



Shivaji University, Kolhapur  
**Department of Technology**  
**FINAL YEAR B.TECH**  
**Environmental Science & Technology**  
**Syllabus w.e.f. 2014-15**  
**Curriculum Structure**  
**Semester – VII**

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	EN 411	Air Pollution and Air Quality Management	4	-	-	4
2	EN 412	Industrial Waste Treatment	3	1	-	4
3	EN 413	Environmental Legislation and policy	3	-	-	3
4	EN 414	Quantity Surveying and Valuation	3	1	-	4
5		Elective-I	3	-	-	3
6	EN 415	Major Project (Phase-I)	-	-	2	2
7	EN 416	Laboratory- I Air Pollution and Air Quality Management	-	-	2	1
8	EN 417	Laboratory- II Industrial Waste Treatment	-	-	2	1
9	EN 418	Laboratory- III Quantity Surveying and Valuation	-	-	2	1
10	EN 419	Industrial Training Report	-	-	-	1
11	AC 414	Audit Course IV Professional Ethics	2	-	-	-
		<b>Total</b>	18	2	8	24
Total Contact hours per week = 28						

**Semester –VIII**

Sr. No.	Subject Code	Subject Title	Contact hours			Credits
			L	T	P	
1	EN 421	Advanced Water and Wastewater Treatment	3	1	-	4
2	EN 422	Project Management Appraisal	3	-	-	3
3	EN 423	Environmental Biotechnology and Bioinformatics	3	1	-	4
4		Elective II	3	-	-	3
5		Elective III - Open Elective (Interdisciplinary)	3	-	-	3
6	EN 424	Major Project (Phase-II)	-	-	4	4
7	EN 425	Laboratory- I Advance Wastewater Treatment	-	-	2	1
8	EN 426	Laboratory- II Environmental Biotechnology and Bioinformatics	-	-	2	1
10	EN 427	Laboratory- III Elective-II	-	-	2	1
11	AC 425	Audit Course V Constitution of India	2	-	-	-
		<b>Total</b>	17	2	10	24
Total Contact hours per week = 29						

Students are expected to do self study for two hours as per the guidance given by the project guide hence contact hours to be taken as two for the calculation of contact hours.

**Note:** Tutorials and practical shall be conducted in batches with batch strength not exceeding 18 students.

**List of Electives for B. Tech**

**ELECTIVE-I**

1. Numerical methods and Environmental statistics
2. Optimization Techniques
3. Environmental Toxicology
4. Environmental Impact Assessment

**ELECTIVE-II**

1. Operation And Maintenances Of Environmental Facilities
2. Noise Pollution and Control
3. Disaster Management And Risk Assessment
4. Environmental Modelling and Simulation

**ELECTIVE-III**

1. Remote Sensing and GIS Applications
2. Finite Element Method
3. Energy Efficient and Cost- Effective Building Technologies
4. Watershed Management



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**EN 411 Air Pollution and Air Quality Management**

**Teaching Scheme: L: 4 hrs/week**

**Credits: 4**

**UNIT 1 The structure of atmosphere**

**6 hrs**

Definition and scope of Air Pollution, scales of Air Pollution, sources of Air Pollution Natural and Artificial, Units of measurement, Quantity and composition of gaseous and particulate pollutions, automobile exhaust quantity, composition and control measures.

**UNIT 2 Effects of pollutions**

**6 hrs**

Effects of pollutions on man, animals, plant and materials, aesthetic value and visibility, Air, pollution episodes, Air quantity, criteria and Air Quality standards, Ambient Air Quality standards and emission standards.

**UNIT 3 Meteorology of air pollution**

**7 hrs**

solar radiation, climate, humidity, wind circulation, Lapse rate and inversion phenomena vertical stability of atmosphere, precipitation, wind patterns, direction, velocity and fluctuations, wind Rose diagrams, Dispersion of pollutants in atmosphere by Eddy diffusion model and Gaussian dispersion model, point sources, line sources, plume behaviour, Maximum Ground line concentration Determination of stack height, sampling time corrections, Effect of inversion trap.

**UNIT 4 Particulate matter and Control of Gaseous pollutants**

**7 hrs**

Definitions of different particulate matters, distribution and sources of SPM. Terminal setting velocity Hood and Duct Design, particulate collection mechanisms, Control equipments for particulate matter, setting chambers, cyclones wet collectors, fabric filters, Electrostatic precipitators, problems on design of equipments, component detailing, collection efficiency, General control of Gaseous pollutants, principles of absorption and adsorption. Basic design of absorption and adsorption unit. Incineration and after burners, control of sulphur dioxides, Nox.

**UNIT 5 Air pollution monitoring, regulatory control and Automobile sources**

**7 hrs**

Emission limits, ambient air sampling, sampling equipment for stack and ambient air sampling, methods of sampling, pollution monitoring of existing sources and new installations. Emission of pollutants from automobiles, reduction of emissions by different methods, Alternative fuels and their utilization.

**UNIT 6 Air quality management and Status in India**

**6 hrs**

Air Quality Standards , Air Quality Monitoring, Preventive Measures , Air pollution control efforts, Zoning, town planning regulation of new industries ,Legalisation and enforcement , environmental impact assessment and air quality, Air pollution control Act and strategy for effective control of air pollution.

**Reference Books**

1. Work and Warner, “Air Pollution”
2. Martin Crawford, “Air Pollution
3. Stern Vol. I, II, III, IV, V – “Air Pollution”
4. R.D. Ross., “Air Pollution and Industries
5. Rao and Rao., “Air Pollution”



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**Final Year B. Tech (Environmental Science & Technology) (Semester VII)**

**EN 412 Industrial Waste Treatment**

**Teaching Scheme: L: 3 hrs/week  
T: 1 hrs/week**

**Credits: 4**

**UNIT 1 Use of Water in industry**

**6 hrs**

Sources of Waste water, Quality and Quantity variations in waste discharge, Water budgeting, Characterization and monitoring of Waste water flow, Stream standards and Effluent standards.

**UNIT 2 Waste volume and strength reduction**

**6 hrs**

Inplant control measures, good housekeeping, Process Change, Leakage prevention, Segregation and Recycling

**UNIT 3 Treatment techniques for removal of specific pollutants in industrial Wastewaters 6 hrs**

Oil and Grease, Cyanide, Fluoride, Calcium, Magnesium, Toxic Organics, Heavy Metals, Radioactive

**UNIT 4 Treatability aspects and Biological treatments for Toxic waste**

**5 hrs**

Treatability aspects of raw industrial wastewater with domestic sewage, partially treated industrial wastewater with domestic sewage, completely treated industrial wastewater with domestic sewage, Waste minimization, 3R concept. Acclimatization of bacteria to Toxic waste, Process sensitivity

**UNIT 5 Major industrial Waste water sources, process, Treatment**

**10 hrs**

Water requirements, Waste water sources, Characterization & composition of wastes, Manufacturing process & flow sheet and Treatment flow sheet in Major industries such as Sugar, Distillery, Dairy, Textile, Paper & Pulp. Fertilizer, Petroleum, Refinery, Pharmaceuticals, tannery, Steel, Foundry, Plating etc.

**UNIT 6 Common Effluent Treatment Plant**

**6 hrs**

Concept, Objectives, Methodology, Cost benefit analysis, Design, concept, Operation and Maintenance, Grouping of Industries

**Reference Books**

1. Nelson Nemerow, "Theories and Practices of Industrial waste treatment "
2. M.N.Rao & Datta "Waste water treatment"
3. IS Standard guide for treatment and disposal of various industries



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**Final Year B. Tech (Environmental Science & Technology) (Semester VII)**

**EN 413 ENVIRONMENTAL LEGISLATION & POLICY**

**Teaching Scheme: L: 3 hrs/week**

**Credit: 3**

**UNIT 1 Introduction**

**8 hrs**

Need and Necessity, Basic information, Various five year plans and the provision for environment in these plans, Various environmental policies like National water policy, sustainable developmental policy, National forest policy, other policies related to environment

**UNIT 2 Environmental Legislation**

**8 hrs**

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 3 Biomedical and Hazardous Waste Rules**

**6 hrs**

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 4 Functions and powers of ministry of Environment and forest and pollution control Boards in centre and state**

**4 hrs**

Energy Bureau of India, energy audit, Environmental audit, National River action Plan, National Lake action Plan

**UNIT 5 Environmental economics**

**8 hrs**

Case studies of various landmark judgments in Environmental field, Critical Evaluation of current environmental Risk Policy, Environmental Management plans at centre and state. Environmental Economics, Basic concepts in economics, GDP, GNP, GEP, Green rating of industries, cost benefit analysis of environmental management

**UNIT 6 Environmental Ethics**

**5 hrs**

Ethics in society, Environmental consequences, Responsibility of environmental degradation, Ethical theories and codes of ethics, changing attitudes, Environmental Education, Role of NGO's in Environmental planning and education.

**REFERENCE BOOKS**

- 1) Environmental Planning and Management in India - Saxena
- 2) All Environmental Legislations, amendments, rules Published by Ministry of Environment and Forest, Govt of India
- 3) Handbook of Environmental Law, Acts, Guidelines, Compliances and Standards Vol. I, II - Trivedi R.K.
- 4) Environmental Law - Kaur Gurkbal
- 5) Environmental Law - Jaswal P.S.

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- 6) Environmental Law - Tripathi S.C.
- 7) Environmental Law - Tiwari H.N.
- 8) Environmental Law Case book - Leelakrishnan P.
- 9) Environmental Law in India - Upadhye J.J.R.
- 10) Introduction to Environmental Law - Shantakumar S.
- 11) International environmental Law - Lakshman
- 12) Environmental Education - Pande V.C.
- 13) Environmental Education in India - AIU
- 14) Environmental Economics - Kolstad C.D.
- 15) Environmental Economics - Sankar Ulganathan
- 16) Environmental Management - Agarwal S.K.
- 17) Environmental Management Handbook - Wall J.D.
- 18) Environmental Management - Uberoi N.K.
- 19) Introduction to Environmental Management - Nag Choudhary BD
- 20) Handbook of Environmental Management & Technology - Burke, Singh BR
- 21) Handbook Environmental Management & Technology - Holmes, Singh
- 22) Environmental Policies in India – Singh Shekhar



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**Final Year B. Tech (Environmental Science & Technology) (Semester VII)**

**EN 414 Quantity Surveying & Valuation**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 4**

**T: 1 hrs/week**

**UNIT 1**

**7 hrs**

General Introduction to Quantity surveying, purpose of estimates types of estimates, various items to be included in estimate. Principles in selecting units of measurement for different trades. Administrative approval and Technical sanction to estimates, I S 1200.

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

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

**UNIT 2**

**7 hrs**

Prime cost, Provisional sums and provisional quantities, taking out Quantities. P. W. D. method, Measurement and Abstract sheets and Recording. M. E. S. Method: Dimensioning, abstracting, bills of quantities use of Performa

Analysis of Rates: Factors affecting the cost. Materials, Labour, task work schedule as basis of labour cost, plants and equipment, hour costs based on total costs and output. Transports, 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 3**

**6 hrs**

Estimate of residential building; Estimate of basic items of buildings.

Detailed estimates of water supply scheme: Estimate of intake works, estimates of water supply line and ESR. Detailed estimate of water treatment plant and distribution system.

Estimate of sewerage system and sewage treatment plant: Detailed estimate of various components like sewerage line, various appurtenances like manholes, flushing systems.

Detailed estimate of sewage treatment plant

Estimate of mechanical equipments and accessories e) Estimates of various electrical equipments. Use of various software for estimating

Approximate Estimates: Purpose, various methods used for building and other Civil Engg. works like Bridge, water supply, Drainage, irrigation and Road projects.

**UNIT 4**

**6 hrs**

Contracts: Essentials of legally valid contract, Appointment and Authority of Agents for Execution contract between government and contract for various water supply and sewage projects. Competitive bidding contracts: Item rate, percentage Rate, Lump sum,



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. Negotiated contracts: Cost plus percentage, cost plus fixed fees, cost plus sliding scale of fees, target costs as based on sharing risks and profits, Turnkey contracts.

**UNIT 5**

**6 hrs**

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. 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 6**

**7 hrs**

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

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

Cost benefit analysis for various water supply and sewage systems

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

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.

**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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**NUMERICAL METHODS AND ENVIRONMENTAL STATISTICS**

**Teaching Scheme: L: 3 hrs/week**

**Credit:3**

<b>UNIT 1 Error and Its Propagation</b>	<b>6 hrs</b>
Solving non-linear equations; Interpolation	
<b>UNIT 2 Solution of simultaneous linear and non-linear equations</b>	<b>6 hrs</b>
Direct and iterative methods.	
<b>UNIT 3 Numerical Differentiation And Numerical Integration</b>	<b>7 hrs</b>
Numerical solution of ordinary differential equations, systems of ODEs, Runge-Kutta method.	
<b>UNIT 4 Classification of partial differential equations</b>	<b>7 hrs</b>
Solution of PDEs, finite difference techniques, implicit and explicit methods, stability, converges of the solution, Finite element method.	
<b>UNIT 5 Statistics</b>	<b>6 hrs</b>
Statistical concepts, Curve fitting least squares, linear and non-linear regression, linear correlation, Multiple regression.	
<b>UNIT 6 Probability:</b>	<b>7 hrs</b>
Frequency distribution, Characteristics of distributions, Central tendency and dispersion, Concepts of probability. The Chi-squared test, F-test, t-test. Analysis of variance, Tolerance and control charts	

**REFERENCE BOOKS**

1. Chapra “Numerical methods”
2. Taha “Operation research”



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**OPTIMIZATION TECHNIQUES**

Teaching Scheme: L: 3 hrs/week

Credit: 3

**UNIT 1 Introduction**

7 hrs

Optimization problem statement, Classification of optimization problems. Classical optimization theory: Unconstrained optimization, Method of Lagrange multipliers, Kuhn-Tucker conditions

**UNIT 2 Linear programming**

7 hrs

Construction of LP model, Graphical method, Simplex method, Big M, Duality, Sensitivity analysis.

**UNIT 3 Transportation problems**

6 hrs

Assignment problems Decision theory, decision tree,

**UNIT 4 Inventory models**

7 hrs

Deterministic models probabilistic model. Game theory Queuing theory, simulation applications

**UNIT 5 Dynamic programming**

6 hrs

Principle of optimality, Computational procedure in DP, DP applications.

**UNIT 6 Introduction to Non-linear programming**

6 hrs

Introduction to Genetic algorithm, simulated annealing, Neural network and fuzzy systems. Applications of optimization techniques to Environmental systems

**REFERENCE BOOKS:**

1. S. S. Rao "Engineering optimization"
2. Taha "Operation research"
3. Goldberg "Genetic algorithm"



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**Final Year B. Tech (Environmental Science & Technology) (Semester VII)**

**ENVIRONMENTAL TOXICOLOGY**

**Teaching Scheme: L: 3 hrs/week**

**Credit: 3**

**UNIT 1 Toxic chemicals in the environment**

**10 hrs**

Air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.

**UNIT 2 Mode of entry of toxic substance**

**10 hrs**

biotransformation of xenobiotics detoxification, Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.

**UNIT 3 Concept of major, trace and Rare Earth Element**

**10 hrs**

Insecticides, MIC effects. Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements

**UNIT 4 Biogeochemical factors in environmental health**

**9 hrs**

Biogeochemical factors in environmental health,. Epidemiological issues goiter, fluorosis, arsenic poisoning.

**REFERENCE BOOKS -**

1. Sodhi “Environmental chemistry”
2. Manhan “Principals of Environmental chemistry”
3. R.B. Philip “Environmental hazards & human health”
4. Niesink & Jon devries “Toxicology - principles & applications”
5. Chatterjee “Parasitology” Perk “ Preventive & Social medicines”



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**Final Year B. Tech (Environmental Science & Technology) (Semester VI)**

**ENVIRONMENTAL IMPACT ASSESSMENT**

**Teaching Scheme: L: 3 hrs/week**

**Credit: 3**

**UNIT 1 Introduction**

**4 hrs**

concept of EIA , necessity of EIA , objectives of EIA , Legal provisions for EIA in India, History of EIA , NEPA & it's implementation , CEQ guidelines , Role of USEPA

**UNIT 2 Components of EIA studies**

**7 hrs**

Types of impacts, planning & management of EIA studies, 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 Impact on air environment**

**7 hrs**

Basic information , effects , conceptual approach , identification of impacts , description of existing air quality conditions , emission inventory , meteorological data necessary , impact prediction , man balance Approach , box model approach , air quality dispersion modeling , assessment of impact , various mitigation measures Noise environment: basic information, regulations, conceptual approach, identification, existing noise condition.

**UNIT 4 Impact of water quality**

**7 hrs**

Basic information of surface water quality & quantity , various regulation , conceptual approach , of impacts , population equivalent , description of existing conditions , impact prediction, man balance approach , mathematical modeling approach , aquatic ecosystem modeling approach, assessment of impact significance, neighbors measures, Impact on soil & groundwater: background information, various regulations, conceptual approach, identification of impacts, existing soil & groundwater environment, impact prediction.

**UNIT 5 Impacts on biological environment. Socioeconomic environment**

**7 hrs**

Background information, Existing condition

**UNIT 6 Public participation in EIA**

**7 hrs**

Basic definition, legal requirement, advantages & disadvantages, procedure of public hearing in India. Environmental site appraisal: Necessity, legal provisions for site appraisal in India, EPA guidelines, Studies involved in site appraisal. Documentation and Reporting of EIA studies,

Environmental Impact Statement, post monitoring of EIA, post impact assessment, Concept of carbon foot prints due to industry.

**REFERENCE BOOKS -**

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



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**Final Year B. Tech (Environmental Science & Technology) (Semester VII)**

**EN 415 MAJOR PROJECT (Phase-I)**

**Teaching Scheme: P: 2hrs/week**

**Credit: 2**

**Project Topics**

Project Topics should preferably be design, development, design aid type and interdisciplinary. The project should aim at training the students in going through all important phases of project studies starting from establishing the need through collection of data, analysis, design, development, drawing, cost estimates and project reports, where appropriate some alternatives which meet the same needs should also be considered and evaluated using appropriate evaluation criteria.

**Methodology for Project Evaluation**

During the First Stage of the Project Students would identify a project in a area related with engineering and carryout the necessary literature review. Based on the literature review during first stage of the project student would write a report which would give a review of literature, problem formulation and methodology to be adopted. The report would be presented through a seminar which would be evaluated

at the end of the term by the panel of internal and external examiners.

The Work may consist of the following points:

1. Problem Formulation
2. Survey of Literature
3. Experimental investigation/ Data collection
4. Design and Fabrication of Model
5. Industrial Assignment

**Note:**

Seminar Report for Phase-I would cover Literature Review, Project Formulation and Time Scaled Schedule for Phase-II of the Project Work. Seminar would be evaluated by the panel of examiners. Preferably same panel of examiners will be maintained during second stage evaluation. Project group will consist of not more than six with minimum three students in a group.



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**EN 416 Laboratory-I (AIR POLLUTION AND AIR QUALITY MANAGEMENT)**

**Teaching Scheme: P: 2 hrs/week**

**Credit: 1**

**PRACTICALS**

**Assignments shall consist of following:**

1. Problems on air pollution.
2. Problems on air pollution control equipments design and collection efficiency.
3. Sampling and Analysis of Ambient Air.
4. Sampling and Analysis of stack or automobile exhaust.



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**EN 417 Laboratory-II (INDUSTRIAL WASTE TREATMENT)**

**Teaching Scheme: P: 2 hrs/week**

**Credit: 1**

**Assignments shall consist of following:**

1. Experiments based on the effluent characterization (Physical, chemical and biological analysis)
2. Visit reports to respective industries under curriculum





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**EN 418 Laboratory-III (Quantity Surveying and Valuation)**

**Teaching Scheme: P: 2hrs/week**

**Credit: 1**

**PRACTICALS**

I – 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.

II – Reports:

- a) Detailed Estimate of a water treatment plant or sewage treatment plant.
- b) Preparing detailed estimate for any one of the following-
  1. Water supply line
  2. Sewerage line
  3. A small culvert
  4. A stretch of road about 1 km long including earthwork
  5. A reach of canal about 1 km long
  6. A percolation tank
- c) Valuation Report for any two of the following-
  1. Water supply/ sewage treatment plant.
  2. Water resource project

The report must include a 'Valuation Certificate' also.



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**EN 419 Industrial Training**

**Teaching Scheme:**

**Credit: 1**

Evaluation of the report on industrial training submitted by the students



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**AUDIT COURSE IV**

**AC 414 PROFESSIONAL ETHICS**

Teaching Scheme	No Credits
<b>Lectures:</b> 2 hours/week	
<b>UNIT 1</b>	<b>3 hrs</b>
Engineering Ethics – Moral Issues, Ethical theories and their uses	
<b>UNIT 2</b>	<b>3 hrs</b>
Engineering as Experimentation – Code of Ethics	
<b>UNIT 3</b>	<b>3 hrs</b>
Engineer’s Responsibility for Safety	
<b>UNIT 4</b>	<b>3 hrs</b>
Responsibilities in Rights	
<b>UNIT 5</b>	<b>3 hrs</b>
Global issues of engineering ethic	
<b>UNIT 6</b>	<b>3 hrs</b>
Introduction to Entrepreneurship awareness and Development: Functions -why men become economic innovators –Various Assistance Programmes for Small Scale and large Scale Industries through agencies, like IDBI, IFC, ICICI, NSIC, SFC, SIDCO and DIC.	

**REFERENCE BOOKS:**

1. Agarwal A. N., “Indian Economy”, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Charles D. Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, 1999.
3. Datta R. and Sundharam, “Indian Economy”, K. P. M., S. Chand & Co. Ltd., New Delhi
4. Seth, M. L., “Principles of Economics”, Lakshmi Narain Agarwal, Agra.



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Final Year B. Tech (Environmental Science & Technology) (Semester VIII)

**EN 421 ADVANCED WATER & WASTEWATER TREATMENT**

Teaching Scheme: L: 3 hrs/week  
T : 1 hrs/week

Credits: 4

**UNIT 1 Need for advanced water and wastewater treatment** **7 hrs**

Solids separation: Types of settling, hindered and zone, settling.

Filtration: design and operation of dual media filter, head loss calculation in depth filtration Water reclamation technologies

**UNIT 2 Ion exchange** **6 hrs**

Process, exchange materials, exchange capacity, ion exchange chemistry and reactions.

**UNIT 3 Membrane filtration** **7 hrs**

Terminology, Process classification, Membrane configurations, Membrane fouling and its control, Application of membranes. Electro dialysis: Theory, Disposal of concentrate waste streams.

**UNIT 4 Adsorption** **6 hrs**

Development of adsorption isotherms activated carbon adsorption kinetics, analysis and design of adsorption columns

**UNIT 5 Gas stripping, Nutrient removal, Wetland treatment systems** **7 hrs**

Analysis, design of stripping towers. Nitrogen and phosphorous removal.

Types, application, free water surface and subsurface constructed wetlands, Design procedure for FWS and SF constructed wetlands

**UNIT 6 Disinfection** **6 hrs**

Disinfection with ozone Chemistry, modelling UV disinfection: system components, modelling

**REFERENCE BOOKS**

1. Metcalf Eddy “Wastewater Engineering treatment and reuse”
2. Ronald Droste “Theory and Practice of water and Wastewater treatment”
3. Weber “Physico-chemical processes of water purification”
4. Soli Arceivala “Wastewater Treatment for Pollution Control”



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**EN 422 PROJECT MANAGEMENT APPRAISAL**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**UNIT 1 Introduction**

**6 hrs**

Principles of Management (by Henry Fayol)

Functions of Management:

- a) Planning – Nature, Process and Importance of Planning,
  - b) Organizing – Types, Organization Charts, Site Layout.
  - c) Staffing – Introduction
  - d) Directing, Co-Ordination, Communication, Motivation and Controlling.
- Decision Making- process; Decision Tree Liner Programming – Graphical Method, Introduction of Simplex Method, Transportation Problem and Assignment Problem, Sensitivity Analysis (Concept Only)

**UNIT 2 Project Management**

**7 hrs**

Objectives, Agencies, Phases; Work Breakdown Structure., Project Planning - Bar Chart, Mile Stone Chart, CPM, Development of CPM Network – Time Estimates, Floats, Critical Path. Network Compression, Resource Allocation, Network Updating

**UNIT 3 PERT**

**6 hrs**

Concept of Probability, Normal and Beta Distribution, Time Estimates, Slack, Probability of Project Completion, Precedence Network: Concept, Introduction to Work Study.

**UNIT 4 Engineering Economics**

**7 hrs**

- (a) Introduction, Importance.
- (b) Time Value of Money, Equivalence, Tangible and Intangible Factors, Economic Comparisons-
  - (a) Present worth Method, Equivalent Annual Cost Method, Capitalized Cost Method, Net Present Value, Rate of Return, Benefit Cost Ratio, Payback Method
  - (b) Linear Break Even Analysis.

**UNIT 5 Site Layout**

**6 hrs**

Factor Affecting, Typical Layout of few Major Construction Projects., Legal Aspects Child Labour Act., Workmen's Compensation Act, Minimum Wages Act.

**UNIT 6 Resource Management**

**7 hrs**

Material Management – Objectives, Functions, Inventory Control- Necessity, Techniques Such As ABC, EOQ Analysis, Safety Stocks, Queuing Theory

**Reference Books:**

1. Stoner “Engineering Management”
2. Davar “Principles of Management”
3. A.S. Deshpande “A Text book of Management”
4. Koontz, Dounell and Weigrick “Essentials of Management”
5. Kast and Rosinweig “Management and Organization” – Tata McGraw Hill publication.
6. S.H. Deshpande “Operation Research”
7. Operation Research – Wagner Wikey Easter Ltd., New Delhi
8. L.C. Zhamb “Quantitative Techniques in Management” Vol. I,
9. Gopal Krishnan, Sdueshan “Material Management”
10. Miller and Stars “Executive Decisions & Operation Research”, Prentice Hall of India, Publisher.
11. Roy Pilcher “Principles of Construction Management”



Shivaji University, Kolhapur  
**Department of Technology**

**Final Year B. Tech (Environmental Science & Technology) (Semester VII)**

**EN 423 Environmental Biotechnology and Bioinformatics**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 4**

**T: 1 hrs/week**

**UNIT 1 Introduction to Biotechnology**

**7 hrs**

Concept of Environmental biotechnology, public perception of biotechnology, Role of biotechnology in Environmental Engineering

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 2 Problems of Environmental Pollution, biological treatment and bioremediation**

**6 hrs**

Sewage and Industrial wastewater, gaseous emissions, solid and semi solid wastes from residences as well as industries, problems associated with their disposals  
Aerobic v/s anaerobic degradation, Kinetics of Aerobic and Anaerobic biodegradation, Concept of bio remediation, various micro organisms involved, bioremediation processes and technologies

**UNIT 3 Biological calcification and bio absorption**

**6 hrs**

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

**UNIT4 Introduction: Biology in the computer age**

**8 hrs**

Computing changes in biology, Bioinformatics just about building database, Meaning of informatics to biologists, challenges offered by biology to computer scientists, skills required for this field, Available information & software for this domain, use web information, understand sequence alignment data, writing programs to align two biological sequences, predict protein structure from sequence, questions bioinformatics can answer, Watson's Definition, Information Flow, Human Genome project.

**UNIT 5 Tools for Bioinformatics**

**6 hrs**

Biological Research on the web, Using search engines, finding scientific articles. Public biological databases, Searching biological databases, Depositing data into the public databases, finding software Judging the quality of information.

**UNIT 6 Sequence Analysis, Pair-wise alignment& Database searching**

**6 hrs**

Chemical composition of bio-molecules, Composition of DNA & RNA, Watson & Crick Solve structure of DNA, Development of DNA sequencing methods, Gene finders & feature detection in DNA, DNA translation, Pair wise sequence comparison, Sequence queries against biological databases, Multifunctional tools for sequence analysis.

**References Books:**

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
9. Cynthia Gibas & Per Jambeck, “*Developing Bio-informatics computer skills*”, (O'REILLY)
10. T K Attwood D J Parry-Smith, “*Introduction to Bioinformatics*”, (Pearson Education )
11. Bryan Bergeron M.D. , “*Bioinformatics Computing*”, (Prentice-Hall of India)





Shivaji University, Kolhapur  
**Department of Technology**

**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**OPERATION & MAINTENANCE OF ENVIRONMENTAL FACILITIES**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**UNIT 1 Introduction**

**6 hrs**

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 O & M of water supply**

**6 hrs**

Intakes, pumps, transmission pipes, water treatment process control Quantity and quality monitoring.

**UNIT 3 Water distribution system**

**7 hrs**

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

**UNIT 4 O & M of wastewater facilities**

**7 hrs**

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 Air pollution control facilities**

**7 hrs**

Regular inspection of device, SPM control equipment, Gravity settlers, Cyclone separators, Bag filters, Scrubbers, Electrostatic precipitator, Gaseous control Devices, incinerators and their trouble shooting.

**UNIT 6 O and M planning**

**6 hrs**

Organizational structure, work planning, preparation and scheduling, cost estimates.

**Reference Books:**

1. CPHEEO manual on water supply and treatment
2. CPHEEO manual on sewerage and sewage treatment
3. Neumann "Industrial air pollution control systems"



Shivaji University, Kolhapur  
**Department of Technology**

**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**NOISE POLLUTION & CONTROL**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**UNIT 1 Introduction to Noise pollution**

**8 hrs**

The menace of noise pollution in India, Engineering definition of noise and sound, Mechanization of hearing, hearing principle, Noise characteristics, decibel levels, sound pressure, power, intensity, frequency band analysis, measurement of noise.

**UNIT 2 Noise survey and noise monitoring**

**5 hrs**

Noise propagation and transmission, noise survey and noise monitoring, environmental monitoring, health monitoring

**UNIT3 Sources of noise**

**5 hrs**

Neighbourhood noise, traffic noise, occupational noise, community noise, common noise levels and permissible noise levels

**UNIT 4 Effects of noise**

**6 hrs**

Effects of noise, effects on health, effects on wild life, effects on plants, hazards of noise physiological and psychological hazards

**UNIT 5 Industrial noise and Legal aspects**

**7 hrs**

Types, sources, frequency, distribution, characteristics / range of industrial noise generated in various industrial operations, measurement of industrial noise. Legislation in India and other countries, Case studies in India and abroad.

**UNIT 6 Engineering control of community noise**

**8 hrs**

Basic control approach, regulatory control, simplified estimation procedures. Types, isolation, suppression, shielding, noise measuring equipments, sound level meter, octave band analyzer, magnetic tape recorder, and audiometer.

Methods of reducing industrial noise: location, lay out, source, enclosure, barrier, acoustical absorbance devices

**REFERENCE BOOKS:**

1. Handbook of Environmental management and technology by Gwendolyn Holmes, Ben Ramnasiue singh and Louis Theodore ( A Wiley – Enter science publication)
2. Standard Hand book of Environmental Engineering by Robert A. Corbett (McGraw Hill Inc.)
3. Industrial Pollution by N. Irving Sax (Van Nostrand Reinhold Company)
4. Environmental issues and programme by I. Mohan (Ashish publishing house)
5. Environmental Engineering by G.N.Pandey and G.C. Carney ( Tata McGraw Hill)

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6. Some thought on Environmental and law by C.S. Mehta (RBSA Publisher)
7. Environmental health criteria 12: NOISE, WHO & ONEP Publication.
8. IS code for practice for noise reduction in industrial buildings IS: 3483, 1965
9. Noise Pollution – S.K.Agrawal- APH Publishing corporation, New Delhi.
10. Soil & Noise pollution: Dr B.K.Sharma & Dr. H.Kaur, Goel Publishing House, Krishana Prakashan mandir, Meerut.



Shivaji University, Kolhapur  
**Department of Technology**

**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**DISASTER MANGEMENT& RISK ANALYSIS**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**UNIT 1 Disaster**

**5 hrs**

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

**UNIT 2 Natural disasters**

**8 hrs**

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 Disaster Management**

**8 hrs**

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

**UNIT 4 Manmade Disasters**

**6 hrs**

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

**UNIT 5 Disaster Management for Manmade Disaster**

**6 hrs**

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 Risk Analysis for Environmental Disasters**

**6 hrs**

Dose- Response Relationship, Control of Environmental Risk, Case studies

**REFERENCE BOOKS**

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



Shivaji University, Kolhapur  
**Department of Technology**

**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**ENVIRONMENTAL MODELLING & SIMULATION**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**UNIT 1 Fundamentals**

**5 hrs**

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 Mathematical model of physical systems**

**6 hrs**

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

**UNIT 3 Modelling Water quality in Environment**

**6 hrs**

Transport phenomena, Advection, diffusion, dispersion, Dispersion and mixing in streams, Air/water interface, Gas transfer (agitated and stagnant), pH modelling

**UNIT 4 Surface water quality modelling**

**7 hrs**

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

**UNIT 5 Water quality of lakes & reservoirs**

**7 hrs**

Hydraulic behaviour, Effect of physical processes on Water quality, Modelling of lakes & reservoirs, 1D model, Vertical modelling, Ecological modelling, Significance, Eutrophication in flowing water

**UNIT 6 Subsurface water quality modelling, Microbe / Substrate modelling**

**8 hrs**

Transport of non reactive & reactive contaminant in Ground water, Gaussian plume model  
Toxics substance model in CSTR, Bio-concentration and Bioaccumulation model.  
Bacteria growth, substrate utilization, Microbial kinetics, batch and CSTR, toxicant modelling in flowing water.

**REFERENCE BOOKS**

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



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**REMOTE SENSING AND GIS APPLICATIONS**

**UNIT 1**

**6 hrs**

**Introduction – EMR Spectrum**

Energy – electromagnetic radiation, Radiation principles, Electromagnetic spectrum, Energy interaction with atmosphere, Atmospheric windows.

**UNIT 2**

**8 hrs**

**Energy Interactions**

Energy interaction with earth surface feature, Spectral vs Diffuse reflectance, Spectral signature of vegetation, water and soil, Ideal Remote Sensing, Real remote sensing, Multi-concept of remote sensing.

**UNIT 3**

**7 hrs**

**Sensor system**

Various types of platforms, Different types of sensors, Indian remote sensing systems, Data acquisition Photographic Remote Sensing, Digital images, Data products and interpretation – various data products characteristics, Principles of interpretation, Ground control points, Ground truth

**UNIT 4**

**6 hrs**

**Remote sensing characteristics**

Spatial, spectral, radiometric and temporal resolution, Thermal sensors, Signal Noise Ratio, Fundamentals of microwave remote sensing

**UNIT 5**

**8 hrs**

**Digital Image Processing**

Operations involved, Source of image acquisition, Data preprocessing – atmospheric, radiometric, geometric corrections.

**Image enhancement**

Histograms, Density slicing, Grey level mapping, Contrast stretching, Filtering, Principle component analysis, Basic pattern recognition concepts, Discrimination Functions

**UNIT 6 GIS**

**7 hrs**

Definition, functions of GIS, Types of data – spatial, non-spatial, point, line polygon, vector and raster database, Spatial databases, Coordinate systems and georeferencing,

Interpolation methods – Deterministic and Statistical, Strategies for development, implementation and management of GIS

**Reference Books**

1. Agarwal C.S. and Garg P.K. “Textbook on Remote Sensing in Natural Resources Monitoring and Management”, Wheeler Publishing, Allahabad.
2. Keith P.B. and Thompson et al. “Remote sensing and water resources management”, American Water Resources Association, Urbana Illinois
3. Lillesand T.M. and Kiefer R.W. “Remote sensing and Image interpretation”, John Wiley and Sons, New York.
4. Meijerink M.J., HAM de Brouwer, Mannaerts C.M. and Velenzuela C.R. “Introduction to the use of Geographical Information Systems for Practical hydrology”, ITC Publication No. 23, UNESCO, Paris
5. Sweain P.H. and Davis S.M. “Remote sensing – The quantitative approach”, McGraw Hill Publications, New York



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**INTRODUCTION TO FINITE ELEMENT ANALYSIS**

**UNIT 1**

**Basic Concep**

**5 hrs**

Introduction to finite element method. History, applications. Stress strain relationship, strain displacement relationship. Equilibrium equations (Minimum potential energy approach, virtual work approach), Basic bar element

**UNIT 2**

**One-dimensional Finite Elements**

**5 hrs**

Bar Element, Beam Element, Consistent nodal loads, Element displacement fields, Shape functions and interpolation polynomials

**UNIT 3**

**Two-dimensional Elements**

**6 hrs**

Equations from theory of Elasticity, Potential energy for the continuum, General finite-element formulation, Triangular elements, CST, LST elements, Rectangular elements.

**UNIT 4**

**Method of Weighted Residuals**

**6 hrs**

Method of Weighted Residuals, The Galerkin Finite Element, Element Formulation, Application of Galerkin's Method to Structural Elements, Bar Element, Beam Element.

**UNIT 5**

**Three-dimensional Analysis**

**8 hrs**

Tetrahedral elements, Constant strain tetrahedron Triangular Elements, Rectangular hexahedral Elements, Axisymmetric Elements, Isoparametric Formulation, Numerical Integration: Gaussian Quadrature

**UNIT 6**

**Applications in Solid Mechanics**

**6 hrs**

Plane-stress, Plane-Strain Formulation, Isoparametric formulation for Plane Quadrilateral Element, Axisymmetric stress Analysis, Strain and Stress Computation

**Reference Books**

1. Matrix and Finite Element Displacement Analysis of Structures, D. J. Dawe, Oxford Uni Press, 1984
2. Fundamentals of Finite Element Analysis, David Hutton, McGraw-Hill, 2004



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3. Concepts and Applications of Finite Element Analysis, Cook R.D. John Wiley, New York 1995
4. Finite Element Methods in Engineering, Belegundu A.D. And Chandrupatla T.R. Prentice hall India 1991
5. Finite Element Methods, Reddy J.N ,John Wiley and sons 1982. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications New York 1995



Shivaji University, Kolhapur  
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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**ENERGY EFFICIENT AND COST EFFECTIVE BUILDING**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**UNIT 1 Buildings and Environment**

**5 hrs**

Energy concepts in building materials and buildings, Global warming and environmental issues related to building materials, Passive and active energy systems, Buildings and climate, Cost effective vs. Energy efficiency in buildings.

**UNIT 2 Ferrocement, Ferro-concrete and Fibre reinforced composites**

**8 hrs**

Introduction, Materials, Construction methods, Durability, Mechanical properties, Applications, Design examples, Ferro-concrete, Applications, Design examples

Fibre reinforced cement composites : Materials, Mechanical properties of FRC, Analysis and behaviour, Applications

Fibre reinforced polymer composites : Materials, manufacturing Processes and Applications

**UNIT 3 Building blocks and Mortars for Masonry**

**8 hrs**

Introduction, Stone and Laterite blocks, Burnt clay bricks, Solid and Hollow concrete blocks, Terracotta blocks, Stabilized Mud blocks, Stone masonry blocks, Selection of building blocks.

Lime, Lime pozzolona and combination mortars for masonry, Raw materials, Process, Properties and Uses, Practical aspects

**UNIT 4 Introduction to design of load bearing structures**

**5 hrs**

Stresses in masonry under compression, Factors influencing compressive strength of masonry, Strength of masonry under compression, Bond strength in masonry, Elastic properties, Design of masonry under vertical gravity loads.

**UNIT 5 Alternative Roofing Systems**

**8 hrs**

Concepts in roofing alternatives, Thatch roofs, Filler slab roofs, Filler materials, Composite beam-panel roofs / floors, hollow hourdi/concrete block roofs / floors.

**Masonry Domes and Vaults:** Historical notes, Relevance of vaults and domes, Analysis and design of brick masonry domes, construction of masonry domes, design of brick masonry vaults, Construction of vaults, Problems of lateral thrust, Vaults and domes.

**UNIT 6 Concepts of Green Buildings**

**6 hrs**

Sustainability concepts, Forms of energy, Embodied and Life cycle energy, Energy Efficiency in Building materials. Building Materials from Agro and Industrial waste, Biomass resources, treated thatch, Industrial wastes, Use of industrial wastes, Active and Passive energy systems, Rain water harvesting, Cladding materials.

**Reference Books:**

1. “Alternative Building Materials and Technologies”, K.S.Jagadish, B.V.V.Reddy, K.S.Nanjuda Rao, New Age International Publishers
2. “Fibre reinforced Cement Composites”, P.N.Balaguru and S.P. Shah, McGraw Hill, Inc.
3. “Fibre cements and Fibre Concretes”, D. J.Hannant, John Wiley and Sons.
4. “Properties of Concrete”, A.M.Neville, ELBS, Longman.



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**WATERSHED MANAGEMENT**

**Teaching Scheme: L: 3 hrs/week**

**Credits: 3**

**UNIT 1 Introduction**

**6 hrs**

Place in environment, global effects, status in India, historical background

**UNIT 2 Watershed Concept**

**6 hrs**

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

**UNIT 3 Land & soil conservation**

**6 hrs**

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

**UNIT 4 Water conservation**

**7 hrs**

Investigation, data & analysis, surface water, utilization of wasted flows, Rainwater harvesting, groundwater, potential & harvesting, well construction, Integrated water resources management.

**UNIT 5 Role of greenery in wetland management**

**7 hrs**

Agriculture, sustainable agriculture, dryland agriculture, selection of water use efficiency, crops, irrigation, water losses, pasture and silvipastures, horticulture, tree culture, farm forestry, afforestation.

**UNIT 6 Socio economics and Appropriate technology**

**7 hrs**

peoples part, awareness, participation, state & integrated approach, sustainable society, role of NGOs, international agencies, future, economic viability. Farm equipment, contour methods, check dams, water catchments & harvesting, low cost technology, Rural technologies Model watershed, Government watershed, Government projects national projects, World Bank projects, ICRISAT, NGOs in water shed management.

**PRACTICAL**

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) J.V.S. Murthy, "Watershed management"
- 2) J.V.S. Murthy, "Watershed management in India"

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- 3) Ghansham Das, “Hydrology & Soil Conservation Engineering” Prentice Hall of India
- 4) R. Suresh, “ Soil & Water Conservation Engineering” Standard Publishers Distributors
- 5) Gurumal Singh, “Manual of Soil & Water Conservation Practices” Oxford & IBH Publishing Company



Shivaji University, Kolhapur  
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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**EN 424 MAJOR PROJECT (PHASE-II)**

**Teaching Scheme: P: 4 hrs/week**

**Credits: 4**

**Methodology of Evaluation**

During the Second Stage of the Project Students would present their project work completed based on the formulation they have presented during first stage. Based on the literature review and project work carried out during second stage of the project student would write a report which would give a review of literature, problem formulation and methodology adopted and the findings of the project work.

The project report would be presented through a seminar which would be evaluated by a panel of internal examiners. During evaluation of the project specific attention would be given to find out the contribution of each team member of the project team.



Shivaji University, Kolhapur  
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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**EN 425 Laboratory-I (Advanced Water and Wastewater Treatment)**

**Teaching Scheme: P: 2 hrs/week**

**Credits: 1**

Assignments shall consist of following:

1. Experiments based on the characterization of water and wastewater (Physical, chemical and biological analysis of water and wastewater)
2. Visit reports to WTP, STP and industrial ETPs.



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**EN 426 Laboratory-II (Environmental Biotechnology and Bioinformatics)**

**Teaching Scheme: P: 2 hrs/week**

**Credits: 1**

The journal consist of following:

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



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**EN427 Laboratory-III (Elective-II)**

**OPERATION & MAINTENANCE OF ENVIRONMENTAL FACILITIES**

**Teaching Scheme: P: 2 hrs/week**

**Credits: 1**

Journal shall consist of the following:

1. Assignments based on the information about various appurtenances used in water and wastewater treatment facilities.
2. Visit reports to various WTP, STP and ETPs.



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**EN427 Laboratory-III (Elective-II)**

**NOISE POLLUTION AND CONTROL**

**Teaching Scheme: P: 2 hrs/week**

**Credits: 1**

The Journals consist of:

1. Study of noise measuring equipments & their use.
2. Study of Noise pollution problems in following & it report
  - a) Industry.
  - b) Traffic.
  - c) Public places.

Assignments based on above theory.





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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**EN427 Laboratory-III (Elective-II)**

**DISASTER MANGEMENT& RISK ANALYSIS**

**Teaching Scheme: P: 2 hrs/week**

**Credits: 1**

A journal consisting of

- i) Assignments based on different mentioned units.
- ii) A visit report on any Major Risk Industry.



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**EN427 Laboratory-III (Elective-II)**

**ENVIRONMENTAL MODELLING AND SIMULATION**

**Teaching Scheme: P: 2 hrs/week**

**Credits: 1**

A journal consisting of

- i) Assignments based on modelling and simulations of various environmental entities.
- ii) A visit report to related industries or field institutions.



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**Final Year B. Tech (Environmental Science & Technology) (Semester VIII)**

**AUDIT COURSE V**

**AC 425 CONSTITUTION OF INDIA**

<b>Teaching Scheme: P: 2hrs/week</b>	<b>No Credits</b>
<b>UNIT 1</b>	<b>4 hrs</b>
Preamble to the constitution of India. Fundamental rights under Part – III – details of Exercise of rights, Limitations & Important cases.	
<b>UNIT 2</b>	<b>3 hrs</b>
Relevance of Directive principles of State Policy under Part – IV. Fundamental duties & their significance.	
<b>UNIT 3</b>	<b>3 hrs</b>
Union Executive – President, Prime Minister, Parliament & the Supreme Court of India.	
<b>UNIT 4</b>	<b>3 hrs</b>
State executive – Governors, Chief Minister, State Legislator and High Courts.	
<b>UNIT 5</b>	<b>4 hrs</b>
Constitutional Provisions for Scheduled Castes & Tribes, Women & Children & Backward classes. Emergency Provisions.	
<b>UNIT 6</b>	<b>3 hrs</b>
Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments.	

**Reference Books:**

1. Durga Das Basu: “Introduction to the Constitution of India”(Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
2. R.C.Agarwal, “Indian Political System”, (1997) S.Chand and Company, New Delhi. Maciver and Page, “Society: An Introduction Analysis”, Mac Milan India Ltd., New Delhi.
3. K.L.Sharma, “Social Stratification in India: Issues and Themes”,(1997), Jawaharlal Nehru University, New Delhi.
4. An Introduction to Constitution of India” by M.V.Pylee, Vikas Publishing, 2002. Sharma, Brij Kishore, “Introduction to the Constitution of India:”, Prentice Hall of India, New Delhi.
5. U.R.Gahai, “(1998) Indian Political System “, New Academic Publishing House, Jalaendhar.
6. R.N. Sharma, “Indian Social Problems “, Media Promoters and Publishers Pvt. Ltd.
7. Yogendra Singh, “(1997) Social Stratification and Charge in India “, Manohar, New Delhi.