3)

Chemical precipitation for removal of heavy metals and dissolved inorganic substances, Removal of Refractory organics, Removal of dissolved inorganic substances, Ultimate disposal of contaminants



**Unit 6: Wetlands****(6)**

Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Free water surface and subsurface constructed wetlands, Floating and emergent plants, Combination systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems.

**Term work:**

A journal consisting of at least six experiments from following:

1. Settling column analysis
2. Development of break through curve for ion exchange process
3. Analysis of heavy metals viz. Cu, Cr, K, Mn, Zn, As, Sr, Ca
4. Development of adsorption isotherm
5. Analysis of Volatile Fatty Acids
6. Determination of MLSS, MLVSS & F/M ratio
7. Determination of SVI

**Reference Books:**

1. Wastewater Engineering treatment and reuse – Metcalf Eddy, Published by TMH.
2. Environmental Engineering – Peavy Row, Published by
3. Physicochemical processes of water purification – W. J. Weber Published by Wiley Interscience
4. Wastewater Treatment for Pollution Control – Soli J. Arceivala, Published by
5. Theory and Practice of Water and Wastewater Treatment – Ronald Droste Published by

**SHIVAJI UNIVERSITY**  
**B.E. (Environmental Engineering) Part I, Semester-VII (Revised)**  
**4. DESIGN OF STRUCTURES- II**

**Teaching Scheme**

Lecture: 4 Hrs/week  
Practical: 2 Hrs/ Week

**Examination Scheme**

Theory : 100 Marks  
Term Work: 25 Marks  
Oral Exam: 25 Marks

Course Learning Objectives:  
At the end of course, the students will

1. Learn design of columns.
2. Study, analysis and design of footings.
3. Learn & design of water tanks.
4. Study design concept of intz tank and tall chimney.

**SECTION – I**

**Unit 1:** (7)  
Analysis and design of axially loaded circular and rectangular columns, Interaction Diagram, Circular column with helical reinforcement

**Unit 2:** (8)  
Design of isolated rectangular column footing with constant depth subjected to axial load and moment, Design of combined rectangular footing.

**Unit 3:** (8)  
Design of water tank- design criteria, permissible stresses, design of circular water tank resting on ground with flexible and rigid base

**SECTION – II**

**Unit 4:** (7)  
Design of rectangular water tank resting on ground by approximate method permissible stresses

**Unit 5:** (8)  
Design of underground water tank in full and empty condition

**Unit 6:** (8)  
Design of over head water tank- Circular and Rectangular water tank, Introduction to concept and design of Intz tank and tall chimney

**Term Work:**

Term work shall comprise of at least eight assignments consisting of design problems on above unit.

**Reference books:**

1. IS 456-2000
2. Limit state theory and Design –Karve and Shah, Structures publications , Pune
3. Reinforced Concrete Design – Limit state - A.K. Jain Nem Chand brothers Roorkee
4. Fundamentals of Reinforced Concrete –Sinha and Roy, S. Chand and company Ltd.
5. Ram Nagar, New Delhi
6. Limit State Design of reinforced concrete P.C.Varghese, Prentice Hall, New Delhi
7. Reinforced Concrete Design- B.C. Punmia Laxmi publications New Delhi
8. Reinforced Concrete Design-M. L. Gambhir-Mc millan India Ltd. New Delhi
9. Special publications -16-Bureau of Indian standards

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B.E. (Environmental Engineering) Part I, Semester-VII (Revised)

**5. ELECTIVE - I**

**1. OPTIMIZATION TECHNIQUES**

**Teaching Scheme**

Lecture: 3 Hrs/week

Tutorial: 1 Hr/ Week

**Examination Scheme**

Theory : 100 Marks

Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Know various concepts of optimization techniques of engineering.
2. Learn Scientific and Engineering Techniques to solve Engineering problems.
3. Acquire skills to analyze and identify better solutions.
4. Study profit maximization, loss and waste minimization, transportation problem, Network techniques.

**SECTION – I**

**Unit 1** **(3)**

Introduction: Birth of O. R., Methodology, Scope and Limitations. Types of O.R. Models, Applications, Use of computers in O R

**Unit 2** **(7)**

Linear Programming: Formulation, graphical method, Simplex algorithm for maximization and minimization problems, sensitivity analysis, duality theory and its use in economic interpretation and decision making.

**Unit 3** **(7)**

Transportation and Assignment Models: Structure, industrial and business applications.  
a) Transportation problems: Use of various methods for solving transportation problems, degeneracy and its solution.  
b) Assignment problems: Solution of various types of problems, Traveling Salesman problem.

**Unit 4** **(3)**

Sequencing: Sequencing of n jobs and 2 and 3 machines, 2 jobs and m machines.

**SECTION- II**

**Unit 5** **(7)**

Inventory Models: Various costs involved, classification of models, EOQ model with and without shortage, EOQ with uniform demand and production lot size model, Multi item inventory control models.

**Unit 6** **(4)**

Decision Theory: Pay off and regret tables, decision rules, decisions under uncertainty and risk, decision tree.

**Unit 7****(7)**

Network Modeling: Fundamentals of CPM / PERT networks; CPM – construction of networks, critical path, forward and backward pass, floats & their significance, crashing for minimum cost and optimum and minimum duration, resource allocation and leveling. PERT – Time Estimates, Construction of Networks, Probability of completing projects by given date.

**Unit 8****(2)**

Replacement Analysis: With & without time value of money, single item and group replacement.

**Term Work:**

Assignments based on above units including two case studies.

**Reference Books:**

1. Introduction to O.R., 6/e (with floppy disk) – Hamdy A. Taha, (PHI)
2. Quantitative Techniques in Management, 2/e - N.D. Vora. (TMH)
3. Introduction to O.R., 7/e (with CD) – Hillier & Lieberman (TMH)
4. Operations Research – Hira & Gupta.
5. Operations Research – J.K. Sharma. (Mac Millan)
6. Operations Research – S.D. Sharma
7. Optimization in Operation Research – Ronald L. Rardin (Pearson education)

# SHIVAJI UNIVERSITY

## B.E. (Environmental Engineering) Part I, Semester-VII (Revised)

### 5. ELECTIVE – I

#### 2. CLEAN DEVELOPMENT MECHANISM

##### Teaching Schemes

Lectures – 3 Hours / Week

Tutorial – 1 Hours / Week

##### Examination Scheme

Theory: 100 Marks

Term Work: 25 Marks

##### Course Learning Objectives:

At the end of the course students will

1. Grasp the significance of climate change & global warming with its effects
2. Understand importance of Kyoto Protocol & flexible mechanism
3. Learn the procedures in Clean Development Mechanism project implementation
4. Understand the procedures in Joint Implementation & Emission Trading in project implementation

#### SECTION - I

##### Unit 1

(6)

Introduction, Climate Change and Global Warming, Greenhouse Gases, Sources of Greenhouse Gases, The United Nations Framework Convention on Climate Change, The Kyoto Protocol, Developments Since Kyoto, The Kyoto Challenge, The Kyoto Mechanisms.

##### Unit 2

(8)

The Clean Development Mechanism, The Size of the CDM Market, Clean Development Mechanism, Working, Credits for Early Action, Organization of the CDM and its Functions, Legal and Institutional Issues in the Organization of the CDM, Governance of the CDM, Organizational Arrangements, Essential CDM Functions, Participation by Public and/or Private Entities in the CDM, Dispute Resolution.

##### Unit 3

(8)

Types of Eligible Projects, Project Eligibility Criteria, Additionality, Supplementality, Transaction Costs, CER Accounting, CERs, Types of CERs, Types of Financing, Common Pricing Structures, Price for CERs, Main Costs, Selling and Buying, Technology Transfer Issues, Sustainable Development Criteria, Project Approval and Registration, Monitoring, Certification of Emissions Reductions, Tracking CER Transfers And Holdings.

#### SECTION - II

##### Unit 4

(8)

Secondary Trading, Joint Implementation (JI), Joint Implementation Supervisory Committee (JISC), Participant Countries, Designated Focal Points (DFP), Accredited Independent Entities (AIE), Voluntary Emissions Reductions (VER), VER Basics, Drives demand for VERs, Sources of VERs, Key principles of VERs, Project Technologies, Types of VER transactions executed, Quality labels available for VERs, Emission Trading

##### Unit 5

(6)

Operational Elements of the CDM, Sharing Project Value between Investors and Hosts, Risk Sharing and Liability Rules, Fungibility of the Tradeable Commodity under CDM, JI and ET, Financing Adaptation and CDM Administrative Expenses.

## Unit 6

(6)

Investment Incentives and Opportunities, Basic Sources of Private and Public Capital for CDM Investments, Project Risk Management – Special Considerations, Financing Tools for CDM Projects, Issues of Equity, Finance and Capacity-Building, Categorizing Host Countries by Market Capacity, Steps needed to promote funding of CDM Projects.

### Term Work:

1. The journal consisting of at least two case studies from developing countries which are registered at CDM website of UNFCCC.
2. Assignments based on above units.

### Reference Books:

1. Clean Development Mechanism in China - Ensuring a Sustainable Approach by Jostein Nygard, Holger Liptow, Deshun Liu
2. Climate Change and the Kyoto Protocol's Clean Development Mechanism Stories from the Developing World (South North: Stories from the Developing World) by Margie Oxford, Stefan Raubenheimer, Barry Kantor
3. Corporate Strategies and the Clean Development Mechanism - Developing Country
4. Financing for Developed Country Commitments - Soren Ender Lutken, Axel Michaelowa
5. The Clean Development Mechanism - Dave, V. Wright
6. Carbon Finance - The Financial Implications of Climate Change (Wiley Finance) by Sonia Labatt and Rodney R. White
7. Emissions Trading: Principles and Practice - T. H. Tietenberg

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**5. ELECTIVE – I**

**3. DISASTER PLANNING AND RISK ANALYSIS**

**Teaching Scheme**

Lecture: 3 Hrs/week  
Tutorial: 1 Hrs/ Week

**Examination Scheme**

Theory : 100 Marks  
Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Understand various disasters and hazards.
2. Study various impacts of disaster.
3. Learn measures for management and control of disasters.
4. Study risk analysis and assessment techniques.

**SECTION - I**

**Unit 1 (2)**

Disaster - Definition, types, Classification, hazards and its types, Difference between natural disasters and manmade disasters

**Unit 2 (9)**

Natural disasters – Causes of occurrence, consequences, Impact on human health, animal health, socioeconomic impacts, and impact on environment, major events of the past and recent , pattern of occurrence in India and world of following

Natural disasters - Earthquakes, Floods, Tsunami, Landslide, Cyclones, Volcanoes, Drought and Pest infestation

**Unit 3 (9)**

Disaster Management, Definition and Purposes, Planning and Control of Various Natural Disasters, Various Mitigative & Preventive Measures, Disaster Management Planning in India at Central level, State level, District & Local level, Application of Remote Sensing and GIS for Disaster Management

**SECTION – II**

**Unit 4 (7)**

Manmade Disasters, types and causes of occurrences, Industrial Disasters and their impacts, Environmental disasters, definition and causes of occurrence and their Impacts

**Unit 5 (7)**

Disaster Management for Manmade Disaster, Identification and control of hazards,

Risk Analysis – Definition, Various Techniques of Risk Analysis for Industries- HAZOP, HAZAN, FMEA, Fault Tree Analysis, Event Tree Analysis

## Unit 6

(6)

Risk Analysis for Environmental Disasters, Dose- Response Relationship, Control of Environmental Risk, Case studies

### Term Work:

A journal consisting of

1. Assignments based on above units.
2. A visit report on any Major Risk Industry.

### References:

1. Disaster Management - B.Narayan, APH Publishing Corporation
2. Industrial Disaster Management - Chakrabarty U.K., Asian company, new Delhi
3. Risk Assessment- An Environmental Perspective - Peter K.Lagoy, Jaico Publishing House, Mumbai
4. Industrial Occupational Safety, Health and Hygiene - A.H. Hommadi, Indian Bibliographies Bureau, New Delhi
5. Pesticides, Man and Biosphere - O.P.Shukla, APH Publishing Corporation, New Delhi
6. Websites of Government of India



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**5. ELECTIVE – I**

**4. RENEWABLE ENERGY ENGINEERING**

**Teaching Scheme**

Lecture: 3 Hrs/week

Tutorial: 1 Hr/ Week

Course Learning Objectives:

**Examination Scheme**

Theory : 100 Marks

Term Work: 25 Marks

At the end of course, the students will

1. Understand energy scenario, potential and demand.
2. Learn types and utilization of renewable energy sources.
3. Study biomass energy potential and conversion technology.
4. Learn concept of energy planning, management and audit.

**SECTION - I**

**UNIT 1**

**(4)**

Introduction: Energy chains, Energy demand, Energy crises. Global & Indian Energy Scene: Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, Energy resources: coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption, need for use of new and renewable energy sources & types. future energy options.

**UNIT 2**

**(10)**

a) Solar Energy: Utilization methods, merits & demerits of solar energy utilization, potential of solar energy, solar radiation, data for India, solar thermal collectors, concentrators & reflectors, collector efficiency, application of solar energy, solar cooker, solar water heating, solar dryer, solar distillation, solar photovoltaic systems, solar pond.

b) Wind Energy: Potential & scope, classification & types of wind machines, application of wind energy, merits & limitations of wind energy. Site selection for wind farm, wind map of India, wind energy station in India.

c) Geothermal Energy: Introduction, types of geothermal resources, potential of geothermal resources in India & world. Environmental problems in utilization of geothermal resources.

**UNIT 3: Energy from ocean**

**(6)**

a) Tidal Energy: Tides, tidal range, tidal power, suitably sites & prospects. Types of tidal power plants, single basin, modulated single basin & double basin schemes, main equipments

b) Ocean thermal energy conversion: Introduction, principle of OTEC, open cycle & closed cycle OTEC schemes, potential & prospects in India.

c) Wave Energy: Introduction, power of wave, wave data collection, wave Machines (wave energy converters), forces on wave machines and associated structures, merits & demerits of wave energy.

## Section - II

### UNIT 4:

(10)

Biomass Energy Resources: Biomass energy and conversion Types:

a) Biochemical Conversion: Sources of energy generation, Industrial waste, agro residues; Anaerobic Digestion: Biogas production; Types of biogas plants, Community biogas plants;

b) Thermo-chemical conversion: Sources of energy generation, Gasification; Types of gasifiers; Industrial applications of gasifiers; Environment benefits of biochemical and thermo-chemical conversion, Briquetting; Utilization and advantages of briquetting

c) Bio-diesel History, Production methods of Bio-diesel: Transesterification, Fuel quality, standards and properties, Availability of Raw materials for bio-diesel, Applications, Bio-diesel potential in

India.

d) Cogeneration, Principle of Cogeneration, Technical Options for Cogeneration, Classification of Cogeneration Systems, Factors Influencing Cogeneration Choice, Important Technical Parameters for Cogeneration, Prime Movers for Cogeneration, Typical Cogeneration Performance Parameters, Relative Merits of Cogeneration Systems. Cogeneration alternatives, Gas turbine Steam turbine, Diesel engine, Bottoming cycles. Industry/ utility cogeneration, Thermodynamic evaluation, Technoeconomic evaluation, Environmental evaluation. Cogeneration in sugar and steel industry, Case Studies

### Unit 5

(4)

Hydro Energy: Introduction, India's Hydro potential and reserves, merits & limitations, low head, medium head, high head schemes, hydro turbines, economics.

### UNIT 6:

(5)

Energy Management & planning: Energy management principles, Energy & pollution trade off, objectives of energy management, energy strategy & energy planning, Energy audit.

### Term Work:

Assignments based on all above units

### Reference Books:

1. Environmental studies: Benny Joseph
2. Environmental Biology: K. C. Agarwal
3. Environmental Encyclopedia: Cunningham, W.P.Cooper, T.H.Hepworth (Jaico Pub.)
4. Energy & Ecology : David M.Gates (Sinaur Associates)
5. Non Conventional Energy Sources: G.D.Rai
6. Power Technologies : Stephenson
7. Energy Technology: S.Rao & B.B.Parulekar

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B.E. (Environmental Engineering) Part I, Semester-VII (Revised)

**5. ELECTIVE – I**

**5. ENVIRONMENTAL BIOTECHNOLOGY**

**Teaching Scheme**

Lecture: 3 Hrs/week

Tutorial: 1 Hr/ Week

**Examination Scheme**

Theory : 100 Marks

Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Understand concept of Environmental biotechnology.
2. Learn microbiology of bioremediation processes and technologies
3. Understand role of biotechnology in control of environmental pollution
4. Study concept of bio absorption and conservation.

**SECTION - I**

**Unit 1** **(3)**

Introduction to Biotechnology, Concept of Environmental biotechnology, public perception of biotechnology, Role of biotechnology in Environmental Engineering

**Unit 2** **(7)**

Problems of Environmental Pollution, Sewage and Industrial wastewater, gaseous emissions, solid and semi solid wastes from residences as well as industries, problems associated with their disposals

**Unit 3** **(7)**

Aerobic v/s anaerobic degradation, Kinetics of Aerobic and Anaerobic biodegradation, Concept of bio remediation, various micro organisms involved, bioremediation processes and technologies

**SECTION - II**

**Unit4** **(7)**

Application of biotechnology for control of environmental pollution and its bio abatement, bioconversion of agriculture and other organic waste matter into useful products like gaseous and liquid fuels, soil conditioners, food for livestock

**Unit 5** **(8)**

Biotechnology in the reduction of carbon dioxide through biological calcification, heavy metal pollution and its bio-abatement, biodegradation of hazardous waste, phenolic compounds and chemical pesticides, concept of bio absorption, factors affecting bio-absorption, limitations of bio absorption

## Unit 6

(4)

Role of biotechnology in conservation of species, organic farming, bio-fertilizers, biological control of pests, concept and types of bio-pesticides and their significance

### Term work:

The journal consist of following

1. At least six assignments based on above units.
2. A report based on industrial visit.

### References:

1. Introduction to Environmental Biotechnology - A.K. Chatterji, Prentice Hall India, New Delhi
2. Environmental Biotechnology - S.K.Agrawal, APH Publishing Corp., New Delhi.
3. Environmental Biotechnology - Basic Concepts and Applications, Indu Shekhar Thakur, I.K. International Pvt. Ltd., New Delhi.
4. Environmental Biology - P.S.Verma & V.K.Agrawal, S.Chand & Company Ltd., New Delhi ,
5. Environmental Biotechnology - Jognand, S.N., Himalaya Publishing house, New Delhi.
6. Elements of Environmental Biotechnology - P.K.Gupta, Rastogi Publishing House, New Delhi
7. Environmental Treatment Technologies for Hazardous and Medical Wastes - Subijoy Dutta, Tata MacGraw Hill Ltd., New York
8. Environmental Pollution and Management of Wastewater by Microbial Techniques - G.R.Pathade & P.K.Goel, ABD Publishers, Jaipur

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**6. SEMINAR**

**Teaching Scheme**

Practical: 2 Hrs / Week

**Examination Scheme**

Term Work: 50 Marks

The topic of seminar shall be based on any area of Environmental Engineering & preferably considering new ideas, concepts, technologies & developments in the field of Environmental Sciences & Technologies. At least two oral presentations and submission of report in soft & hard copies is expected.

**7. PROJECT**

**Teaching Scheme**

Practical: 2 Hrs / Week

**Examination Scheme**

Term Work: 25 Marks

The project work to be based on any problem pertaining to Environmental Engineering. The work to be completed shall consist of

- Identification of problem, Literature survey & Data collection.
- Preparation of Synopsis.
- At least one presentation highlighting significance, relevance & scope of the project work.

The same project work will continue for detailed study, laboratory analysis, field visits as necessary for the project work.

**8. VOCATIONAL TRAINING**

**Teaching Scheme**

Tutorial: 1 Hr / Week

**Examination Scheme**

Term Work: 25 Marks

Evaluation of the report on vocational training submitted by the students

# SHIVAJI UNIVERSITY

## B.E. (Environmental Engineering) Part II, Semester- VIII (Revised)

### 1. ENVIRONMENTAL MANAGEMENT SYSTEMS

#### Teaching Scheme

Lectures – 3 Hrs / Week

Practical – 2 Hrs / Week

#### Examination Scheme

Theory: 100 Marks

Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Understand various Environmental Management Systems available worldwide
2. Learn different elements of ISO 14001: 2004 Standard
3. Learn EMS auditing in organization
4. Study Certification process required by ISO
5. Understand Environmental Performance Evaluation of an organization

#### SECTION – I

##### Unit 1: Introduction to ISO 14001

(2)

Definitions, Purpose, Scope, ISO 14001 family, Deming's PDCA Cycle, General requirements, EMS Elements

##### Unit 2: General Requirements and Planning

(9)

Environmental policy, Compliance, Continual improvement, Pollution prevention Planning, Aspects, Aspects Procedure, Aspects list, Significant determination information, Significant aspects/impacts list, Legal and other requirements, Listings of applicable legal and other requirements, Appropriate instructions for compliance, Permits, manifests, Objectives and targets, Minutes/notes of objectives and target development, List of objectives and targets, Related action plans

##### Unit 3: Implementation and Operation

(9)

Structure & Responsibility, Job descriptions, Organizational charts, Training, Training needs listings/matrix, Manuals, course materials, Sign-in sheets, Test records, certificate copies, Communications, Specific work instructions, Records of communication and correspondence, Document control, Documents, procedures, and manuals, Operational control, Critical operations/aspects listing/matrix, Specific work instructions, Emergency plans and protocols, Practice and drill results, Environmental issues and instructions within other work instructions, Contractor policies, work orders, Supplier requirements, Emergency response, Emergency plans and protocols, Practice and drill results

#### SECTION - II

##### Unit 4: Checking and Corrective Action

(8)

Monitoring and measurement, - Objectives and target action plans, Function-specific procedures and work instructions, Records of monitoring and measurement data collected, including calibration records, Non-conformance and corrective/preventive action, Corrective action reports, Evidence of discussion and follow-up (meeting notes, etc.), Records, Control of records

##### Unit 5: EMS Auditing

(8)

EMS audit, Specific audit procedures, checklists, forms, schedule, EMS audit notes and working documents, EMS audit reports

**Unit 6: Management Review****(4)**

Meeting agendas and attendance, Meeting minutes and action items, Evidence of follow-up actions, reports

**Term work:**

Case study of at least one large scale industrial unit covering eighteen article of EMS manual

**Reference Books:**

1. International Standard ISO 14001 – Environmental Management Systems – Requirements with Guidance for Use
2. International Standard ISO 14004 – Environmental Management Systems – General Guidelines on Principles, Systems & Support Techniques

# SHIVAJI UNIVERSITY

## B.E. (Environmental Engineering) Part II, Semester – VIII (Revised)

### 2. INDUSTRIAL WASTE TREATMENT

#### Teaching Scheme

Lectures: 3 Hrs/ Week

Tutorial: 1Hr/week

#### Examination Scheme

Theory Paper: 100 Marks

Term Work: 25 Marks

#### Course Learning Objectives:

At the end of the course, students will

1. Understand the manufacturing process, water requirement, wastewater generation, characteristics and effects of wastewater from various industries on receiving bodies
2. Know the benefits and techniques of waste minimization in industries
3. Study the various conventional and novel techniques for treatment of industrial waste and concepts of CETP
4. Understand the treatment required for removal of specific pollutants from industrial waste.
5. Learn concepts and benefits of common effluent treatment plant

### SECTION - I

#### Unit 1. Manufacturing process & Flow Diagram of various Agro based and Non agro based industries (10)

Study of manufacturing process & flow sheet, Water requirements, sources and characteristics of waste water for a) agro based industries- Sugar, Distillery, Dairy, Textile, Paper & Pulp and b) non agro based industries- tanneries, Steel & Foundry, Fertilizer, Oil Refinery, pharmaceutical industry etc.

#### Unit 2: Industrial Wastewater Introduction (6)

Industrial wastewater versus municipal wastewater, environmental impacts of untreated industrial wastewater, Effluent standards, Benefits of Prevention and Control of Industrial Pollution, water budget, Waste minimization - 4 R concepts, Waste volume and strength reduction, Zero discharge concepts

#### Unit 3. Industrial Wastewater Treatment options (4)

Unit operations and unit processes, flow sheet development, Equalization, Neutralization for industrial wastewater treatment,

### SECTION - II

#### Unit 4. Removal of specific pollutants (6)

Removal of Oil & grease, Heavy metals and Cyanide, floatation, treatment of radioactive substances, applications of advanced oxidation processes, adsorption and membrane filtration

#### Unit 5. Treatment Flow Diagram (10)

Study of treatment options and waste minimization for a) agro based industries- Sugar, Distillery, Dairy, Textile, Paper & Pulp and non agro based industries- tanneries, Steel & Foundry, Fertilizer, Oil Refinery, pharmaceutical industry etc.



## Unit 6. Common Effluent Treatment Plant

(4)

Concept of Common Effluent Treatment Plant- Objectives, Grouping of Industries, methodology, cost distribution, benefits, Biological treatment for Toxic waste, Acclimatization of bacteria

### Term work

- 1) Assignments based on above units
- 2) Industrial visit report for any two industries

### References:

1. W .W. Eckenfelder Jr., "Industrial Water Pollution Control", McGraw-Hill Book Company, New Delhi, 2000.
2. "Theories and Practices of Industrial Waste Treatment", Nelson Nemerow, Wiley Publication Company,.
3. "Wastewater Engineering Treatment and Reuse", Metcalf And Eddy, Tata McGraw Hill Publication.
4. MOEF standards Guide for Treatment and Disposal of Waste from Various Industries".
5. H.M.Freeman, "Industrial Pollution Prevention Hand Book", McGraw-Hill Inc., New Delhi,
6. "Pollution Prevention: Fundamental & Practice", Bishop, P.L.,McGraw-Hill, 2000.
7. "Industrial Pollution Prevention", T.T.Shen, Springer, 1999.
8. "Industrial Wastewater Systems Hand book", R.L.Stephenson and J.B.Blackburn, Jr., Lewis Publisher, New Yark, 1998
9. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
10. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
11. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical , CRC Press, Boca Raton, 2006.

**SHIVAJI UNIVERSITY**  
**B.E. (Environmental Engineering) Part II, Semester – VIII (Revised)**

**3. QUANTITY SURVEYING AND VALUATION**

**Teaching Scheme**

Lectures: 3 Hrs / Week

Practical: 2 Hrs / Week

**Examination Scheme**

Theory: 100 Marks

Term work: 50 Marks

Oral exam: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Understand various components of buildings and environmental structures and the detail of these
2. Study various methods of measurements and calculating quantities of various items of the buildings.
3. Understand to calculate the various materials and labour required for various items in the building.
4. Understand calculation of rates of various items of the buildings
5. Study how to prepare a detailed estimate.
6. Understand the concept of valuation and various concepts in valuation.
7. Study various methods of valuation and find out market value by various methods.

**SECTION – I**

**Unit 1**

**(4)**

General Introduction to Quantity surveying, purpose of estimates types of estimates, various items to be included in estimate. Mode of measurement of various items, I S 1200, Administrative approval and Technical sanction to estimates, Prime cost, Provisional sums and provisional quantities

**Unit 2**

**(3)**

Specifications: Purpose and basic principles of general and detailed specifications, specifications for different items of work for building, water supply and sewerage works

**Unit 3**

**(6)**

a) Estimate of residential building; Estimate of basic items of buildings  
b) Detailed estimates of water supply and sewerage schemes: Estimates for water supply and sewerage lines, Estimates of treatment plants. Estimating of various appurtenances in water supply and sewerage works. Estimates of various mechanical and electrical equipments in water supply and sewerage works, Analysis of Rates: Factors affecting the cost. Materials, Labour, task work schedule as basis of labour cost, rates of various machinery, tools and plants, overhead charges, Rates for various items of construction of civil Engineering works, standard schedule of Rates. Price escalation, DSR and use of DSR for estimating

**Unit 4**

**(8)**

Approximate Estimates: Purpose, various methods used for building and other Civil Engg. works like Bridge, water supply, Drainage, irrigation and Road projects. Different methods for executing work like contract method, Departmental, Organizational set-up of various govt. bodies like PWD, Water Supply Departments and general idea about its working and delegation of power, classification of works, Methods for carrying out work . Two Envelop method,, measurement books, mode of payment, bill forms, Global contractors, local competitive bidding

## SECTION – II

### **Unit5: (8)**

a) Contracts: Essentials of legally valid contract, Different types of contracts, suitability of different types of contracts. Item rate, percentage Rate, Lump sum, Cost plus percentage, cost plus fixed fees, cost plus sliding scale of fees, target costs as based on sharing risks and profits, Turnkey contracts Appointment and Authority of Agents for execution contract between government and contract for various water supply and sewage projects. Competitive bidding contracts:

b) Tender Procedure: Various types of tenders, preparing tender papers, invitation of tenders, tender notice, submission, scrutiny and Acceptance of tenders, conditions of contracts, right and responsibilities of the parties to contract.

### **Unit 6: (8)**

a) Principles of valuation: Definition of 'value' unit price and cost attributes of values. Different types of value. Books value, salvage & scrap value, Replacement value, Reproduction Value, Earning value. Market value, Potential value, distress value, speculation values, sentimental value, Accommodation values, Essential characteristics of market value

b) Valuer and his duties, purpose of valuation and its function. Factors affecting the valuation of properties, Tangibles and intangibles, Landed properties, freehold and lease hold properties. Different type of Lease

### **Unit 7: (4)**

a) Depreciation: Different methods of calculating depreciation: declining balance method, sinking fund method, depreciated cost, factors for obsolescence.

b) Sinking Fund: Definition, purpose, calculation of sinking fund, Sinking fund calculations for various equipments and machinery used in water supply and sewerage schemes.

d) BOT, BOOT: Concepts of execution of works by the methods like BOT, BOOT

### **Unit 8: (3)**

Various methods of valuation: Methods of Valuation applicable for residential and commercial buildings, methods of valuation for public buildings, valuation for water supply and sewerage schemes, valuation of different components of the scheme, Introduction to Arbitration.

### **Term Work:**

#### **1. Tutorials:**

- a) Writing specifications for at least 10 items of work for various items in water supply and Sewerage system.
- b) Rate Analysis for at least ten items of work.

#### **2. Reports:**

A) Detailed Estimate of a water treatment plant or sewage treatment plant.

B) Preparing detailed estimate for any one of the following-

- i) Water supply line
- ii) Sewerage line
- iii) A small culvert
- iv) A stretch of road about 1 km long including earthwork
- v) A reach of canal about 1 km long
- vi) A percolation tank
- vii) Valuation Report for any two of the following-
  - a) Water supply/ sewage treatment plant.
  - b) Water resource project

The report must include a 'Valuation Certificate' also.

**Reference Books:**

1. Quantity Surveying – P. L. Bhasin
2. Elements of estimating and costing – S. C. Rangawala.
3. Civil Engg. Contracts and Estimates – B. S. Patil
4. Professional Practice – Roshan Namavati (Estimating and Valuation)
5. Estimating and Costing - Datta
6. Estimating, costing and specifications in civil engineering – Chakraborty M.
7. Estimating and Costing - Birdi
8. Bombay P. W. D. volumes I and II
9. Valuation of real properties – S. C. Rangawala
10. District Schedule of Rates for PWD, MJP

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B.E. (Environmental Engineering) Part II, Semester - VIII (Revised)

**4. INDUSTRIAL HEALTH AND SAFETY**

**Teaching Scheme**

Lectures: 3 Hrs / Week

Practical: 2 Hrs / Week

**Examination Scheme**

Theory: 100 Marks

Term work: 25 Marks

**Course Learning Objectives:**

At the end of the course, the students will

1. Study industrial environment in accordance with the safety at the workplace.
2. Understand occupational health, industrial hygiene, accident prevention techniques.
3. Understand safety auditing and management systems.
4. Know about risk assessment and management through quantitative and qualitative risk assessing tools.
5. Understand industrial legislations enacted for the protection of employees health at work places.

**SECTION: I – INDUSTRIAL SAFETY**

**Unit: 1**

**(06)**

- a. Principles of Accident Prevention: Accident, Types, Causes, Consequences, Accident Statistics, Unsafe Acts and Unsafe Conditions, Cost of Accident (Direct and Indirect), Basic Activities in Accident Prevention, Accident Investigation and Reporting, Investigators Qualification, Investigation Strategy, Benefits, Documentation and Contents of Good Report.
- b. Theories of Accident Causation: Errors and Mistakes, Types of Errors, Decision Making, Heinrich Domino Theory, Accident/Incident Theory, Human Factors Theory, Human Behavior Theory, System Theory, Combination Theory.

**Unit: 2**

**(06)**

- a. Management of Safety and Health: Safety, Need, Parameters Associated with Safety, Theory of Safety, Principles of Safety, Ergonomics, Three 'E's, Safety Audit, Checklist Analysis, What-If Analysis, Safety Review, Safety Warning System
- b. Training for Safety and Health, Identifying Training Needs - Organizational Needs, Job-Related Needs, Individual Needs, Identifying Training Objectives and Methods, Training Evaluation and Feedback, Relationships within the Organization and Outside the Organization, Motivation.

**Unit: 3**

**(08)**

- a. Hazard Management Process: Hazard Identification, Workplace Inspection, Consultation, Risk Assessment, Risk Assessing Tools, Concept of Risk Priority Number, Risk Control Techniques, Machine Guarding Techniques, Types of Guards, Need and Importance for Safety, Safe Handling, Transportation and Storage of Hazardous Chemicals, Material Storage Data Sheet, Housekeeping Issues, Concept of 5-S.
- b. Plant and Machine Layout for Safety: Objectives, Site Selection, Factors Affecting Layout, Selection and Design, Requirements, Types of Plant Layout (Process Oriented and Product Oriented Layout), Need for Re-layout, Lockout -Tagout (LOTO) System, Basic LOTO Procedure, Personal Protective Equipments, Types, Need and Selection.

## SECTION: II – OCCUPATIONAL HEALTH AND SAFETY

### Unit: 5 (06)

Fundamentals of Health and Safety Management System: Importance, Key Elements of Health and Safety Management System, Key Steps in Health and Safety Model, Audits and Reviews- Key Requirements, Benefits and Practical Aspects. Measurement of Individual and Organizational Performance, Occupational Health and Safety Assessment Series (OHSAS) 18001, Legal Requirements.

### Unit: 6 (07)

Occupational Health and Industrial Hygiene: Definition, Objectives, Need, Chronic and Acute Effects, Various Exposure Limits, LD-50, LC-50, TLV, TWA, STEL, Health and Other Effects of Various Harmful Agents and Conditions - Physical, Chemical, Biological and Ergonomic, Protection of Workers, Personal and Work Place Monitoring Systems, Confined Space Entry, Hazards and Requirements of Safety, Working Underground, Working at Height, Hot Work Permit and Cold Work Permit, On-Site and Off-Site Emergency Management Plans.

### Unit: 7 (07)

- a. Occupational Health and Safety Issues: Poor Working Conditions, Causes, Consequences, Losses, Types of Occupational Health Hazards, Routes of Entry, Occupational Disorders, Impacts and Control, Prevention, Medical Surveillance, Role and Responsibility of Safety Representative.
- b. Factories Act, 1948, Workman's Compensation Act, 1948, Employees State Insurance Act, 1948, Mines Act, Air (Prevention and Control) Pollution Act, 1981, Water (Prevention and Control) Pollution Act, 1974, Boiler Vessels Act, Child Labour and Women Employee Act.

#### Term work:

A journal consisting of following -

1. At least six assignments based on above theory
2. At least one industrial visit report on
  - a) Industrial Safety
  - b) Occupational Health

#### Reference Books:

1. Occupational Safety and health -by David L. Goetsch, Prentice Hall, Ohio
2. Safety manual - EDEL Engineering consultancy Pvt. Ltd.
3. Hazardous Material & Waste management- by Gayle Woodside, John Wiley & sons Inc.
4. Environmental Health & Safety Auditing Handbook - by Lee Harrison, Mac Graw Hill Inc.
5. Health Hazards of the Human Environment - World Health Organization, Geneva, 1972
6. Textbook of Preventive & Social Medicine - by K. Park, Banarsidas Bhanot Publishers.
7. Industrial and Occupational Safety, Health & Hygiene - by Dr. A.H. Hommadi
8. Introduction to Industrial Safety - by K.T. Kulkarni
9. R. K. Jain and Sunil S. Rao , Industrial Safety, Health and Environment Management Systems, Khanna publishers, New Delhi (2006)
10. Slote L. Handbook of Occupational Safety and Health, John Willey and Sons, NewYork
11. Frank P. Lees, Loss of prevention in Process Industries, Vol. 1 and 2, Butterworth-Heinemann Ltd., London (1991).
12. Industrial Safety -National Safety Council of India.
13. The Factories Act with amendments 1987, Govt. of India Publications , Mumbai
14. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)

15. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad (1993).
16. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, Jaico Publishing House, Delhi (1999).
17. Handbook of Environmental Risk Assessment and Management: Peter Calow, Blackwell Science Ltd. USA (1998).

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B.E. (Environmental Engineering) Part II, Semester- VIII (Revised)

**5. ELECTIVE - II**

**1. MANAGERIAL TECHNIQUES**

**Teaching Scheme**

Lectures: 3 Hrs/week

Tutorial: 1Hr/week

**Examination Scheme:**

Theory: 100 marks

Term work: 25 marks

Course Learning Objectives:

At the end of course, the students will

1. Understand importance of managerial techniques in Environmental Engineering
2. Learn personal management techniques and operation & maintenance of treatment plants.
3. Understand significance of environmental governance.
4. Study various financial & production management techniques

**SECTION – I**

**Unit 1 (7)**

Introduction to managerial techniques in Environmental Engineering Industry importance, functional implementation, scope. Management functions, principles, various departments, importance, personnel marketing, finance, and production

**Unit 2 (6)**

Personal management techniques, selection & recruitment, promotion, job analysis, labour welfare, factories act, workers participation in management

**Unit 3 (7)**

Operation & maintenance of treatment plants, formation of Env Engg Management cell in industry, Case studies in personnel, marketing & business administration in related to Env Engg & management

**Section – II**

**Unit 4 (5)**

Introduction to environmental consultancies, factories having environmental departments, Importance, functions, scope, use, organizational chart various agencies supporting environmental consultancies

**Unit 5 (6)**

Financial management technique- capital structure, budgeting, costing, working capital management, fund flow analysis. Managerial economics, demand, supply, market status, working of international banks, nationalised banks, co-operative banks, scheduled banks.

**Unit 6 (6)**

Production management technique- material management, manufacturing, installation, production, control, method study, introduction to IS 9001, 14000 certification.

**Unit 7 (3)**

Information technology in Environment Engineering, Management information systems, Softwares in Environmental Engineering



**Term Work:**

A Journal consisting of assignments based on above units and report on the industrial visit.

**Reference Books:**

1. Principles of management - Koontz Odonell
2. Marketing management - Katler
3. Financial management - Khan & Jain
4. Production management - O.P.Khanna
5. Personal management - Memoria
6. Business organization - Sinha
7. Quality Control - Juran
8. Information technology - Balguru swamy.
9. management accounting - Khan & Jain

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**5. ELECTIVE - II**

**2. WATERSHED MANAGEMENT**

**Teaching Scheme**

Lecture: 3 Hrs/week

Tutorial: 1 Hrs/ Week

**Examination Scheme**

Theory : 100 Marks

Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Understand the concept, necessity & scope of watershed Management
2. Study planning & utilization of water using different technologies.
3. Improve communication skill so as to create awareness about team work, community participation among society.
4. Promote professional and multi disciplinary approach for success in various branches of civil & environmental engineering.

**SECTION – I**

**Unit 1 (4)**

Introduction: Place in environment, global effects, status in India, historical background.

**Unit 2 (4)**

Watershed concept - Need, characteristics, proforma for basic data on watershed, watershed management, integrated multidisciplinary approach, administrative aspects.

**Unit 3 (6)**

Land & soil conservation: land survey preparation and development, soil & soil moisture conservation, soil survey, conservation measures, rainwater management, reclamation of saline soils.

**Unit 4 (5)**

Water conservation: investigation, data & analysis, surface water, utilization of wasted flows, rainwater harvesting, groundwater, potential & harvesting, well construction, integrated water resources management.

**SECTION – II**

**Unit 5 (5)**

Role of greenery in wetland management: Agriculture, sustainable agriculture, dry land agriculture, selection of water use efficiency, crops, irrigation, water losses, pasture and silvipastures, horticulture, tree culture, farm forestry, afforestation.

**Unit 6 (5)**

Socio economics: peoples part, awareness, participation, state & integrated approach, sustainable society, role of NGOs, international agencies, future, economic viability.

**Unit 7 (5)**

Appropriate technology: farm equipment, contour methods, check dams, water catchments & harvesting, low cost technology, rural technologies.

## Unit 8

(6)

Impact of water shed management: Model watershed, Government watershed, Government projects national projects, World Bank projects, ICRISAT, NGOs in water shed management

### Term work:

A journal consisting of the following -

1. Preparing model management plan for one watershed in nearby area.
2. Field visit to an ideally managed watershed area & its report.
3. Plan & prepare budget for watershed.
4. To find economical viability of the watershed management plan.

### Reference Books:

- |  |  |
|--|--|
| 1. Watershed management                          | : J.V.S.Murthy.                                  |
| 2. Watershed management in India                 | : J.V.S.Murthy.                                  |
| 3. Hydrology & Soil Conservation Engineering     | : Ghansham Das, Prentice Hall of India           |
| 4. Soil & Water Conservation Engineering         | : R. Suresh, Standard Punlishers                 |
| 5. Manual of Soil & Water Conservation Practices | : Gurumal Singh, Oxford & IBH Publishing Company |

# SHIVAJI UNIVERSITY

B.E. (Environmental Engineering) Part I, Semester- VIII (Revised)

## 5. ELECTIVE - II

### 3. ENVIRONMENTAL MODELING AND SIMULATION

#### Teaching Scheme

Lecture: 3 Hrs/week

Tutorial: 1 Hr/ Week

#### Examination Scheme

Theory : 100 Marks

Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Study mass balance principles & reaction kinetics
2. Understand mathematical models for natural systems and water quality.
3. Understand transport phenomena and models for surface & subsurface water
4. Study microbial kinetics and biomodeling.

#### SECTION - I

##### Unit 1 (4)

Fundamentals: Mass balance principle, Reaction kinetics (types of reaction, rate and order of reaction, Effect of temperature), Analysis of experimental data, Determination of rate constants

##### Unit 2 (5)

Mathematical model of physical systems- Hydraulic models of natural systems (Types of reactors), CFSTR, PFR Models, Ideal flow models, Mass balance applications

##### Unit 3 (5)

Modeling Water quality in Environment: Transport phenomena, Advection, diffusion, dispersion, Dispersion and mixing in streams, Air/water interface, Gas transfer (agitated and stagnant), pH modeling.

##### Unit 4 (6)

Surface water quality modelling-, Water quality in rivers & streams, Point and non-point sources, BOD model, Point source Streeter –Phelps equation, Nitrogenous BOD modeling, Sediment oxygen demand, Stream quality modelling using QUAL2E

#### SECTION – II

##### Unit 5 (6)

Water quality of lakes & reservoirs- Hydraulic behavior, Effect of physical processes on Water quality, modeling of lakes & reservoirs, 1D model, Vertical modeling, Ecological modeling, Significance, Eutrophication in flowing water

##### Unit 6 (5)

Subsurface water quality modeling: Transport of non reactive & reactive contaminant in Ground water, Gaussian plume model

**Unit 7****(3)**

Microbe / Substrate modeling: bacteria growth, substrate utilization, Microbial kinetics, batch and CSTR, toxicant modeling in flowing water.

**Unit 8****(3)**

pH modeling, Toxics substance model in CSTR, Bio-concentration and Bioaccumulation model.

**Term Work :**

A journal consisting of the following -

1. Assignments on each of the units
2. Study and application of QUAL2E model

**Reference Books:**

1. Surface water quality modeling - Steven Chopra, McGraw hill
2. Water quality modeling; modification - Tchobanoglous (Addision & Wesley Edward Schroedar)
3. Environmental Engineering - Sincero and Sincero
4. USEPA: [www.epa.gov.in](http://www.epa.gov.in) QUAL2E model
5. Metcalf & Eddy. Waste Water Engg. Treatment & Disposal, Tata McGraw - Hill Pub.

# SHIVAJI UNIVERSITY

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## 10. ELECTIVE - II

### 4. OPERATION AND MAINTENANCE OF ENVIRONMENTAL SYSTEMS

#### Teaching Scheme

Lectures: 3 Hrs/week

Tutorial: 1Hr/week

#### Examination Scheme:

Theory: 100 marks

Term work: 25 marks

Course Learning Objectives:

At the end of course, the students will

1. Understand importance of maintenance of environmental systems
2. Understand water treatment process control, water distribution system, quantity and quality monitoring.
3. Study operation & maintenance of wastewater treatment facilities
4. Understand operation & maintenance air pollution control devices.

### SECTION - I

#### Unit 1 (6)

Introduction: Need of O and M, Basic principles, corrective and preventive maintenance  
Data: detailed plans, drawings, operation manuals, computer usage in O and M.

#### Unit 2 (7)

O & M of water supply: Intakes, pumps, transmission pipes, water treatment process control, Quantity and quality monitoring.

#### Unit 3 (7)

Water distribution system: loss of carrying capacity of pipes, pipe breaks and leakages, leak detection, record keeping, O and M of Appurtenances, Use of network models in O and M.

### SECTION - II

#### Unit 4 (8)

O & M of wastewater facilities: Sewerage system, Inspection methods, Manual and television, Cleaning and rehabilitation, Safety in sewer inspection, O and M of wastewater treatment plant, Monitoring and operational problems, Corrective measures.

#### Unit 5 (7)

Air pollution control facilities: Regular inspection of devices, SPM control equipment, Gravity settlers, Cyclone separators, Bag filters, Scrubbers, Electrostatic precipitator, Gaseous control devices, incinerators and their trouble shooting.

#### Unit 6 (4)

O and M planning: Organizational structure, work planning, preparation and scheduling, cost estimates.

#### Term work:

- a) Assignments based on above units/facilities.
- b) Visit to Treatment plants, industries & preparation of report.
- c) Case study of Water / Waste water Treatment plant
- d) Study of organizational structure of O & M in Municipal Corporation.

**References:**

1. CPHEEO manual on water supply and treatment
2. CPHEEO manual on sewerage and sewage treatment
3. Industrial air pollution control systems – Neumann
4. O & M of Water treatment plant –Charles R Cox

SHIVAJI UNIVERSITY  
B.E. (Environmental Engineering) Part II, Semester-VIII (Revised)

**5. ELECTIVE – II**

**5. OCCUPATIONAL HEALTH & SAFETY ASSESSMENT SERIES**

**Teaching Scheme**

Lectures: 3 Hrs / Week

Tutorial: 1 Hr / Week

**Examination Scheme**

Theory: 100 Marks

Term Work: 25 Marks

Course Learning Objectives:

At the end of course, the students will

1. Study significance OHSAS 18001 in industrial environment in accordance with the safety at the workplace.
2. Understand OHSAS procedure & documentation.
3. Study Performance Measurement and Investigative/Root Cause Analysis Reports.
4. Understand OH&S-MS Audit Procedure and Supporting Documentation.

**SECTION - I**

**Unit 1**

**(4)**

Introduction to Occupational Health & Safety Management Systems, OHSAS 18001, Occupational Health and Safety Policy, Planning, Hazard Identification, Risk Assessment and Risk Control, Initial Hazard Analysis Strategy, Hazard Analysis Strategy, Legal and Other Requirements, Health and Safety Regulatory and Other Requirements, Objectives and OH&S Management Programs

**Unit 2**

**(8)**

Implementation, Structure and Responsibility, Organizational Chart Showing Key OH&S-MS Personnel, Training, Awareness, and Competence, Training Needs Analysis, Overall Analysis of Regulatory Applicability, Procedure, Consultation and Communication, Communications Procedure, OH&S Management System Documentation, OH&S-MS Manual, List of OH&S-MS Procedures, List of Key OH&S-MS Documents and Records, Control of Documents and Data, Document Control, Document Control Procedure for External Documents, New Documents, Document Revisions, Deletion of Documents

**Unit 3**

**(8)**

Records and Record Management, Health and Safety Records Retention Matrix, Record Control Procedure, Operational Control, Management of Change Procedure, Operational Control Procedures, Management of Change: Process Modification Request, Emergency Preparedness and Response, Emergency Contact Manual, Incident and Emergency Situation Review: Working Summary Table, Accident and Emergency Situation Prevention and Mitigation Matrix, Incident Report Form



## SECTION - II

### **Unit 4** **(8)**

Corrective Action, Performance Measurement and Monitoring, Regulatory Compliance Calendar, OH&S-MS Objective and Target Review Procedure, Calibration Procedures, Monitoring and Measurement, Accidents, Incidents, Nonconformance, Corrective and Preventive Action, Investigative/Root Cause Analysis Reports, Corrective Action Report Form, Root Cause Analysis Documentation Form

### **Unit 5** **(8)**

OH&S-MS Audit, OH&S-MS Audit Procedure, OH&S-MS Audit Schedule, Production Area Interview Checklist, OH&S-MS Audit Report and Supporting Documentation

### **Unit 6** **(4)**

Management Review, Management Review Procedure, Management Review Agenda and Minutes Record, Management Review Presentation, Certification

#### **Term Work:**

A journal consisting of at least one assignment on each unit and one case study of large industrial unit

#### **Reference Book:**

Manual of OHSAS 18001

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**6. PROJECT**

**Teaching Scheme**

Practical: 4 Hrs / Week

**Examination Scheme**

Term Work: 75 Marks

Oral Exam : 50 Marks

The project decided in B.E. Part I will be continued in B.E. Part II for further study.

It may include

- Additional data collection
- Field visits
- Laboratory Analysis
- Computer Programming & modeling, if necessary

The submission of completed work in the form of a hard copy and soft copy per project group to the department and self copy for each project group member.

**SHIVAJI UNIVERSITY**  
**Board Of Studies in Environmental Engineering**

Subject Equivalence in Proposed Revised Structure implemented from 2016-17

<b>B.E. ( Environmental Engineering) Part-I</b>	
Air Pollution – II	Air Pollution & Control at BE – I
Industrial Waste Treatment	Industrial Waste Management at BE – II
Advanced Water & Wastewater Treatment	Advanced Water and Wastewater Treatment at BE – I
Environmental Impact Assessment	Environmental Impact Assessment & Legislation at BE - I
Elective –I	Elective I at BE – I
<b>B.E. ( Environmental Engineering) Part-II</b>	
Environmental Management System	Environmental Management Systems at BE - II
Environmental Policy & Legislation	Design of Structure – II at BE – II
Industrial Health & Safety	Industrial Health and Safety at BE – II
Hazardous Waste Management	Operation & Maintenance of Environmental Systems (EI – II)
Elective – II	Elective II at BE – II