# University of Pune

## Faculty of Technology

*Board of Studies in Civil and Environmental Technology*

## CURRICULUM STRUCTURE

| Subject No | Course Title | | Semester | Credits |
|---|---|---|---|---|
| CEC 001 | Core 1(Theory): | Mathematics for Technology | I | 4 |
| CEC 001L | Core 1(Lab): | Mathematics for Technology | I | 1 |
| CEC 002 | Core 2 (Theory): | Advanced Design of Concrete Structures | I | 4 |
| CEC 002L | Core 2 (Lab): | Advanced Design of Concrete Structures | I | 1 |
| CEC 003 | Core 3 (Theory): | Construction Management | I | 4 |
| CEC 003L | Core 3 (Lab): | Construction Management | I | 1 |
| CEC 004 | Core 4 (Theory): | Fluid Mechanics | II | 4 |
| CEC 004L | Core 4 (Lab): | Fluid Mechanics Lab | II | 1 |
| CEC 005 | Core 5 (Theory): | Design of Water & Wastewater Treatment Systems | II | 4 |
| CEC 005L | Core 5 (Lab) | Environmental Engg Lab | II | 1 |
| CEE 100 | Elective I* (Theory) | | I | 4 |
| CEE 100L | Elective I* (Lab) | | I | 1 |
| CEE 200 | Elective II* (Theory) | | I | 4 |
| CEE 200L | Elective II* (Lab) | | I | 1 |
| CEE 300 | Elective III* (Theory) | | II | 4 |
| CEE 300L | Elective III* (Lab) | | II | 1 |
| CEE 400 | Elective IV* (Theory) | | II | 4 |
| CEE 400L | Elective IV* (Lab) | | II | 1 |
| CEE 500 | Elective V* (Theory) | | II | 4 |
| CEE 500L | Elective V* (Lab) | | II | 1 |
| CEE 600 | Elective VI* (Theory) / DS (Directed Study) (Theory) | | III | 4 |
| CEE 600L | Elective VI* (Lab) / DS (Directed Study) (Lab) | | III | 1 |
| CEE 700 | Elective VII* (Theory) / DS (Directed Study) (Theory) | | III | 4 |
| CEE 700L | Elective VII* (Lab) / DS (Directed Study) (Lab) | | III | 1 |
| CEC 006 | Seminar –I (Advanced Topic related to field of research OR related to courses in semester I) | | I | 3 |
| CEC 007 | Seminar –II (Advanced Topic related to field of research OR related to courses in semester II) | | II | 3 |
| CEC 008 | Seminar –III (Advanced Topic related to field of research presenting Literature review of M.Tech Project) | | III | 3 |
| CEC 009 | Cyber Security / Information Security | | I | 2 |
| CEC 010 | Human Rights | | II | 2 |
| CEC 011 | M.Tech Project I | | III | 7 |
| CEC 012 | M.Tech Project II (Dissertation Submission) | | IV | 20 |

**Note**

Candidates are expected to perform minimum three (3) assignments for every Lab course, and submit report as a bonafide document to supervisor/course instructor. The assignment may be in the form of modeling/ simulation/ programming/ experimental investigation/ fieldwork/ tutorial etc.

The candidates are expected to select electives from the list provided. All the electives are open electives, which mean the electives can be taken across the boards.

The degree will be awarded as "***M Tech (Civil & Environmental Technology)***" with major in either of the following:

1. CM: ***Construction Management***
2. ENV: ***Environmental***
3. STR: ***Structures***
4. WR: ***Water Resources***

The major will be decided based on the following:

1. Minimum 03 electives out of first 05 electives in semester I & II should belongs to the concern stream mentioned in the syllabus.
2. The dissertation should be in the field of research from the respective stream.

**TABLE: List of Electives:**

| Subject No | Elective No | Stream | Course Name |
|---|---|---|---|
| CEE 100 | CEE 101 | CM | Risk Analysis and Mitigation |
| CEE 100 | CEE 102 | CM | TQM in Construction |
| CEE 100 | CEE 103 | CM | MIS in construction Industry |
| CEE 100 | CEE 104 | ENV | Industrial Wastewater Management |
| CEE 100 | CEE 105 | ENV | Sanitary Chemistry & Microbiology |
| CEE 100 | CEE 106 | STR | Theory Of Elasticity |
| CEE 100 | CEE 107 | STR | Advanced Structural Analysis By Matrix Approach |
| CEE 100 | CEE 108 | STR | Reliability Based Civil Engineering Design |
| CEE 100 | CEE 109 | WR | Dam Engineering |
| CEE 100 | CEE 110 | WR | wave mechanics |
| CEE 200 | CEE 201 | CM | Construction Techniques and Equipments |
| CEE 200 | CEE 202 | CM | Green Construction |
| CEE 200 | CEE 203 | CM | Human resource Management in construction Industry |
| CEE 200 | CEE 204 | ENV | Air & Water Quality Modelling |

| | | | |
|---|---|---|---|
| CEE 200 | CEE 205 | ENV | Energy & Environment |
| CEE 200 | CEE 206 | STR | Dynamics Of Structures |
| CEE 200 | CEE 207 | STR | Plastic Analysis & Design Of Steel Frames |
| CEE 200 | CEE 208 | WR | Planning and Management of Water resources |
| CEE 200 | CEE 209 | WR | Optimization Techniques |
| CEE 300 | CEE 301 | CM | Construction contracts and materials management |
| CEE 300 | CEE 302 | CM | Project Economics and Financial Management |
| CEE 300 | CEE 303 | ENV | Environmental Sanitation & Sanitation Practices for Rural India |
| CEE 300 | CEE 304 | ENV | Environmental Structure Design |
| CEE 300 | CEE 305 | STR | Finite Element Method |
| CEE 300 | CEE 306 | STR | Soil-Structure Interaction |
| CEE 300 | CEE 307 | WR | Open channel flow |
| CEE 300 | CEE 308 | WR | Irrigation and Drainage |
| CEE 400 | CEE 401 | CM | Construction Materials and Techniques |
| CEE 400 | CEE 402 | CM | Work study and Incentive Management |
| CEE 400 | CEE 403 | ENV | Environmental Legislation and Management System |
| CEE 400 | CEE 404 | ENV | Environmental Geotechnology |
| CEE 400 | CEE 405 | STR | Theory of Plates and Shells |
| CEE 400 | CEE 406 | STR | Advanced Design of Steel Structures |
| CEE 400 | CEE 407 | STR | Advanced Foundation Design |
| CEE 400 | CEE 408 | WR | Sediment Transport & River Mechanics |
| CEE 400 | CEE 409 | WR | Ground water modeling |
| CEE 500 | CEE 501 | CM | Maintenance and rehabilitation of buildings |
| CEE 500 | CEE 502 | CM | Solar Energy and Buildings |
| CEE 500 | CEE 503 | ENV | Solid and Hazardous Waste Management |
| CEE 500 | CEE 504 | ENV | Air Pollution and Control |
| CEE 500 | CEE 505 | STR | Earthquake Resistant Design of Structures |
| CEE 500 | CEE 506 | STR | Design of Precast Components and Ferrocrete |
| CEE 500 | CEE 507 | WR | Hydrology |
| CEE 500 | CEE 508 | WR | Remote Sensing and GIS in WRE |

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - I**

*Core - CEC 001*

**MATHEMATICS FOR TECHNOLOGY (COMPUTATIONAL METHODS)**

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 4 Hrs. /Week** | **In-semester: 50 Marks** |
| **Credits: 4** | **End-semester: 50 marks** |

**Unit 1: Numerical differentiation I:**

Partial differential equation Laplace and Poisson's equation-solution, method of characteristics for solution of initial boundary value problems, relaxation method

**Unit 2: Numerical differentiation II:**

Finite Difference, Gaussian elimination and Gauss, Jordan methods, matrix inversion, Gauss Seidel method –Newton- Raphson method

**Unit 3: Statistics and Probability:**

Moments, Skewness and Kurtosis, Probability, conditional probability, various theoretical distributions like binomial, normal, log-normal, Poisson, gamma distribution, Pearson type I, II & II distribution test of significance, Gumbel distribution, testing of hypotheses – Large sample tests for mean and proportion, Chi-square test, errors, types of errors.

**Unit 4: Regression and Correlation:**

Regression and correlation – rank correlation – multiple and partial correlation – analysis of variance-one way and two way classifications – experimental design – Latin square design

**Unit 5: Transforms:**

Laplace Transformer: LT of standard function, inversions and their application in civil engg. Fourier Transformer: Fourier integral, Fourier transform and their application in civil engg.

**Unit 6: Matrix method and Finite element:**

Matrix method analysis (Stiffness) co ordinate calculation for different types of structure. Finite element method basics (1D and 2D) co ordinate calculations.

**Reference Books**


1. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
2. Venkatraman, M.K., Numerical Methods in Science and Engineering, National Publisher Company.
3. Numerical Methods by Krishna Raju

4. Shanthakumar M.S., Numerical Methods & Analysis

5. Gupta, S.C. and Kapur, V.K., “Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 1999.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Core - CEC 002*

### ADVANCED DESIGN OF CONCRETE STRUCTURES

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Design Loads and combinations:**

Calculations of design dead load, live load, wind load, snow load and loading combinations in accordance with the relevant Indian codes of practice (IS: 875-1987 (5 parts)). Seismic loadings, Loads resulting from uneven settlement, Blast load, Dash load/Collision of vehicle, Fire load, load due to soil pressure etc.

Introduction to Liquid induced loads for operational, for testing, internal pressure loads, thermally induced loads, Insulation loads etc.

**Unit 2: Analysis of RCC Slabs:**

Yield line theory for analysis of slabs, Various patterns of yield lines, Assumptions in yield line theory, Equilibrium and virtual work method of analysis, Design of various slabs such as rectangular, triangular, circular with various edge conditions , Design for limit state of strength and serviceability orthotropically reinforced slabs,

**Unit 3: Liquid Retaining Structures (Over Ground):**

Basic design philosophy. Analysis and design of single cell rectangular water tanks subjected to hydrostatic loading based on plate theory.

Design of overhead water tanks, Intz tanks

**Unit 4: Liquid Retaining Structures (Under Ground):**

Design of Under Ground Water Tank with Counterforte Retaining Wall, subjected to Surcharge, Basic design philosophy. Calculation of lateral earth pressure based on Rankine's theory. Analysis and design of RC gravity walls, cantilever walls.

**Unit 5: Foundation Design:**

Design of foundation system and Geotechnical design for Hydraulic Failure such as failure by uplift (buoyancy), failure by heave; failure by internal erosion; failure by piping.

Design of Raft and Pile foundation.

**Unit 6: Ductile Detailing of RCC Structures:**

Ductile detailing as per IS: 13920.

**Reference Books**


1. Pillai S U and Menon Devdas, Reinforced Concrete Design, TATA Mc-Graw hill publishing co. Ltd., New Delhi
2. B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi
3. N.C. Sinha, S.K. Roy – Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi
4. P.C. Varghese – Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi
5. H.J. Shah– Reinforced Concrete, Vol I & II - Charotar Publishing House
6. Joseph E. Bowels – Foundation Analysis and Design-, TATA Mc-Grawhill
7. Nainan P Kurian – Design of Foundation Systems, Narosa publication house
8. M.J.Tamlinson – Foundation Design & Construction, ELBS publication
9. G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.
10. J.E. Bowles, Foundations Analysis and Design, 3rd Ed., McGraw-Hill, 1968.
11. R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd
12. Fang , H.Y.,(1991),” Foundation Engineering Handbook”, Chapman & Hall,NY.
13. Teng .W.C.(1962), Foundation Design , Prentice Hall International.
14. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi
15. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi
16. IS:13920 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Force, 1993
17. IS: 1904-1986, “Code of Practice for Design and Construction of Foundations in Soils, general Requirements”.
18. IS: 2911-1979, “Code of Practice for Design and Construction of Pile Foundation”

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - I**

*Core - CEC 003*

**CONSTRUCTION MANAGEMENT**

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 4 Hrs. /Week** | **In-semester: 50 Marks** |
| **Credits: 4** | **End-semester: 50 marks** |

**Unit 1: Introduction:**

Traditional management and modern scientific management, Principles of management, Theories of Taylor, Fayol, Mayo, McGregor, Weber, Gilbreth. Project Management -Basic forms of organization. Construction scope, project management phases & processes, construction project Management practice, construction project manager's role & skills, major causes of project failure.

**Unit 2: Construction Planning and Scheduling:**

Construction Management & General Contracting , Project work breakdown levels, development methodology, WBS, Defining project activities & estimating activity durations. Scheduling – Bar chart, network scheduling, linear scheduling, and precedence network analyses with examples.

**Unit 3: Resource management and Cost control:**

Resource allocation, leveling, constraining, updating, earned value. Compression of network & Project cost.

**Unit 4: Construction Equipments:**

Construction Equipments – Understanding basics and functions of Equipment Earthmoving Machinery, Concreting Equipment, Material Handling Equipment and Transportation of Equipments.

**Unit 5: Equipment Management:**

Equipment Management, Costing, Optimum utilization and Equipment selection, depreciation, interest on capital, Manpower, Spare parts etc, Documentation, Log-Books, History Books.

**Unit 6: Construction safety:**

Accidents, types, primary accidents to be taken, legal formalities, safety policy, equipment safety.

**Lab:**

One assignment on each unit with special emphasis on use of software like MSP, Primavera etc., wherever required.

**Reference Books**


1. Construction Project Management: Planning, Scheduling and Control by Chitkara, K.K., Tata McGraw-Hill Publishing Company, New Delhi, 1998

2. Project Planning, Scheduling and Control in Construction by Calin M. Popescu, Chotchai Charoenngam, An Encyclopedia of terms and Applications, Wiley, New York, 1995.

3. Project Management for Construction, Fundamental Concepts for Owners, Engineers, Architects and Builders by Chris Hendrickson and Tung Au, Prentice Hall, Pittsburgh, 2000.

4. Scheduling Construction Projects by Willis, E. M. John, Wiley & Sons, 1986

5. Financial and Cost Concepts for Construction Management by Halpin, D. W., John Wiley & Sons, New York, 1985.

6. Work study – Currie.

7. Roy, Pilcher Construction Management Construction Planning, Equipment and Methods by Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., McGraw Hill, Singapore, 2006.

8. Construction Equipment and Management by Sharma S.C., Khanna Publishers, New Delhi, 1988.

9. Construction Equipment and Job Planning by Deodhar, S.V., Khanna Publishers, New Delhi, 1988.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - II**

*Core - CEC 004*

**FLUID MECHANICS**

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 4 Hrs. /Week** | **In-semester: 50 Marks** |
| **Credits: 4** | **End-semester: 50 marks** |

**Unit 1: Introduction:**

Revision of concepts in basic Fluid Mechanics such as classification of flows, Equation of continuity for three dimensional flow in Cartesian co-ordinates, equation of continuity for one-dimensional flow along a streamline, types of motion, rotational and irrotational motion, velocity potential, stream function and flow net, Euler's equation of motion along a streamline and its integration, Bernoulli's equation. Development of boundary layer on a flat plate nominal, displacement, momentum, energy thicknesses, laminar, transitional and turbulent boundary layer, laminar sub layer, Local and mean drag coefficients

**Unit 2: Kinematics:**

Continuity Equation in polar and cylindrical coordinates, conformal mapping, Standard two dimensional flow pattern, source, sink, doublet

**Unit 3: Laminar Flow:**

Navier strokes equation-derivation, flow between parallel plates-it's exact solution, Laminar flow through a circular pipe

**Unit 4: Boundary Layer Theory:**

Karman's momentum integral equation, Karman Pohelhausen's solution, boundary layer separation

**Unit 5: Turbulent Flow:**

Characteristics of turbulent flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, prandtl's mixing length theory, velocity distribution in turbulent flow- prandtl's velocity distribution equation. Reynolds' equation of motion, typical solution, Energy and Momentum equation, Statistical theory of turbulence

**Unit 6: Fundamentals of Compressible Flow:**

Compressible fluid flow-fundamental equation, continuity equation, energy equation, velocity of propagation, Pressure, density and temperature in terms of Mach number,

Normal shock in one dimensional compressible flow and compressible flow around immersed bodies

**Reference Books**

1. Fluid Mechanics and Hydraulic Machines – Sukumar Patil, Tata McGraw-Hill

2. Fluid Mechanics- Grade & Mirajgaonkar

3. Fluid Mechanics and Machinery- D. Ramadurgaiah, New age International

4. Boundary Layer Theory- H. Schlichting, Springer New-York 2000

5. Fluid Mechanics-Victor L Streeter & E.B. Wylie, Mc-Graw Hill

6. Fluid Mechanics-Frank M White, Mc-Graw Hill

7. Fluid Mechanics-Fundamentals and Applications- Cengel and Cimbala, McGraw-Hill

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)
### SEMESTER - II
*Core - CEC 005*
### DESIGN OF WATER & WASTEWATER TREATMENT SYSTEMS

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit I:**

Estimation of water demand based on population projection. Designs of source intakes, raw water pumping main, economic design of rising main, determination of storage capacity of reservoirs.

**Unit II:**

Raw Water Characteristics, Flow charts for WTPS wrt various sources, Theory & Design of Aeration System – Cascade Aerator; Theory & Design of Plain ST & Clari-flocculator; Tube Settlers.

**Unit III:**

Filteration: Theory & Design; Disinfection: Theory & design

**Unit IV:**

Sewage generation, Collection and Transmission: Theory & Design; . Wastewater Characteristics; Theory & design of primary units: Screen Chamber, Grist Chamber. PST

**Unit V:**

Principles & design of Biological Treatment Units: ASP, TF, OP, MAL;

**Unit VI:**

Theory of UASB; On-site sanitation for rural areas: two pit latrines; ST followed by leach pit / soak pit / dispersion trenches.

**Reference Books**


1. Weber, W.J., Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.

2. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. Environmental Engineering, McGrawHills, New York 1985.

3. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw-Hill Publication, New Delhi, 2003

4. Water & Waste Water Engineering by Fair and Gayer. C.A. Sastry, Water TreatmentPlants, Narosa Publishing House, Bombay, 1996.

5. CPHEEO Manuals on Water Treatment and Sewerage & Sewage Treament – MoEF, GoI, New Delhi

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - I**

*Elective - CEE 101*

**RISK ANALYSIS AND MITIGATION**

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: General:**

Importance of Risk, types of risks for various construction projects

**Unit 2: Risk analysis and Management for projects (RAMP):**

Identifying risk events. Probability distribution. Stages in Investment life

**Unit 3: Risk Analysis:**

Sensitivity analysis scenario analysis simulation, decision tree analysis, risk profile method, certainly equivalent method; risk adjusted discount rate method

**Unit 4:**

Certainty index method, 3 point estimated method; use of risk prompts, use of Risk Assessment tables, details Of RAMP process, utility of Grading of construction entities for reliable risk assessment.

**Unit 5: Risk Mitigation:**

By elimination, reducing, transferring, avoiding, absorbing or pooling. Residual risk, mitigation of unqualified risk.

**Unit 6: Risk Cover:**

Coverage of risk through CIDC's, MOU with the Actuarial Society of India through risk premium such as (BIP) – Bidding Indemnity Policy (DIMO) – Delay in meeting obligation by client policy, (SOC) – Settlement of claims policy (LOP)- Loss of profit policy (TI). Transit Insurance policy (LOPCE) Loss of performance of construction equipment policy.

**LAB**

Tutorials based on solving the problems on topics covered in each unit.

**Reference Books**


- Industrial Engineering and Management of manufacturing systems.- Dr.Surendra Kumar & Satya Prakashan
- RAMP Handbook by institution of Civil Engineers and the faculty and Institute of Actuaries- Thomas Telford publishing, London.

Construction Engineering and Management – Seetharaman.

Projects Planning analysis selection implementation and Review – Prasanna Chandra.

## UNIVERSITY OF PUNE

**M. Tech. (Civil and Environmental Technology)**

**SEMESTER - I**

*Elective - CEE 102*

**T.Q.M IN CONSTRUCTION**

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Basic Concepts:**

Concept of Quality, Quality dimension TQM, Historical review of evolution of TQM, Various gurus of TQM, Benefits of TQM, Deming approach, Juran's trilogy, Philip B. Corby four absolutes of Quality. Quality of Design, Quality of conformance & Quality of performance, Concept of internal &external customer

**Unit 2: Pillars of TQM:**

Leadership, customer satisfaction, Employee involvement, continuous process improvement, supplier participation, Performance measures, The quality costs concept, Quality Costs Categories, Collection & analysis of quality costs data, reduction of quality cost

**Unit 3: TQM Approaches:**

Tools & Techniques of TQM: Brainstorming, Cause effect diagram, Pereto analysis, Affinity diagram, Matrix diagram, Why-Why, Tree diagram, PDCA Cycle. Statistical tools in QC - Basic Philosophy & Concept variables & attributes. Controls chart variables & attributes, Process Capability Analysis, Acceptance sampling

**Unit 4: Advanced Quality Management Tools:**

Bench marking: Reasons to bench mark, Process, Deciding what to benchmark, QFD: QFD team, benefits, VOC, House of quality, Kaizen, Quality Circle: Concept and Philosophy, Six Sigma, FMEA

**Unit 5: ISO 9001 - 2008 Series of Standards & QS 9000 QM System :**

History & evolution of ISO 9001 series, Importance, overview, structure and Clauses of ISO 9001 - 2008 series standards, their contents interpretation & implementation, Quality system documentation & audit, Equivalent Indian standards. **QS 9000 QM System:** Introduction to QS 9000 and its requirements. Environmental management system, Concept & requirement of ISO 14001, Benefits of environmental management system

**Unit 6: Applications:**

Implementation of TQM in construction industry (case studies), Barriers to implementation, benefits. National quality awards criteria & other quality awards.

**LAB:**

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures.

**REFERENCES:**

1. James, J.O Brian, " Construction Inspection Handbook - Quality Assurance and Quality Control ", Van Nostrand, New York, 1989.

2. Kwaku A., Tenah and Jose M.Guevera, " Fundamental of Construction Management and Organization ", Prentice Hall of India, 1995.

3. Juran Frank, J.M. and Gryna, F.M. " Quality planning and Analysis ", Tata McGraw Hill, 1982.

4. Hutchins. G., " ISO 9000 ", Viva Books, NewDelhi, 1993.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - I**

*Elective - CEE 103*

**MIS IN CONSTRUCTION**

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 4 Hrs. /Week** | **In-semester: 50 Marks** |
| **Credits: 4** | **End-semester: 50 marks** |

**Unit 1: Introduction:**

Introduction to Management Information systems (MIS), Overview, Definition. MIS and decision support systems, Information resources, management subsystems of MIS. Architecture - Evolution of Information Systems

**Unit 2: System Development:**

Modern Information System - System Development Life Cycle - Structured Methodologies - Management information system structure based on management activity whether for operational control, management control or strategic planning.

**Unit 3: Information Systems:**

Integrated Construction Management Information System - Project Management Information System- Functional Areas, Finance, Marketing, Production, Personnel - Levels, DSS, EIS, and ES - Comparison, Concepts and Knowledge Representation - Managing International Information System

**Unit 4: Implementation And Control:**

Control - Testing Security - Coding Techniques - Defection of Error - Validating - Cost Benefit Analysis - Assessing the value and risk of Information System

**Unit 5: System Audit:**

Software Engineering qualities - Design, Production, Service, Software specification, Software Metrics, Software quality assurance

**Unit 6: Systems Methodology:**

Objectives - Time and Logic, Knowledge and Human Dimension Software life cycle models - Verification and Validation

**LAB:**

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, and surprise test, declared test, seminar, final orals and any others. The teacher may add any of other academic activity to evaluate student for his/her in semester performance.

**REFERENCES:**

1. Kenneth C Laudon and Jane Price Laudon, Management Information Systems - Organisation and Technology, Prentice Hall, 1996.

2. Gordon B. Davis, Management Information System: Conceptual Foundations, Structure and Development, McGraw Hill, 1974.

3. Joyce J Elam, Case series for Management Information Systems ,Simon and Schuster, Custom Publishing, 1996.

4. Ralph H Sprague and Huge J Watson, Decision Support for Managers, Prentice Hall, 1996.

5. Michael W. Evans and John J Marciniah, Software Quality assurance and Management, John Wiley and Sons, 1987.

6. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 104*

### INDUSTRIAL WASTEWATER MANAGEMENT

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

**Sources of Pollution:** Physical, Chemical, Organic and Biological properties of Industrial Wastes – Differences between industrial and municipal waste waters –Effects of industrial effluents on sewers and treatment plants.

**Unit 2:**

Pre and Primary Treatment: Equalization, Proportioning, Neutralization, Oil Separation by Floatation – Waste Reduction - Volume Reduction – Strength Reduction.

**Unit 3:**

Waste Water Treatment Methods: Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process – Air Stripping and Absorption Processes – Special Treatment Methods – Disposal of Treated Waste.

**Unit 4:**

Manufacturing process and sources of effluent from the process of industries like chemical, fertilizer, petroleum, petro -chemical, paper, sugar, distillery, textile, tannery food processing, dairy and steel manufacturing.

**Unit 5:**

Characteristics and composition of effluent and different methods of treatment & disposal of effluent for the following industries:

Steel, Petroleum Refineries, Textiles, Tanneries, Atomic Energy Plants and other Mineral Processing Industries.

**Unit 6:**

Common Effluent Treatment Plants (CETPs): Location, Need, Design, Operation & Maintenance Problems and Economical aspects.

**Reference Books**


1. W. Wesley Eckenfelder Jr., Industrial Waste Water Pollution Control.

2. Arceivala, S. J., Wastewater Treatment for Pollution Control, McGraw-Hill, 1998.

3. Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001.

4. M. N. Rao & Datta, Waste water treatment.

5. N. L. Nemerow, Liquid waste of Industry, Addison Wesely. 1996

6. Callegly, Forster and Stafferd, Treatment of Industrial Effluent, Hodder and Stonghton. 1988

7. Hardam S. Azad, (ED), Industrial Wastewater Management Hand Book 1988.

8. Indian standards: IS: 2490 (1963), IS: 3306 (1065).

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 105*

### SANITARY CHEMISTRY & MICROBIOLOGY

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

Significance of Environmental Chemistry in Environmental Engineering, Units of Measurement, Stoichiometry. Basic Concepts from General Chemistry, Physical Chemistry, Organic Chemistry, Equilibrium Chemistry, Colloidal Chemistry and nuclear Chemistry as applied to the Measurement of Pollution Parameters.

**Unit 2:**

Principles of Optical Methods such as Absorption, Spectrophotometry, Flame photometry, Fluorometry

**Unit 3:**

Principles of Chromatographic Methods such as Gas chromatography, High Performance Liquid Chromatography and Ion Chromatography

**Unit 4:**

Scope and Areas of Environmental Microbiology, Cell and its Structure, Introduction to Enzyme and Metabolic Reactions, Aerobic and anaerobic respiration, Classification.

**Unit 5:**

Microscopy and Micrometry, Observations, Measurements and Isolation of Microorganism, Different Cultures, Media and Techniques of Staining and Enumeration of microorganism.

**Unit 6:**

Applied Microbiology of Soil, Air, Water and Biological Processes of Wastewater Treatments, Industrial Microbiology.

**Reference Books**


1. C. N. Sawyer, P. L. McCarty and G.F. Parkin, Chemistry for Environmental Engineering and Science, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.

2. G.W. Vanloon and S. J. Duffy ‘Environmental chemistry – a global perspective, Oxford University press, New York., 2000.

3. Tortora. G. J, B. R. Furke, and C.L. Case, “Microbiology-An Introduction” (4th Ed.), Benjamin/Cummings Publ. Co., Inc., California, 1992.

4. Pelczar, M. J.,Chan E. C. S. and Krieg, N. R. Microbiology, Tata McGraw Hill, New Delhi,1993

5. Benefield L. D., Judkins J. F. and Weaned R.L., Process Chemistry for Water and Wastewater Treatment, Prentice Hall, Inc. London, 1987.

6. R.E. McKinney, "Microbiology for Sanitary Engineers", McGraw Hill Book Company, 1962.

7. W. G. Walter and R. H. McBee, “General Microbiology”, East West Edition, 1969.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - I

*Elective - CEE 106*

## THEORY OF ELASTICITY

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

### Unit 1: Analysis of Stress and Strains

Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain-displacement relations, strain compatibility condition and stress compatibility conditions.

### Unit 2: Stress-Strain Relationship

Generalized Hook's law for Isotropic, Orthotropic, Transversely Isotropic materials, plane stress, plane strain and axisymmetric problems, Problems in 2D Cartesian coordinate system, Airy's stress function, bending of beams.

### Unit 3: Polar Coordinate System

Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain-displacement relationship for plane stress and plane strain conditions, Bending of curved bar, Stress concentration problems.

### Unit 4: Axisymmetric Problems

Equilibrium equations, Strain displacement relations, Stress-strain relationship, Stress-compatibility equations, Plane stress and Plane strain conditions. Cylinders subjected to internal and external pressure.

### Unit 5: Torsion

Assumptions and Torsion equation for general prismatic solid bars, Warping of Non-circular sections and St. Venant's theory. Prandtle's stress function approach. Torsion of Circular, Elliptical and Triangular cross-section bar. Torsion of thin-walled structures by membrane analogy, Torsion of rolled sections and shear flow.

### Unit 6: Beams on Elastic Foundation

Differential equation, Infinite beams with concentrated load, concentrated moment, and finite uniformly distributed load. Semi-Infinite beams with free end subjected to finite uniformly distributed load, hinged end. Finite beams with free end and hinged end.

### Reference Books

1. Timoshenko and Goodier - Theory of Elasticity, McGraw-Hill Publications

2. S. Crandall, N. Dahl and T. Lardner - Mechanics of Solids, McGraw Hill Publications

3. Wang - Applied Elasticity, Dover Publications

4. Irving Shames, Mechanics of deformable solids, Prentice Hall

5. Scholer, Elasticity in Engineering, McGraw-Hill Publications

6. Sadhu Singh – Theory of Elasticity, Khanna Publishers

7. L.S.Sreenath – Advanced Mechanics of Solids, Tata McGraw-Hill Publications

8. S M A Kazimi – Solid Mechanics, Tata McGraw-Hill Publications

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 107*

### ADVANCED STRUCTURAL ANALYSIS BY MATRIX APPROACH

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Review of basic concepts in structural analysis:**

*Structure* (structural elements, joints and supports, stability, rigidity and static indeterminacy, kinematic indeterminacy);

*Loads* (direct actions, indirect loading);

*Response* (equilibrium, compatibility, force-displacement relations); levels of analysis;

Analysis of *statically determinate structures* (trusses, beams, frames);

Applications of *principle of virtual work* and displacement-based and force-based *energy principles*; deriving stiffness and flexibility coefficients.

**Unit 2: Review of analysis of indeterminate structures:**

*Force methods:* Statically indeterminate structures (method of consistent deformations; theorem of least work).

*Displacement Methods:* Kinematically indeterminate structures (slope-deflection method; moment distribution method).

**Unit 3: Matrix concepts and Matrix analysis of structures:**

Matrix; vector; basic matrix operations; rank; solution of linear simultaneous equations; eigen values and eigenvectors.

Introduction; coordinate systems; displacement and force transformation matrices; Contra-gradient principle; element and structure stiffness matrices; Element and structure flexibility matrices; equivalent joint loads; stiffness and flexibility approaches.

**Unit 4: Matrix analysis of structures with axial elements:**

*Introduction:* Axial stiffness and flexibility; stiffness matrices for an axial element (two dof), plane truss element (four dof) and space truss element (six dof);

*One-dimensional axial structures:* Analysis by conventional stiffness method (two dof per element) and reduced element stiffness method (single dof); Analysis by flexibility method;

*Plane trusses:* Analysis by conventional stiffness method (four dof per element) and reduced element stiffness method (single dof); Analysis by flexibility method;

*Space trusses:* Analysis by conventional stiffness method (six dof per element) and reduced element stiffness method (single dof).

**Unit 5: Matrix analysis of beams and grids:**

*Conventional stiffness method for beams:* Beam element stiffness (four dof); generation of stiffness matrix for continuous beam; dealing with internal hinges, hinged and guided-fixed end supports; accounting for shear deformations;

*Reduced stiffness method for beams:* Beam element stiffness (two dof); dealing with moment releases, hinged and guided-fixed end supports;

*Flexibility method for fixed and continuous beams:* Force transformation matrix; element flexibility matrix; solution procedure (including support movements);

*Stiffness method for grids:* Introduction; torsional stiffness of grid element and advantage of torsion release; analysis by conventional stiffness method using grid element with six dof; analysis by reduced stiffness method (three dof per element);

**Unit 6: Matrix analysis of plane and space frames:**

*Conventional stiffness method for plane frames:*

Element stiffness (six dof); generation of structure stiffness matrix and solution procedure; dealing with internal hinges and various end conditions;

*Reduced stiffness method for plane frames:* Element stiffness (three dof); ignoring axial deformations; dealing with moment releases, hinged and guided fixed end supports;

*Flexibility method for plane frames:* Force transformation matrix; element flexibility matrix; solution procedure (including support movements); Ignoring axial deformations;

*Stiffness method for space frames:* Introduction; element stiffness matrix of space frame element with 12 dof and 6 dof; coordinate transformations; analysis by reduced stiffness method (six dof per element);

**Reference Books**


1. M.B. Kanchi, " Matrix Structural Analysis"
2. Gere Weaver, " Matrix Structural Analysis"
3. Pandit Gupte, S.A. by Matrix Approach, T.M., 1994.
4. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
5. Asslam Kassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.

6. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.

7. Devdas Menon, "Structural Analysis", Narosa Publishing House, 2008.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 108*

### RELIABILITY BASED CIVIL ENGINEERING DESIGN

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1:**

Concepts of structural safety: Design methods, statistics and probability: Data reductions, Histograms, Sample correlation. Random variable, Discrete and continuous variables and common probability distribution.

**Unit 2:**

Resistance distribution and parameters: Statistical analysis of materials: steel, concrete bricks and mortar, Dimensional variations, characterization of variables and allowable stresses based on specified reliability.

Probabilistic Analysis for live load, gravity load and wind load.

**Unit 3:**

Computation of basic structural reliability, Reliability analysis of simple element such as beam and column. Reliability methods, basic variables, first order second moment methods (FOSM) and concept of reliability index. Reliability of structural systems: Redundant and non-redundant systems, series, parallel and mixed systems.

**Unit 4:**

Monte Carlo Methods of Analysis: Study of structural safety-generation of random numbers continuous, discrete and jointly distributed variables-Application to reliability analysis of concrete structures.

**Unit 5:**

Reliability based design: Load and resistance factors of design, safety checking formats and code calibrations, I.S. code provision, Introduction to stochastic process.

**Unit 6:**

Decision Analysis: Introduction, simple risk decision problems, decision problems, decision model, decision tree, decision criteria, decision based on existing information, Prior analysis

### Reference Books

1. R. Ranganathan, Reliability Analysis and Design of Structures, Mc Graw Hill.

2. Edward Haugen, Probabilistic Approaches to Design, John Wiley and Sons, London.

3. R. E. Melchers, Structural Reliability-Analysis and Prediction, Ellis Horwood Ltd. Chichester, UK.

4. R. Ranganatha, Structural Reliability Analysis and Design, Jaico Publications, Mumbai, 1999.

5. P. T. Christensen and M. J. Baker, Structural Reliability Theory and its Application, Springer-Verlag, Berlin Haldelberg, New York, 1982.

6. A.H.S. Ang and W.H. Tang, Probability concepts in Engineering Planning and Design, Vol.II, John Wiley, New York, 1984.

7. P. T. Cristensen and Y. Murotsu, Applications of Structural Systems Reliability Theory, Sopringer-Verlag, Berlin, 1986.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - I

*Elective - CEE 109*

## DAM ENGINEERING

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Reservoir Planning**

Types, developments, Storage and diversion works, Purpose: Single and multipurpose,

Investigation for locating a reservoir, Selection of site, estimation of required storage, mass curves, reservoir losses, reservoir operation, economics of reservoir planning, benefit cost ratio, price escalation of projects

**Unit 2: Dams**

Introduction, Classification of dams based on function, hydraulic design, materials of construction, Choice of type of dam, selection of dam site, site investigations, sun surface explorations

**Unit 3: Gravity Dams:**

Forces acting on the gravity dams earthquake force- pseudo-statics and dynamic response approach, load classifications, stability analysis, distribution of shear and normal stresses, principle stresses, Stress concentration around openings, foundation treatments, Design of concrete dam.

**Unit 4: Earthen Dams:**

Seepage through dam and its foundations, stability analysis for sudden drawdown condition, steady seepage condition, end of constructions, seismic effects, pore pressures, protection of upstream and downstream slopes.

**Unit 5: Arch Dams**

Arch dams-General concepts of trail load theory, elastic shell methods, thick cylinder theory

**Buttress Dam and Rock fill Dams:**

Relevant rock fill characteristics, general design principal method of construction and compaction.

Buttress dam- Concepts and Design

**Unit 6: Spillways:**

Spillway-types, components, design principles, Design of different spillways such as Ogee, side channel, siphon. Energy dissipation devices and their design

**Reference Books**


1. Concrete Dams – R.S. Varshney
2. Irrigation Water Resources & Water Power Engineering P.N. Modi
3. Earth Dams – J.L. Sherard
4. Water resources Engineering Principles and Practice- S. Murty Challa- New Age International
5. Elements of water resources engineering – K.N.Duggal, J.P.Soni, New Age International

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 110*

### WAVE MECHANICS

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Introduction**

Introduction, Generation, Decay, Classification, Measurement, Wave Forecasting: The Significant Wave, Simplified versus Elaborate Technique, Simplified Methods- SMB method, Hasselmann method, Darbyshire and Draper's Technique, Forecasting in Hurricanes, Numerical Wave Modeling (introduction only, no mathematical treatment): Phase resolving models, Phase averaging models

**Unit 2: Wave Theories**

Basic hydrodynamic equations, wave theories - Linear wave theory, Finite amplitude wave theories (introduction only, no mathematical treatment): Stokes, wave theory, Cnoidal wave theory, Solitary wave theory, Dean stream function theory, Trochoidal wave theory, Non-linear versus linear wave theory, Choice of wave theory

**Unit 3: Random waves**

Wave spectrum analysis, wave spectra and statistics, Theoretical spectra: Pierson-Muskowitz Spectrum, Bretschneider Spectrum, JONSWAP Spectrum, Scott Spectrum, Scott-Wiegel Spectrum, Wave statistics: Short term wave statistics, Tucker method, Long term wave statistics- Gumbel distribution, Weibull Distribution, Log Normal Distribution, Fretchet Distribution, Upper bound Type III u distribution, Long Term Distribution of Individual Wave Heights

**Unit 4: Wave propagation**

Wave shoaling, wave refraction, wave diffraction, wave reflection, combined effects using numerical solutions, wave breaking, wave set up and set down, wave runup

**Unit 5: Wave Forces On Shore-Based Structures**

Forces on Vertical Faced Structures: Non- breaking wave forces, breaking wave forces, forces by broken waves, forces on Seaward structures, forces on landward structures, oblique wave attack. Forces on sloping face structures: Single rubble mound, composite breakwater

**Unit 6: Wave Force On Small Diameter Members**

The Morison’s equation, Total Wave Force On The Entire Member Length, Wave Forces Using Stokes (V) Theory, Calculation Of Wave Forces Using Dean’s Theory, Wave Force On Inclined Members (introduction only-rigorous mathematical treatment to be avoided), Wave Slam, Limitations of the Morrison’s Equation

**Reference Books**


1. Sarpkaya, T., Issacson, M. (1981). “Mechanics of Wave Induced Forces on Offshore Structures”,Van Nostrand Reinhold.

2. U.S. Army Corps of Engineers. (2002). “Coastal Engineering Manual”, U.S. Army Corps of Engineers, Washington, D.C.

3. WMO. (1988). “Guide to Wave Analysis and Forecasting”, Pub. NO. 702, World Meteorological Organization, Secretariat of WMO, Geneva.

4. Dean, R. G., Darlymple R. A. (1991). “Water Wave mechanics for Engineers and Scientists”, World Scientific

5. Sorensen, R. M. (1997). “Basic Coastal Engineering”, Springer

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - I

*Elective - CEE 201*

## CONSTRUCTION TECHNIQUES AND EQUIPMENTS

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Earth work equipments:**

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment-Dozers, Rippers, Excavators, dragline and clamshell, Trucks and hauling equipments, Scrappers, Earthwork finishing equipments, Compaction equipments

**UNIT 2: Material Handling equipments:**

Cranes: Mobile cranes, Tower cranes, Hydraulic cranes, Sizes and capacity, Application and operations, Conveyor systems: types and applications.

**Unit 3: Construction plants:**

Ready mix concrete plants, Hot mix asphalt plants, Aggregate production plants

**Unit 4: Highway construction:**

Special equipments for highway construction, Construction techniques, Automation in highway construction

**Unit 5: Concreting techniques and Equipments:**

Concrete placing underwater, concrete pumps, boom placers, mixers, conventional methods.

**Unit 6: Equipment management:**

Construction services, Equipment economics, selection, maintenance, Cost Control of Equipment - Depreciation Analysis.

**LAB:**

One hour per week of tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures.

A Visit to RMC plant / construction equipment factory /Aggregate production plants etc. is higly recommended.

**Reference Books**


1. Construction Planning, Equipment and Methods by Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., McGraw Hill, Singapore, 2006.

2. Construction Equipment and Management by Sharma S.C., Khanna Publishers, New

3. Delhi, 1988.

4. Construction Equipment and Job Planning by Deodhar, S.V., Khanna Publishers, New Delhi, 1988.

5. Standard handbook of Heavy construction, James J. O'Brien, Jhon A. Havers and Frank W. Stubbs. Third edition, McGraw-Hill Publication.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 202*

### GREEN CONSTRUCTION

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit1:**

Concept of Sustainability, Major Environmental Challenges, Global Warming (a movie can be shown),

**Unit 2:**

Introduction to Green Buildings; LEED, LEED Principles. Sustainable Urban Development, Sustainable Sites - LEED Credits.

**Unit 3:**

Energy Conservation in Buildings, HVAC Systems, Energy and Atmosphere, Conducting an Energy Audit, Fossil Fuels vs. Renewable Energy (a movie can be shown).

**Unit 4:**

Water Conservation in Buildings, Green Construction Materials, Building Deconstruction, Construction waste management, Recycling, Indoor Environmental Quality – Basic.

**Unit 5:**

Economics of Green Buildings

**Unit6:**

Green building rating systems-LEED/IGBC Rating system. (http://www.igbc.in/site/igbc/index.jsp), Process of rating a building.

**LAB:**

One hour per week of tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. A visit to any Green rated building is highly recommended.

**Reference Books**


1. C.J. Kibert (2008) “Sustainable Construction: Green Building Design and Delivery”, 2nd Ed., John Wiley, Hoboken, New Jersey

2. G.T. Miller Jr. (2004) “Living in the Environment: Principles, Connections, and Solutions”, 14th Ed., Brooks Cole, Pacific Grove, California

3. McDonough, W. and M. Braungart (2002) Cradle to Cradle: Remaking the Way We Make Things (New York: Farrar, Straus and Giroux).

4. Web Based Book: Building Green for the Future: Case Studies of Sustainable Development in Michigan (Urban Catalyst Associates, 2005). You may download it at [http://theacuffs.com/urbancatalystassociates/]. Go to "publications and presentations" and click on link.

**ONLINE SOURCES:**

- http://www.igbc.in/site/igbc/index.jsp
- http://www.grihaindia.org/
- http://www.greenbuildingsindia.com/
- http://www.greenbuildingcongress.com/site/gbc/index.jsp
- http://www.ecoconstruction-india.com/magazine
- Architronic - The Electronic Journal of Architecture http://architronic.saed.kent.edu/
- Bob's Solar Project http://www-personal.umich.edu/~bgoodsel/solar/blog.htm
- Canadian Architect http://www.cdnarchitect.com
- Center for Building Science News http://eande.lbl.gov/CBS/NEWSLETTER/CBSNEWS.html
- Center for Sustainable Systems http://www.umich.edu/~nppcpub/resources/compendia/architecture.html
- Encompass - Alberta's Environmental Magazine http://www.encompass.org
- Encyclopedia of Alternative Energy and Sustainable Living
- http://www.daviddarling.info/encyclopedia/AEmain.html
- Energy Science News - US Dept. of Energy http://www.pnl.gov/energyscience/index.html
- Energy Source Builder Newsletter http://www.oikos.com/esb/index.html
- Energy User News http://www.energyusernews.com/

- ENEWS - Energy Electronic Library http://www.unicamp.br/nipe/enews/
- Environmental Building and Design http://www.yourhomeplanet.com/
- Environmental Design & Construction Magazine http://www.edcmag.com
- Environmental Energy Technologies Division News http://eetd.lbl.gov/news/EETDNews.html
- Financial Times Energy http://www.ftenergy.com
- Green Building Pages http://www.greenbuildingpages.com/main.html
- Green@work Magazine http://www.greenatworkmag.com
- Home Energy Magazine http://www.homeenergy.org/
- Inter Americas Adobe Builder Magazine http://www.adobebuilder.com
- Natural Home Magazine http://www.naturalhomemagazine.com
- Online journal of ecological design. http://www.ecotecture.com
- SOLAR TODAY magazine http://www.solartoday.org
- The bimonthly newsletter from the Alliance to Save Energy. http://www.ase.org/e-FFICIENCY/
- The Canadian Architect and Builder Online http://collections.ic.gc.ca/architect/
- The Last Straw http://www.strawhomes.com/
- Urban Land Institute http://www.uli.org
- USGBC Green Building Links http://www.usgbc.org/DisplayPage.aspx?CMSPageID=76&

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 203*

### HUMAN RESOURCE MANAGEMENT IN CONSTRUCTION

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Manpower Planning:**

Manpower Planning, Organizing, Staffing, directing, and controlling – Personnel Principles

**Unit 2: Organization:**

Organization – Span of Control – Organization Charts – Staffing Plan - Development and Operation of human resources - Managerial Staffing – Recruitment – Selection - Placement, Training and Development.

**Unit 3: Human Behavior:**

Introduction to the field of people management - basic individual psychology; motivation - Job design and performance management - Managing groups at work - self-managing work teams – intergroup behavior and conflict in organizations – Leadership - Behavioral aspects of decision-making; and communication for people management

**Unit 4: Welfare Measures:**

Compensation – Safety and health – GPF – EPF – Group Insurance – Housing - Pension – Laws related to welfare measures.

**Unit 5: Management and Development Methods:**

Compensation - Wages and Salary, Employee Benefits, employee appraisal and assessment – Employee services - Safety and Health – Discipline and discharge

**Unit 6: Performance Appraisal:**

Performance appraisal. - Employee hand book and personnel manual - Job descriptions and organization structure and human relations – Productivity of Human resources. Special Human resource problems.

**LAB:**

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures.

**REFERENCES:**


1. The Complete Standard Handbook of Construction Personnel Management by Carleton Counter II and Jill Justice Coutler , Prentice-Hall, Inc., New Jersey, 1989.

2. Personnel Management by Memoria,C.B., Himalaya Publishing Co., 1997.

3. Handbook of Human Resources Administration by Josy.J. Familaro, McGraw-Hill International Edition, 1987.

4. Management by Charles D Pringle, Justin Gooderi Longenecter, CE Merril Publishing Co. 1981.

5. Human Relations and Organisational Behaviour by Dwivedi R.S, Macmillian India Ltd., 2005.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - I

*Elective - CEE 204*

## AIR AND WATER QUALITY MODELLING

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1**

Modeling Concepts : Casual and statistical models-Characteristics- Steps in model development - Importance of model building.- conservation of mass and mass balance – calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

**Unit 2**

Water Quality Modeling: Water quality models – Historical development – Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods.

**Unit 3**

Air Pollution Modeling: Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants - Meteorological settling for dispersal of air pollutants – Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

**UNIT 4**

Air Quality Models: Types modeling technique, modeling for non reactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models- diffusion models – Gaussian plume derivation- modifications of Gaussian plume equation- long term average-multiple cell model- receptor oriented and source oriented air pollution models-model performance, accuracy and utilization.

**Unit 5**

Water Quality Index: Categories of water quality index. Determination of water quality index (WQI): Industrial and municipal effluent index, ambient water quality index, combined water quality index and Delphi method.

**Unit 6**

Air Quality Index: Categories of air quality index. Determination of air quality index (AQI): National AQI, Extreme value indices, Regional indices.

**Reference Books**


1. Steven C. Chapra, Surface Water Quality Modeling, Tata McGraw-Hill Companies, Inc., New Delhi, 1997.

2. J. L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.

3. Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport, (Ed.), (Third Ed.) Volume I , Academic Press, 2006.

4. Deaton and Wine Brake, Dynamic Modeling of Environmental Systems, Wiley & Sons, 2002

5. E. V. Thomson, Principles of Surface Water Quality Modeling and Control, Happer and Row Publishers New York, 1987.

6. M.D. Palmer, Water Quality Modeling, the World Bank Washington DC.

7. Lohani B. N. and North A. M. Environmental Quality Management, South Asian Publishers Pvt. Ltd., New Delhi, 1984.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - I

*Elective - CEE 205*

## ENERGY AND ENVIRONMENT

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Energy Crisis:**

Historical events, energy requirement of society in past and present situation, availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability.

**Unit 2: Non-conventional energy sources:**

Hydro power plant, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies.

**Unit 3: Solar Energy Option:**

Sun as source of energy, direct methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application, environmental impacts of solar energy.

**Unit 4:**

Biomass Energy**:** Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies, environmental impacts of biomass energy. (Including numerical)

**Unit 5: Energy Storage:**

Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems (Including numerical)

**Unit 6: Energy recovery systems:**

Approaches to waste Energy Utilization, Equipment, Utilization System, objective, principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration. (Including numerical)

**Reference Books**


1. Bewik M.W.M. - Handbook of organic waste conversion
2. Bokris J.O. - Energy, the solar hydrogen alternative.

3. Rai G.D - Non-conventional Energy Sources

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - I**

*Elective - CEE 206*

**DYNAMICS OF STRUCTURES**

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 4 Hrs. /Week** | **In-semester: 50 Marks** |
| **Credits: 4** | **End-semester: 50 marks** |

**Unit 1:**

Nature of exciting forces, degrees of freedom and mathematical modelling of dynamic systems. Single degree freedom system (SDOF): An undamped and damped free vibrations, Viscous and Coulomb's damping.

**Unit 2:**

SDOF system: Undamped and damped Forced Vibrations to harmonic excitations, Fourier analysis of periodic forces. Response to unit impulse and arbitrary loading by Duhamel's integral.

**Unit 3:**

SDOF system: Step and Ramp forces, Pulse loadings, Response to ground motion and transmissibility. Non-linear analysis by step-by-step method with linear acceleration.

**Unit 4:**

Multiple degrees of freedom (MDOF) system: Free vibrations of a shear building, fundamental frequencies and mode shapes, Orthogonality of mode shapes, Power and Stodola methods. Concept of Tuned Mass Dampers.

**Unit 5:**

MDOF System: Forced Vibrations of shear building, transformation of coordinates and mode superposition method, Response to ground motion. Non-linear analysis by Wilson-Theta method.

**Unit 6:**

Continuous system: Free transverse vibrations of beams for various boundary conditions. Free vibration analysis of a cantilever beam by Rayleigh Ritz and Finite Element Method.

**Reference Books**


1. Mario Paz – Structural Dynamics Theory and Computation, CBS Publications
2. Anil K Chopra – Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice-Hall Publications

3. R.W Clough and J Penzin – Dynamics of Structures, McGraw Hill Publications

4. R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications

5. Madhujit Mukhopadhyay – Structural Dynamics Vibrations and Systems, Ane Books India Publishers

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 207*

### PLASTIC ANALYSIS AND DESIGN OF STEEL FRAMES

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

Plastic collapse loads of gable portal frames, various mechanisms.

Analysis of Multi Bay- Multi Storey rectangular portal frame, Joint & Various mechanisms (Two bays - Three storeys)

**Unit 2:**

Secondary design considerations: Effect of axial force, shear, residual stresses and brittle fracture on moment capacity. Design of beams with high shear, interaction of bending & axial force: section and member strength.

**Unit 3:**

Design of rectangular and gable portal frames

**Unit 4: Design of corner connection with and without haunches:**

Review of semi-rigid connections. Design of beam to column Moment resisting connections. End plate: Flush & extended, T-Stub connections. Combined tension & shear considerations in welded & bolted connection.

**Unit 5:**

Elastic stability & structural Instability, Review of critical loads of long columns for various boundary conditions; beam-columns, critical load of simple rectangular frames. Columns with initial imperfection.

**Unit 6:**

First order elastic (FOE) & first order inelastic (FOIE) (Plastic) analysis of rectangular portal frames. Elastic & limit state of strength of frame.

**Reference Books**


1. Design of Steel Structure by N Subramanian, Oxford University Press, New Delhi.

2. “Limit state Design of Steel Structures” , S K Duggal , McGraw Hill education, 2010

3. “Limit State Design of Steel Structures”, Dr. M R Shiyekar, PHI Publication, 3rd Print

4. “Stability Analysis & design of Structures” M.L. Gambhir, Springer, SIE

5. “Stability of structures” , Ashwini Kumar, Allied Publishers Ltd.

6. “Advanced Analysis of steel frames, Theory Software and application”, W F Chen, S. Toma, CRC press, Tokyo

7. “ Plastic Analysis and Design of Steel Structures”, M Bill Wong, Elsevier

8. “LRFD steel design using Advanced Analysis”, W F Chen, S. Kim, CRC press.

9. A.S. Arya and J.L. Ajmani – Design of Steel Structures, Nemchand& Bros., Roorkee

10. Ramchandra – Design of Steel Structures Vol – II, Standard Book House, Delhi

11. B.G. Neal – Plastic Method of Structural Analysis, Chapman & Hall

12. L.S. Beedle – Plastic Design of Steel Frames, John Willey & Sons

13. Steel Designers Manual – ELBS

**General Reading Suggested:**

**Codes:**

1. IS: 800 - 2007 Code of Practice for General Construction in Steel

2. AISC Steel Construction Manual

**Hand books:**

1. SP: 6 (6) – 1972 Handbook for Structural Engineers: Application of plastic Theory in Design of Steel Structures

2. Handbook for Structural Engineers SP 6 (8) 1972 (Reaffirmed 1995) – Bureau of Indian Standards.

**E-Resources:**

1. Teaching Resource for Structural Steel Design – INSDAG Kolkatta

2. NPTEL

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - I

*Elective - CEE 208*

### PLANNING AND MANAGEMENT OF WATER RESOURCES

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Introduction:**

Objectives: of water resource planning and management, its Necessity, Aspects of water resources planning, water resource development; needs and opportunities; social goals.

**Unit 2:**

constraints in the development of planning and management of water resources like non reversibility; planning region and horizon. Demand for drinking water; irrigation, hydropower; navigational; planning for flood control.

**Unit 3:**

**Reservoir operation studies** - Characteristics and functions of reservoir; reservoir sedimentation; conservation storage; conflict among uses. Effect on river regime; long term simulation; reliability; resiliency and vulnerability assessment

**Unit 4:**

**Management of Ground-Water Resources:** Ground water evaluation; conjunctive use of surface and ground water. Basin planning; inter-basin transfer of water.

**Unit 5:**

Cost benefit studies of single and multipurpose projects– multi objective planning models, financial analysis of water resources projects.

**Unit 6:**

**Economic Planning:** Allocation of cost of multipurpose projects; repayment of cost.Discounting techniques; benefit cost parameters; estimation of benefits and costs; appraisal criteria; social benefit cost analysis.

**Reference Books**


1. James, L .D., and Lee, R. R., “Economics of Water Resources Planning”, Mc Graw Hill.

2. Principles of Water Resources planning-by Goodman.

3. Water Resources System Planning – by M.C. Chaturvedi.

4. Water Resources Planning and Management by-O.J. Helwege.

5. Water Management System Application-A.K. Biswas

6. Water resource Engineering- Linsley and Franzini, Mc Graw-Hill

7. Water resources planning and management- Grafton and Hussey, Cambridge Uni. Press.

UNIVERSITY OF PUNE

**M. Tech. (Civil and Environmental Technology)**
**SEMESTER - I**
*Elective - CEE 209*
**OPTIMIZATION TECHNIQUES**

**Teaching Scheme:**
**Lectures: 4 Hrs. /Week**
**Credits: 4**

**Examination Scheme:**
**In-semester: 50 Marks**
**End-semester: 50 marks**

**Unit 1**

System Concepts: System concepts, definitions, needs for system approach, different types of system parameters and variables.

**Unit 2**

Linear Programming: Revision, Big M Method, duality, sensitivity analysis. Application of Linear Programming for Hydraulics & Water Resource

**Unit 3**

Non Linear Programming: Unconstrained one Dimensional search methods, Dichotomous search method, Fibonacci, Golden section, multivariable unconstrained, gradient techniques, steepest ascent and descent methods, Newton's methods, Application of Dichotomous search method, Fibonacci & Golden section to the various sectors of Water Resource Engineering, constrained Lagrangian multiplier techniques

**Unit 4**

Dynamic Programming: Principle of optimality, recursive equations. Application of Dynamic programming to Water Resource Engineering

**Unit 5**

Stochastic Methods: Queuing theory, simulation technique, sequencing model, Morkov's process

**Unit 6**

Theory of games, 2 person zero sum game with and without saddle point, mixed strategies (2 x n games or m x 2 games), 2 x 3 game with no dominance, graphical method

**Reference Books**


1. Engineering Optimazation Theory & Practice – S.S. Rao., Wiely.
2. Operation Research – Taha Hamdey A.
3. Principles of Operation Research – Wagner, Prentice Hall.
4. Operation Research – Hira and Gupta, S.Chand

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - II

*Elective - CEE 301*

### CONSTRUCTION CONTRACTS AND MATERIALS MANAGEMENT

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 4 Hrs. /Week** | **In-semester: 50 Marks** |
| **Credits: 4** | **End-semester: 50 marks** |

**Unit 1: Administration & Injunctions**

The standard forms of building contracts, the rights of building owners, adjoining owners and third parties. The Indian Contract Act, Sale of Goods Act. Professional ethics. Injunction: Types, Temporary, perpetual, mandatory

**Unit 2: Industrial Act and Labour Laws**

Industrial Dispute Acts, payment of wages act, Minimum Wages Act, Indian Trade Union Act, Limitation Act, and Workmen's Compensation Act.

**Unit 3: Arbitration, Bailment, Indemnity and Guarantee**

**Arbitration**-Awards & Dispute Resolving boards – Indian Arbitration Act, arbitration agreement, conduct of arbitration, power and duties of arbitrator. **Indemnity and Guarantee**-Difference between the two contracts, consideration for guarantee, surety's liability, discharge of surety. **Bailment**- Nature of transactions, delivery of bailee, Bailee's responsibility, Termination, Bailment of pledges.

**Unit 4: Introduction to Material Management**

Objectives, Importance and functions of material management, Integrated materials management-scope and advantages. Material management organization.

**Unit 5: Material Management**

Material Research, Material Planning, Codification, identification of sources of procurement, vendor analysis, Inventory Control- Necessity.

**Unit 6: Inventory Management**

Inventory Management, Inventory systems, ABC analysis, E.O.Q. Replenishing model, Obsolete, Surplus and Scrap management

**LAB:**

One hour per week of tutorial is to be utilized for case study based assignment solving to ensure that students have properly learnt the topics covered in the lectures.

**Reference Books**


1. Concrete Technology by Santhakumar A.R., Oxford University press,New Delhi. 2007.

2. Materials for Civil and Construction Engineers by Mamlouk, M.S. and Zaniewski, J.P.,

3. Prentice Hall Inc., 1999.

4. Engineering Materials 1: An introduction to Properties, applications and designs by

5. Ashby, M.F. and Jones.D.R., H.H. Elsevier Publications, 2005.

6. Civil Engineering Materials by Shan Somayaji, Prentice HallInc. 2001

7. Material management An Integrated Approach, P. Gopal Krishnan and M. Sundarsan, PHI publication, New Delhi

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - II**

*Elective - CEE 302*

### PROJECT ECONOMICS AND FINANCIAL MANAGEMENT

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit I: Principles of Economics:**

Importance of the economic background to measurement, objectives of business firm. Factors bearing on size of firms. Motives to growth. Obstacles to growth of firms, Study of present economy.

**Unit II:Capital:**

Analysis of need f or working capital, Estimation of requirements of working capital, Credit Management, Cash Management, Managing payments to suppliers and out standings.

**UNIT III:Economic Analysis:**

Cost implication to different forms of construction and maintenance and maintenance and replacement lives of material, Installation and running cost of services, Capital investment in project, Cost analysis by traders and by functional element, Cost Planning techniques, Cost control during design and Construction, Depreciation, Break-even analysis, Cash flow analysis.

**UNIT 4:Financial Planning:**

Long term finance planning, Stock, Borrowings, Debentures, Loan Capital, Public Deposit, Dividend Policies, Bonus Shares, Market value of shares, Reserves. Over and under capitalization, Introduction to Micro financing.

**UNIT 5:Budget:**

Budgetary control system. Types of budgets, Procedure for master budgets. Budget manual, Role of financing institutes in Construction.

**UNIT 6:Case Studies:**

Case studies for 1)BOT 2)Dams 3)Mass Transit System 4)Infrastructure Projects 5)Government Funded Projects with respect to a) Project Appraisal b) Raising of funds c) Cost to complete analysis

**LAB:**

One hour per week of tutorial is to be utilized for case study based assignment solving to ensure that students have properly learnt the topics covered in the lectures.

**Reference Books**


1. Construction project scheduling and control ----Mubarak, Wiley India.
2. Construction Management & PWD Accounts --- D Lal, S. K. Kataria & Sons, 2012
3. Construction Management and Accounts -- Singh H. Tata McGraw Hill, New Delhi, 1988
4. Construction Management: Planning and finance-- Cormican D. Construction press, London, Feb 2002.
5. Principles of Corporate Finance, Brealey R.A. Tata McGraw Hill, New Delhi, 2003.
6. Engineering Economics—Kumar---Wiley,India.
7. Engineering Economy, Leland T. Blank. Anthony Tarquin. McGraw Hill, 2008.
8. Engineering Economics, David Bedworth, Sabah Randhawa. McGraw Hill, 1996.
9. Real Estate, Finance and investment, Bruggeman. Fishr, McGraw Hill, 2010.
10. Foundations of Financial Management', Block Hirt. McGraw Hill, 2009.
11. Case studies in finance, Burner, McGraw Hill, 2009.
12. Cases in Finance , DeMello McGraw, 2003.
13. The cost management toolbox ; A Managers guide to controlling costs and
14. boosting profits. Oliver, Lianabel. Tata McGraw Hill, 1999.
15. "Financial Management" – Indian Institute of Banking and Finance – Macmillan Publications.
16. Projects planning, Analysis Selection, Implementation and Review, Prasanna Chandra Tata McGraw Hill, New Delhi, 2005
17. Fundamentals of Engineering Economics—Pravin Kumar, Wiley, India.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - II

*Elective - CEE 303*

### ENVIRONMENTAL SANITATION & SANITATION PRACTICES FOR RURAL INDIA

**Teaching Scheme :** **Examination Scheme:**

**Lectures :4 Hrs./Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**UNIT – I: Epidemiology:**

Communicable diseases, Micro-organisms, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control.

**UNIT – II: Insects and Rodent Control:**

Mosquitoes, life cycles, factors of diseases control methods – natural and chemical, Fly control methods and prevention of fly breeding, Rodents and public health, plague control methods, engineering and bio-control methods, disinfectants (Phenols, Lime, Chlorine, Ammonium compounds), Insecticides (DDT, BHC).

**UNIT – III: Industrial sanitation:**

Schools, Public Buildings, Hospitals, Eating establishments, Swimming pools – Study of factors like Light, Heat, Ventilation, Plumbing fixtures, Cleanliness and maintenance and comfort.

**UNIT – IV: Industrial Hygiene:**

Occupational Hazards, Industrial poisons, Dust, Noise, Heat, Compressed air, Vibrations and shocks- Industrial plant sanitation.

**UNIT – V: Rural Sanitation:**

Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems.: Two-pit latrines, human excreta based biogas plants

**UNIT -VI**

Rural sanitation improvement schemes – Solid Waste, Liquid Waste (Sullage & Black water management). Case studies on sanitation.

**Reference books:**


1. Victor Ehalers & Earnest W Steel, Municipal and Rural sanitation.
2. Bhatia H. S., Environmental Pollution and Control, Galgotia Publication Pvt. Ltd., New Delhi.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - II

*Elective - CEE 304*

### ENVIRONMENTAL STRUCTURE DESIGN

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Vibration and Seismic analysis for pipe and pipe support structure:**

Single Degree of Freedom Systems - Free and Damped Vibrations, Fundamentals of Vibration**:** Elements of a vibratory system, S.H.M., degrees of freedom, modeling of a system, concept of linear and non-linear systems, equivalent spring, linear and torsional systems, Undamped free vibrations: Natural frequency by equilibrium and energy methods for longitudinal. Damped free vibrations:

**Unit 2:**

Different types of damping, equivalent viscous damping, free vibrations with viscous damping – over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, dry friction or coulomb damping - frequency and rate of decay of oscillations. Single Degree of Freedom Systems - Forced Vibrations in environmental structure.

**Unit 3: Design of Cylinders**

Cylinders: Thick and thin cylinders, thin cylindrical and spherical vessels, Lame„s equation, Clavarino„s and Birnie„s equations, design of hydraulic and pneumatic cylinders, auto-frottage and compound cylinders, gasketed joints in cylindrical vessels (No derivation)

**Unit 4: Pressure Vessels**

Modes of failures in pressure vessels, unfired pressure vessels, classification of pressure vessels as per I. S. 2825 - categories and types of welded joints, weld joint efficiency, stresses induced in pressure vessels, materials for pressure vessel, thickness of cylindrical shells and design of end closures as per code, nozzles and openings in pressure vessels , reinforcement of openings in shell and end closures - area compensation method, types of vessel supports (theoretical treatment only).

**Unit 5: Design of RCC Structure**

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. - effect of earth pressure and uplift considerations - selection of materials of construction.

**Unit 6: Design of concrete roofing systems**

a) Cylindrical b) Spherical and c) Conical shapes using membrane theory of various types of folded plates & shell for roofing with concrete, IS Codes for the design of water retaining structures. Design of circular, rectangular and spherical type of RCC tanks.

**Reference Books**


1. Dynamics of structure theory and application to earthquake engineering- A.K. Chopra- Prentice

1. Hall Publication.

2. Structure Dynamic -Mario Paz CBS Publication

3. Unit Operation by G.K. Ghavane

4. Water and Waste Water Engineering - Metcalf Eddy – Tata Mc Graw Hill Publication

5. Water and Wastewater Engineering-Vol. II Fair, Geyer & Okun Wiley Toppan

6. Design of RCC Structure by Duggal

7. Mechanical Vibrations- Grover G. K. , Nem Chand and Bros., Roorkee

8. Theory of Vibration with Applications- Thomson, W. T., CBS Publishers and Distributors

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 305*

## FINITE ELEMENT METHOD

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

Approximate solution of boundary value problems-Methods of weighted residuals, approximate solution using variational method, Modified Galerkin method, Boundary conditions and general comments

**Unit 2:**

Basic finite element concepts-Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method, Application: Axial deformation of bars, Axial spring element

Analysis of trusses-Two dimensional truss element, three dimensional space truss element, Stresses due to lack of fit and temperature changes.

**Unit 3:**

Beam bending-Governing differential equation for beam bending, Two node beam element, Exact solution for uniform beams subjected to distributed loads using superposition, Calculation of stresses in beams, Thermal stresses in beams

Analysis of structural frames-Plane frame element, Thermal stresses in frames, Three dimensional space frame element

**Unit 4:**

General one dimensional boundary value problem and its applications-One dimensional heat flow, Fluid flow between flat plates-Lubrication Problem, Column buckling

Higher order elements for one dimensional problems-Shape functions for second order problems, Isoparametric mapping concept, Quadratic isoparametric element for general one dimensional boundary value problem, One dimensional numerical integration, Application: Heat conduction through a thin film

Two dimensional boundary value problems using triangular elements, Equivalent functional for general 2D BVP, A triangular element for general 2D BVP, Numerical examples

**Unit 5:**

Isoparametric quadrilateral elements-Shape functions for rectangular elements, Isoparametric mapping for quadrilateral elements, Numerical integration for quadrilateral elements, four node quadrilateral elements for 2D BVP, Eight node serendipity elements for 2D BVP

Isoparametric triangular elements-Natural (or Area) coordinates for triangles, Shape functions for triangular elements, Natural coordinate mapping for triangles, Numerical integration for triangles, Six node triangular element for general 2D BVP

Numerical integration-Newton-Cotes rules, Trapezium rule, Simpson's rule, Error term, Gauss-Legendre rules, Changing limits of integration, Gauss-Leguerre rule, Multiple integrals, Numerical integration for quadrilateral elements, Numerical integration for triangular elements

**Unit 6:**

Applications based on general two dimensional boundary value problem-Ideal fluid flow around an irregular object, Two dimensional steady state heat flow, Torsion of prismatic bars

Two dimensional elasticity-Governing differential equations, Constant strain triangular element, Four node quadrilateral element, Eight node isoparametric element

Axisymmetric elasticity problems-Governing equations for axisymmetric elasticity, Axisymmetric linear triangular element, Axisymmetric four node isoparametric element

Three dimensional elasticity-Governing differential equations, Four node tetrahedral element, Eight node hexahedral (brick) element, Twenty node isoparametric solid element, Prestressing, initial strains and thermal effects

**Lab Practice**

1. Three FEM assignments by using coding tools such as EXCEL, MATLAB etc for
    a) Formulation of stiffness matrix for any 1-D element
    b) Formulation of stiffness matrix for any 2-D element
    c) Formulation of stiffness matrix for any 3-D element
    d) Assembly procedure using Jacobian matrix
2. Finite Element Method – Software applications of any one of following cases
    a) Plane stress / plane strain problem
    b) Axisymmetric problem
    c) Three dimensional problem

d) Plate or shell structures

**Reference Books**


1. J.N. Reddy – An Introduction to finite element method – Tata McGraw Hill Publishing Co. Ltd

2. C.S. Krishnamoorthy – Finite Element Analysis – Theory & Programming – Tata McGraw Hill Publishing Co. Ltd

3. Zienkiewicz & Taylor - The Finite Element Method 4th Edition – Vol – I & II – McGraw Hill International Edition

4. G.R. Buchanan – Finite Element Analysis Schaum's outlines - Tata McGraw Hill Publishing Co. Ltd

5. S.S. Bhavikatti - Finite Element Analysis – New Age International Publishers, Delhi

6. S.S. Rao - The Finite Element Method in Engineering 4th Edition – ELSEVIER Publication

7. Robert D. Cook, D.S. Malkus, M.E. Plesha – Concepts & Applications of Finite Element Analysis – John Wiley & Sons.

8. Segerlind L.J. – Applied Finite Element Analysis - John Wiley & Sons.

## UNIVERSITY OF PUNE

**M. Tech. (Civil and Environmental Technology)**
**SEMESTER - II**
*Elective - CEE 306*
## SOIL-STRUCTURE INTERACTION

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Introduction, Importance and Applications of SSI:**

a) Introduction to SSI, Importance of SSI, Applications and examples of SSI for structural engineer, Effects of structure roughness/smoothness on soil behaviour.

b) General soil-structure interaction problems – Shallow Foundations, Sheet piles, Mat/Raft foundations etc., Contact pressures and soil-structure interaction for shallow Foundations, Fixed/Flexible Base.

**Unit 2: Soil Structure Interaction – Parameters:**

a) Concept of sub grade modulus, effects/parameters influencing sub grademodulus, Flexiable and Rigid Foundations – Rigidity calculations, Static and Dynamic Spring Constants – Winkler Model, Estimation of soil spring constants/stiffness for foundations design.

b) SSI Models - Elastic Continuum, Winkler Model, Multi-Parameter Models, Hybrid Model. Structure Contact Interface,

**Unit 3: Soil Behaviour:**

Arching in soils. Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits/pipes in soils. Beams on elastic foundation concept, introduction to the solution of beam problems.

**Unit 4: Seismic Soil-Structure Interaction:**

Dynamic response of soil, strain-compatibility, and damping characteristics of soil-structure. Shake-table tests.

**Unit 5: SSI in Retaining Structures:**

Curved failure surfaces, their utility and analytical/graphical predictions from Mohr-Coulomb envelope and circle of stresses. Earth pressure computations by friction circlemethod. Earth pressure distribution on walls with limited/restrained deformations,Dubravo’s analysis. Earth pressures on sheet piles, braced excavations. Design of supporting system for excavations.

**Unit 6: Soil-Pile Behaviour:**

Introduction, axial and laterally loaded piles, load-displacement behaviour,Modified Ramberg Osgood Model, pile group, interaction effect in pile group, soil-pile modeling in

FEM, Elastic continuum and elasto-plasticanalysis of piles and pile groups. Non-linear load-deflection response.

**Assignment:**

Technical review and critique of a research article/paper on any one of the topics from the above syllabus –

A detailed review and critique of a research article/paper in writing (5-10 pages) is expected from the students.

**Reference Books:**


1. Bowels J.E., “Analytical and Computer Methods in Foundation”, McGraw Hill Book Co. New York.

2. Desai C.S. and Christian J.T., “Numerical Methods in Geotechnical Engineering” McGraw Hill Book Co. New York.

3. Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers, 1989.

4. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co.

5. Prakash, S., and Sharma, H. D., “Pile Foundations in Engineering Practice.” John Wiley & Sons, New York, 1990.


**General Reading Suggested:**

**Codes/Hand books:**


1. “Foundation Engineering Handbook,” H.-Y. Fang, Editor, Van Nostrand Reinhold, 2nd Ed., New York, USA.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 307*

## OPEN CHANNEL FLOW

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

**Uniform flow**-Review and revision of uniform flow formulae and design of channels, Depth-energy relationship, specific energy, specific force, Critical flow, critical flow computations

**Unit 2: Gradually Varied Steady Flow:**

Gradually varied steady flow and rapidly varied steady flow in open channels, surface profiles in GVF analysis, Different method of computations, Chow's methods, standard step method, and finite difference method

**Unit 3: Rapidly varied flow--Hydraulic Jump:**

Formations of jump in expanding and contracting channel, jump type, jump control, jump on sloping floors,

**Unit 4: Spatially Varied Flow:**

Differential Equation of spatially varied flow, profile computation, SVF with lateral inflow.SVF with lateral outflow

**Unit 5: Unsteady Flow:**

Gradually varied unsteady flow: Continuity equation, dynamic equation, Monoclinal rising waves,dynamic equation for uniformly progressive flow, wave profile of uniformly progressive flow, wave propagation, Rapidly varied unsteady flow: Uniformly progressive flow, positive surge, negative surge, dam break problem

**Unit 6: Flood Routing:**

Hydraulic and Hydrologic flood routing, Reservoir and channel routing, Differential form of Momentum Equation, Muskinghum method, Finite difference scheme, Method of characteristics.

**Reference Books**


1. Open Channel Hydraulics – Ven Te Chow, Mc-Graw Hill.
2. Flow through Open Channel-K.G.Ranga Raju, Tata Mc-Graw Hill.
3. Flow in Open Channel – K. Subramanya, Tata Mc-Graw Hill.

4. Flow through open channels—Rajesh Srivastava—Oxford University Press

**5.** Open Channel Hydraulics-French, Mc-Graw Hill.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - II

*Elective - CEE 308*

### IRRIGATION AND DRAINAGE

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Soil water Relationships:**

Water storage zones and relative equilibrium states, flow of water in saturated and unsaturated soil, soil moisture determination

**Unit 2: Water-Soil Plant Relationships:**

Evaporation, transpiration, consumptive use, Salinity and Alkalinity in irrigated soil, Soil Erosion and conservation

**Unit 3: Drip Irrigation**

General concept, advantages, disadvantages, elements, design concepts

**Unit 4: Lift Irrigation :**

General concept, elements of lift irrigation schemes, design consideration involved in intake well, jackwell, rising main, distribution system, concept of cost economics.

**Unit 5: Sprinkler Irrigation:**

General concept, advantage and disadvantages, components of the system, types of Sprinklers, design concept

**Unit 6: Drainage of Irrigated Land:**

Need and purpose of drainage, water logging, design and construction of drainage systems, Ministry of agriculture- WMD recommendations.

**Reference Books**


1. Irrigation, Water Resources & Water Power Engineering, P.N. Modi
2. Irrigation Engineering Theory & Design – R.S. Varsheny.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 401*

## CONSTRUCTION MATERIALS AND TECHNIQUES

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Rock Excavation and Trenchless technology**

Introduction, Planning, Drilling: process and equipments, Special blasting techniques, . Introduction to TT, Concept, Methods used in Trenchless technology, equipments and applications of trenchless technology.

**Unit 2: Piles, pile driving and Offshore structures**

Introduction, Pile types, materials for piles, Pile driving equipments, Pile installation and Inspection. Off shore structure, types, methods of construction.

**Unit 3: Dewatering and tunneling Techniques**

Introduction, Various methods of dewatering, Pumps for dewatering, Vacuum dewatering in concrete slab construction, its process and Equipment. Mechanical excavation for tunneling in hard and soft strata.

**Unit 4: Materials and methods:**

Hot and cold weather concreting – underwater concreting - mass concreting - high strength and high performance concretes ,fibre reinforced concrete- GFRC- Ready mixed concrete - light weight concrete – Ferro cement- Self compacting concrete.

**Unit 5: Use of waste products and industrial by-products:**

Construction and demolition waste,Fly ash, micro-silica, GGBFS and other mineral products- Geo-textiles and geosynthetics – applications in Civil Engineering .

**Unit 6: Concreting Techniques**

Concrete placing underwater, concrete pumps, boom placers, mixers, conventional methods. Grouting: Drilling pattern ,procedure, grounting pressures, Applications, Limitations Effeciency of grouting for dams,tunnels shafts.

**LAB:**

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures.

**Reference Books**


1. Practical foundation engineering hand book by Robert wade Brown, McGraw Hill Publications, 1995.

2. Construction Dewatering: New Methods and Applications by Patrick Powers. J., John Wiley & Sons, 1992

3. Advanced Construction Techniques by Jerry Irvine, CA Rocketr, 1984.

4. Concrete repair and maintenance illustrated by Peter.H.Emmons, Golgotha Publications Pvt. Ltd., 2001.

5. Construction Technology by Sankar, S.K. and Saraswati, S., Oxford University Press, New Delhi, 2008,

6. Neville, A.M., Properties of Concrete, Pearson Education Asia (P) Ltd, England, 2000.

7. Mehta, P.K and Montevic. P.J., Concrete- Microstructure, Properties and Materials, ICI, 1997.

8. Vedhikizen Van Zanten, R., (Ed), Gerotextiles and Geomembranes in Civil Engineering.

9. Koerner, R.M., Construction and Geotechnical Methods in Foundation Engineering, McGraw Hill Co., 1985.

10. Rosen, H.J., Construction Materials for Architecture, John Wiley, 1985.

11. Flinn, R.A and Trojan, P.K., Engineering Materials and their Applications, Jaico Publications House, Delhi, 1999.

12. Nawy E , Fundamentals of High Performance Concrete, Second Edition, John Wiley & Sons, New York, 2001.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 402*

## WORK STUDY AND INCENTIVE MANAGEMENT

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Work Study:**

The evolution of work study: F.W.Taylor, Gilbreth, definations, objective, basic procedure of work study,method study and incentive management. Study and work measurements, work content,productivity. Work study and its applications to civil engineering.

**Unit 2: Method study:**

Definations,objectives,procedure,selection of the work,recording the facts,process chart,symbols,flow process charts,multiple activity charts, two handed process charts, string diagrams, travel charts, other types of charts and diagrams.

**Unit 3: Work Measurement:**

Time study, objectives,procedure, concept of various allowances, performance rating, standard performance, standard time, time study equipments. Activity sampling, PETS, Standard data, analytical estimation, work specifications.

**Unit 4: Application of work study :**

The human context of work study, work study as a service to management, Limitations of work study. Critism of time study, training of personals in work study.

**Unit 5 : Value Engineering**

Meaning of value, basic and secondary functions, factor contributing to value such as aesthetic, ergonomic, technical, economic: identifying reasons or unnecessary costs. 10 Commandments of value analysis; value analysis team; principles of value analysis, elements of a job plan viz. orientation, Information, presentation. Implementation, follow up action, benefits of value analysis, various applications; assessing effectiveness of value analysis.

**Unit 6: Merit Rating:**

Job evaluation, Installation of incentive schemes, the work improvement and system concept, causes of failure of incentive schemes, Ergonomics.

**LAB:**

One hour per week of tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures

**Reference Books**


1. Projects – Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata McGraw Hill Publications.

2. Construction Management and Planning – B. Sengupta and H. Guha, Tata McGraw Hill Publications

3. Civil Engineering Project Management – C. Alan Twort and J. Gordon Rees, Elsevier Publications

4. Total Project Management – The Indian Context – P. K. Joy, MacMillian Publications

5. Work Study, R.M.Currie

6. Work study applied to building,Gearry.

7. Incentive Management,Lincon

8. Industrial Engineering and Management,O.P.Khanna

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 403*

## ENVIRONMENTAL LEGISLATION AND MANAGEMENT SYSTEM

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: (7/8 hours)**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement,Rio declaration, Functions and Constitutions of SPCB and CPCB.

**Unit -2 (7/8 hours)**

Water (P & Cp) Act, 1974: Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

**Unit -3 (7/8 hours)**

Air (P & Cp) Act, 1981: Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

**Unit -4 (7/8 hours)**

Environment (Protection) Act 1986: Genesis of the Act – delegation of powers – Role of Central Government - Latest EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management.

**Unit -5 (7/8 hours)**

Fundamentals of Environmental Management and ISO 14000 series: Background and development of ISO 14000 series. Environmental management Plans, principles and elements. The ISO 14001- Environmental management systems standard. Environmental law in India: Environmental policy and laws.

**Unit -6 (7/8 hours)**

Role of Judicary and NGO: International concern for environment, Role of judiciary in environmental protection, Environmental audit, ISO certification, Environmental

management system, International and national efforts at environmental protection; Environmental policy. Relevant Provisions of Indian Forest Act, Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

**Unit – 7 (7/8 hours)**

Important powers and functions of the MPC board under both the water and air acts, Role of SPCB in implementation of various notifications issued by Central Govt. under Environment (Protection) Act, 1986, Hazardous waste (Management and Handling) Rules, 1989, Bio-Medical Waste (M & H) Rules, 1998, Notifications issued by Govt. of Maharashtra for the protection and improvement of environment.

**Unit – 8 (7/8 hours)**

Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – responsibilities of generators and role of Pollution Control Boards, Procedure of public hearing for obtaining Environmental Clearance. Role of NGO in Nature Conservation.

**Reference Books:**


1. CPCB, “Pollution Control acts, Rules and Notifications issued there under “Pollution
2. Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
3. Shyam Divan and Armin Roseneranz “Environmental law and policy in India “Oxford
4. University Press, New Delhi, 2001.
5. Greger I. Megregor, “Environmental law and enforcement”, Lewis Publishers,
6. London1994.
7. Constitution of India [ Referred articles from part-III, part-IV and part-IV A]
8. Pares Distn. Environmental Laws in India (Deep, Lated edn.)
9. Handbook of environmental management and technology: Gwendolyn Holmes, Ben
10. Ramnarine Singh, Louis Theodore.
11. The ISO 14000 Handbook: Joseph Cascio.
12. ISO 14004: Environmental management systems: General guidelines on principles,
13. systems and supporting techniques (ISO 14004:1996 (E)).
14. ISO 14001: Environmental management systems: Specification with guidance for use

15. (ISO 14001:1996b(E)) ( International organization for standardization-Switzerland).

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER -II

*Elective - CEE 404*

## ENVIRONMENTAL GEOTECHNOLOGY

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

Soil classification, Identification and classification, criteria for classifying soil - classification on the basis of grain size, plasticity, symbolic & graphic presentation, Classified soils and engineering properties, Soil structure & clay minerals Clay minerals, clay water relations, clay particle interaction, soil structure & fabric, granular soil fabric. (Including numerical)

**Unit 2: Introduction to Environmental Geotechniques:**

Environmental cycles and their interaction-Soil water environment interaction relating to geotechnical problems-Effect of pollution on soil water behavior. Sources, production and classification of wastes Environmental regulations in India-Case studies of foundation failures by ground contamination, (Including numerical)

**Unit 3: Site Selection And Method of Disposals:**

Criteria for selection of sites for waste disposal facilities parameters controlling the selection of wastes disposal sites-current practices for waste disposal, subsurface disposal techniques-Passive contaminant systems-Leachate contamination-applications of geomembrane and other techniques in solid and liquid waste disposal-rigid or flexible membrane liners.(Including numerical)

**Unit 4: Hydrology of Contaminants:**

Transport phenomena in saturated and partially saturated porous media-contaminant migration and contaminant hydrology-Hydrological design for ground water pollution control-Ground water pollution downstream for landfills, bearing capacity of compacted fills-foundation for waste fill ground-pollution of aquifers by mining and liquid wastes-protection of aquifers (Including numerical)

**Unit 5: Remedial Measures:**

Ground modification techniques in waste fill, Remedial measures for contaminated grounds-Remediation technology-Bio-remediation Geosynthetics - types, functions, properties and functional requirements. Design and Application of geosynthetics in geo-environment, Reinforced soil Mechanism.

**Unit 6:**

Applications–reinforcement soil structures with vertical faces, reinforced soil embankments. Reinforcement soil beneath unpaved roads, reinforcement of soil beneath foundations, Open excavation and slope stabilization using soil nails. (Including numerical)

**References Books**


1. Hazardous Waste Management - Wentz, C.A., McGraw Hill, Singapore, 1989.
2. Geotechnical Practice for Waste disposal - Daniel, B.E., Chapman and Hall, London, 1993
3. Proceedings of the International symposium of Environmental Geotechnology Vol.I and Vol.II- Environmental Advance Soil Mechanics – Braja Mohan Das- Tata Mc-Grawhill
4. Geotechnical Engineering - Shashi K. Gulati & Manoj Datta – Tata Mc-Graw Hill
5. Basic and Applied Soil Mechanics- Gopal Ranjan & A.S. Rao- New Age Pub.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER -II

*Elective - CEE 405*

## THEORY OF PLATES AND SHELLS

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

a) Introduction: Thin and thick plates, small and large deflections. Small deflection theory of thin plates: Assumptions, Moment Curvature relations. Stress resultants. Governing differential equation in Cartesian co-ordinates, various boundary conditions. Pure Bending of Plates

b) Analysis of Rectangular Plates: Navier solution for plates with all edges simply supported. Distributed loads, point loads and rectangular patch load.

**Unit 2:**

a) Levy's Method: Distributed load and line load. Plates under distributed edge moments. Raleigh- Ritz approach for simple cases in rectangular plates.

b) Introduction to shear deformation theories. Reissener - Mindlin Theory, Moment curvature relationship for First order shear deformation theory.

**Unit 3:**

a) Circular Plates: Analysis of circular plates under axi-symmetric loading. Moment Curvature relations.Governing differential equation in polar co-ordinates.

b) Simply supported and fixed edges. Distributed load, ring load, a plate with a central hole.

**Unit 4:**

a) Introduction: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations.

b) Shells of Revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.

**Unit 5:**

a) Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions.

b) Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions. Application to pipes and pressure vessels.

**Unit 6:**

Beam theory of cylindrical shells: Principles of Lundgren's beam theory, beam analysis, arch analysis, application to cylindrical roof shells.

**Term Work**

The term work shall consist of a journal giving details of at least 8 out of 12 of the following experiments / assignments of which Sr.No 11 and 12 are compulsory.

1. Assignment based on Section I
2. Assignment based on Section II

**Reference Books**


1. S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.
2. Ansel C. Ugural Stresses in Plates and Shells, Mc Graw Hill
3. G. S Ramaswamy, Design and Construction of Concrete Shell Roofs, CBS Publications
4. Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition
5. Chandrashekhara K., Analysis of Plates, New Age International Edition

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER -II

*Elective - CEE 406*

### ADVANCED DESIGN OF STEEL STRUCTURES

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

Hoarding Structures – Analysis and design of hoarding structures under dead live and wind load Conditions. Introduction to fatigue failure, Code provisions.

**Unit 2:**

Castellated beams – Fabrication of the castellated beam from rolled beam. Design of castellated beam for bending and shear, Code provisions

**Unit 3:**

Microwave Towers – Introduction, structural configuration, function, analysis and design.

Transmission Towers – Introduction, structural configuration, bracing systems, analysis and design, codal provision for design of tower and foundation.

**Unit 4:**

Tubular Structures - Tubular Trusses, joint details, tubular scaffoldings, codal provisions, Circular Hollow, Rectangular Hollow sections

**Unit 5:**

Cold Form light gauge section- Type of cross section, Stiffened, multiple stiffened and unstiffened element, flat- width ratio, effective design width, Design of light gauge compression, tension and flexural members. Codal provisions

**Unit 6:**

Review of Rigid and semi-rigid connections. Design of beam to column Moment resisting connections. End plate: Flush & extended, T-Stub connections. Combined tension & shear considerations in welded & bolted connection.

**References Books**


1. Ram Chandra - Design of steel Structures Vol II, Standard Book House, Delhi

2. Punmia and Jain- Comprehensive Design of steel structure.

3. Teaching resource materials by INSDAG, Kolkatta

4. IS: 800 – 2007 Code of Practice for General Construction in Steel 22/29

5. IS: 875 – 1964 Code of Practice for Structural Safety of Building: Loading Standards(Revised)

6. N Subramanian - Design of Steel Structure, Oxford University Press, New Delhi.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER -II

*Elective - CEE 407*

### ADVANCED FOUNDATION DESIGN

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: SOIL STRUCTURE INTERACTION**

Foundation objectives and their importance, Classification of foundations, Soil classification. Geotechnical design parameters, bearing capacity, settlements and factors affecting settlement.

Loads for design, depth of foundation and depth of soil exploration. Parameters for design of foundation on various types of soil, soil structure interaction.

**Unit 2: DESIGN OF RAFT FOUNDATIONS**

Types of rafts, Design of Flat slab raft foundation, Design of beam and slab raft foundation.

**Unit 3: PILE FOUNDATION –I**

Function and Classification of piles, Concrete piles, Precast and cast-in-situ piles. Static point and skin resistance capacity of a Pile, Pile settlements.

Laterally loaded Piles. Various pile group patterns, Efficiency of Pile in group, Negative skin friction.

Shell Foundations: Types and applications, Soil structure interaction, Membrane analysis for Hyper and Conical RC shells with and without edge beams, detailing of critical sections.

**Unit 4: PILE FOUNDATION-II**

IS code recommendations for structural design for various piles. Design of RC cast-in-situ and precast pile by IS code method. Pile group analysis by rigid and flexible methods, Design of pile cap.

**Unit 5: SHEET PILE**

Introduction to Sheet piles, its functions, construction factors Design of sheet piles

**Unit 6: CAISSONS**

Introduction to Caisson, its functions, types, applications and forms, Design and construction factors.

**Assignments:**

Technical review and critique of a research article/paper on any one of the topics –

(1) Drilled Shaft (2) Caisson - Construction, Analysis, Design, Problems, Case Study

A detailed review and critique of a research article/paper in writing (5-10 pages) is expected from the students.

**References Books**


1. Kurain N.P, Modern Foundations: Introduction to Advance Techniques: TataMcGraw Hill,1982

2. Kurain N. P, Design of foundation systems Principles and Practice, Narosa Publishing house, New Delhi, 2005.

3. Dr. H.J.Shah, Reinforced Concrete, Vol II, Charotar Publishing House.

4. Winterkorn H.F. and Fang H.Y. Ed., Foundation Engineering Hand Book, Van-Nostrand Reynold, 1975

5. Bowles J.E., Foundation Analysis and Design (4th Ed.), Mc.Graw –Hill, NY, 1996

6. Poulose H.G. and Davis E.H., Pile foundation Analysis and Design, John-Wiley Sons, NY, 1980.

7. Leonards G. Ed., Foundation Engineering, Mc.Graw-Hill, NY, 1962

8. Shamsher Prakash, Soil Dynamics, McGraw Hill

9. Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill

10. O'Neil, M.W. and Reese, L.C. "Drilled Shafts: Construction Procedures and Design Methods", FHWA Publication No. FHWA-IF-99-025, Federal HighwayAdministration, Washington, D.C., USA, 1999.

11. P. C. Varghese, "Design of Reinforced Concrete Foundations", PHI Learning Pvt. Ltd., New Delhi, 2009.

12. IS 1904: 1986 Code of practice for design and construction of foundations in soils: general requirements (Third Revision)

13. IS 2911: Part 1 : Sec 1 to3 : 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles

14. IS 2911: Part 1: Sec 4 : 1984 Code of practice for design and construction of pile foundations: Part 1 Concrete piles

15. IS 2911: Part 3: 1980 Code of practice for design and construction of pile foundations: Part 3 Under-reamed piles

16. IS 2950: Part 1: 1981 Code of Practice for design and construction of raft foundations: Part 1: Design

17. IS 2974: Part 1to 5: 1982 Code of practice for design and construction of machine foundations

**GENERAL READING SUGGESTED:**

**CODES:**

1. Reese, L.C. and O'Neill, M.W., 1988. "Drilled Shafts: Construction and Design."

2. FHWA, Publication No.HI-88-042, USA.

3. FHWA-NHI-10-016, “Drilled Shaft: Construction Proceduresand LRFD Design Methods,”2010, U.S. Department of TransportationFederal Highway Administration, Washington, D.C., USA.

4. (http://www.fhwa.dot.gov/engineering/geotech/foundations/nhi10016/nhi10016.pdf)

**Hand books:**

1. “Foundation Engineering Handbook,” H.-Y. Fang, Editor, Van Nostrand Reinhold, Kulhawy, F.H. (1991). “Drilled Shaft Foundations.” Chapter 14, 2nd Ed., New York, pp. 537-552.

**e-Resources:**

1. http://www.fhwa.dot.gov/engineering/geotech/library_listing.cfm … … (Free Reports)

2. www.Wikipedia.com

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

### SEMESTER - II

*Elective - CEE 408*

### SEDIMENT TRANSPORT & RIVER MECHANICS

**Teaching Scheme:** **Examination Scheme:**

**Lectures:4 Hrs./Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1:Introduction:**

Introduction fluvial hydraulics, Definition of sediment, Origin and formation of sediments, Nature of sediment problems, fundamental properties of individual sedimentary particles, Concept of fall velocity, Bulk properties of sediment

**Unit 2:Incipient Motion:**

Approaches of establishment of incipient motion, Shields analysis, Regimes of flow – study of different bed forms like ripples, dunes, anti - dunes with characteristics, significances, resistance analysis

**Unit 3:Sediment Transport:**

Modes of sediment transport, Introduction to different bed load equations – empirical, dimensional and semi-theoretical equations. Detailed study of DuBoy's equation, Enstein equation, Meyer-Peter and Müller equation. Concept of suspended load, total load, wash load.

**Unit 4:Stable Channel Design:**

Concept of stable channel, Design procedures such as Kennedy method, Lacey's method. Brief introduction of other methods such as Bunch, Simmon- Albertston method, Tractive force approach

**Unit 5:Sediment Measurements:**

Measurement of bed load and suspended load , Plan forms of river bends, Channel characteristics, bifurcations, confluences, river gauging, continuity Equation for sediment, stream bed changes during Floods, Silting of reservoir

**Unit 6:River Training Works:**

Objective of river training and bank protection, River training for flood control, navigation, Guiding the flow, sediment control, River bank protection, Introduction to sediment transport through pipes, Introduction to alluvial river models

**Reference Books**

1. Yang. C.T. "Sediment Transport theory and Practice " McGraw –Hill , New-York, 1996

2. Graf, W.H. “Hydraulics of Sediment Transport”, McGraw –Hill , New-York,1971

3. Raudkivi, A.J. “loose Boundary Hydraulics”2nd edition, Pergamon Press, 1976

4. F.M.Hendorson,” Open Channel Flow “Mac Millon , New York , 1996

5. Grade, R.J. and Ranga Raju, K.G.”Mechanics of Sediment Transport and Alluvial Stream

6. Problems” New Age International (P) Ltd. Publications, New Delhi , 2006.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 409*

## GROUND WATER MODELING

**Teaching Scheme :** **Examination Scheme:**

**Lectures :4 Hrs./Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Groundwater Occurrence & Movement:**

General Introduction, Darcy's law, application of Darcy's law to confined and unconfined aquifers, wells - fully & partially penetrating wells, multiple wells, interference of wells, pumping test with steady and unsteady flow

**Unit 2: Surface and sub-surface investigation of ground water:**

Geological/geophysical exploration/remote sensing/electric resistivity/seismic refraction based methods for surface investigation of ground water, test drilling and ground water level measurement

Sub-surface ground water investigation through geophysical/resistivity/ spontaneous potential/radiation/temperature/caliper/fluid conductivity/fluid velocity/miscellaneous logging

**Unit 3: Planning of groundwater development:**

Water balance, assessment of recharge, utilizable recharge, Groundwater estimation norms in India, Constraints on groundwater development, Planning of ground water development in canal command areas-conjunctive use models, planning of ground water development in coastal aquifers

**Unit 4: Numerical modeling of groundwater flow:**

Ground water modeling through porous media/analog/electric analog/digital computer models; Review of differential equations, finite difference solution, direct problem, inverse problem; groundwater modeling using finite element method

Artificial ground water recharge: Concept, methods of artificial ground water recharge, waste water recharge for reuse, water spreading

**Unit 5: Management of Ground Water:**

Ground water basin management concept, hydrologic equilibrium equation, ground water basin investigations, data collection & field work, dynamic equilibrium in natural aquifers, management potential & safe yield of aquifer, stream-aquifer interaction

**Unit 6: Saline water intrusion in coastal aquifersl:**

Ghyben-Herzberg relation between fresh & saline waters, shape & structure of fresh & saline water interface

Upcoming of saline water, fresh-saline water relations on oceanic islands, sea water intrusion in Karst terrains, saline water intrusion control

**Reference Books**


1. Remson, I., Hornberger, G. M., and Molz. F. J., Numerical methods in sub-surface hydrology, Wiley Inter Science.

2. Rushton, K. R. and Redshaw, S. C., Numerical analysis by analog & digital methods, John Wiley.

3. Todd, D. K., Groundwater Hydrology, John Wiley, 1980.

4. Groundwater Modeling by Anderson.

5. Numerical ground water modeling by A K Rastogi, Penram International Publishing (India) Pvt Ltd. 2007

## UNIVERSITY OF PUNE

**M. Tech. (Civil and Environmental Technology)**
**SEMESTER - II**
*Elective - CEE 501*

### MAINTENANCE AND REHABILITATION OF BUILDINGS

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 4 Hrs. /Week** | **In-semester: 50 Marks** |
| **Credits: 4** | **End-semester: 50 marks** |

**UNIT 1: Durability**:

Life Expectancy of Different Types of Buildings –Influence of Environmental Elements Such as Heat, Moisture, Precipitation and Frost on Buildings- Design and Construction Errors, Corrosion Mechanism- Effect of Biological Agents like fungus, moss, plants, trees, algae, -Termite Control and Prevention - Chemical Attack on Building Materials and Components- Aspects of Fire and Fire Prevention on Buildings- Impact of Pollution on Buildings.

**UNIT 2: Maintenance:**

Definitions, objectives , Phases of Maintenance, Repair and Rehabilitation- Common Defects In Buildings And Measures To Prevent And Control The Same- Building Failures – Causes And Effects- Cracks In Buildings -Preventive Measures o Various Aspects- Inspection, Assessment Procedure For Evaluating Damaged Structure -Causes of Deterioration - Testing Techniques- Non Destructive Testing Methods.

**UNIT 3: Materials** :

Materials For Repair - Special Mortar And Concretes, Concrete Chemicals, Special Cements And High Grade Concrete – Expansive Cement, Polymer Concrete, Sulphur Infiltrated Concrete, Ferro Cement, Fiber Reinforced Concrete- Admixtures Of Latest Origin.

**UNIT 4: Techniques for Repair**

Surface Repair – Material Selection – Surface Preparation – Rust Eliminators And Polymers Coating For Rebars During Repair – Repair Of Cracks In Concrete And Masonry-Methods Of Repair - Epoxy Injection, Mortar Repair For Cracks - Guniting And Shotcreting - Waterproofing Of Concrete Roofs.

**UNIT 5: Strengthening Measures**

Flexural Strengthening, Beam Shear Capacity Strengthening, Column Strengthening, Shoring, Under Pinning And Jacketing

**UNIT 6: Demolition Of Buildings** – Introduction – Planning, Precautions And Protective Measures In

Demolition Work-Sequence Of Operations- Demolition Of Structural Elements.

**LAB:** One hour per week of tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures

**Reference Books**


1. Denison Campbell, Allen and Harold Roper, “Concrete Structures ", Materials, Maintenance and Repair,

2. Longman Scientific and Technical UK, 1991.

3. R.T.Allen and S.C.Edwards, " Repair of Concrete Structures ", Blakie and Sons, UK, 1987.

4. A.R. Santhakumar,, “Concrete Technology”, 2012 Oxford University Press ,2006

5. Edward D. Mills,” Building Maintenance and Preservation: A Guide for Design and Management”, Butterworth-Heinemann, 1996

6. Raikar, R.N., " Learning from failures - Deficiencies in Design ", Construction and Service - R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.
7. CPWD “Handbook on Repairs and Rehabilitation of RCC Buildings”, 2002
8. Xilin Lu ,”Retrofitting Design of Building Structures”,Science Press,2010

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)
### SEMESTER - II
*Elective - CEE 502*

### SOLAR ENERGY AND BUILDINGS

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Principles**

Energy consumption and physical quantities, Forms of energy, Principles of thermodynamics, solar radiation: Quality & Quantity. Energy uses.

**Unit 2: Sun and Building**

Solar heat gain, solar geometry, solar and thermal control, Ventilation. Solar houses: case studies (MIT solar house 1-4, Tokyo house, Nagoya laboratory…..)

**Unit 3: Economics and prospects**

Annual heat requirement, solar contribution, Value of heat, Cost benefit studies, solar heat industry: Water heaters, pool heaters, photoelectric devices, building applications, refrigeration and their costs.

**Unit 4: Design guide**

Device and feasibility study, System, size and collector position, heat emitters and control, developments.

**Unit 5: Net zero building overview**

Definition, classification, alternative approaches, certification and trends. Project conception and delivery.

**Unit 6: Passive architecture:**

Passive design, design science, building envelop, passive strategies. Renewable energy.

**Reference Books**


1. Solar energy and buildings, S. V. Szokplay, Architectural Press, Pennsylvania State University
2. Net zero energy design, Tom Hootman, Jhon willy & sons, New Jersey.
3. Energy efficient buildings in India, Mili Mujumdar, Ministry of non conventional energy sources,Tata energy research institute, New Delhi
4. Design with energy: The conservation and use of energy in buildings, John Litter and Randall Thomas, Cambridge University Press
5. Passive solar buildings, J Douglas Balcomb, ISBN-0-262-02341-5, Massachusetts Institute of Technology.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - II**

*Elective - CEE 503*

**SOLID AND HAZARDOUS WASTE MANAGEMENT**

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit-I: Introduction:**

Problems and issues of solid and hazardous waste management, Waste management planning, Toxicology and risk assessment.

**Unit-II: Types and sources of solid and hazardous wastes:**

Need for solid and hazardous waste management - Legislations on management and handling of municipal solid wastes, hazardous wastes and biomedical wastes.

**UNIT-III: Waste generation rates:**

Composition - Hazardous Characteristics – TCLP tests – waste sampling- reduction of wastes at source – Recycling and reuse. Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations -labeling and handling of hazardous wastes.

**UNIT-IV: Waste processing:**

processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

**UNIT-V: Disposal:**

site selection - design and operation of sanitary landfills- secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – landfill remediation

**UNIT-VI:**

Elements of integrated waste management. Economy and financial aspects of waste management. Other Waste Types: Nuclear and Radio Active Wastes.

**Reference Books:**


1. Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, Integrated Solid Waste Management, McGraw- Hill, New York, 1993
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000

3. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental
4. Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
5. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
6. Charles A. Wentz, Hazardous Waste Management, Second Edition, Pub: McGraw Hill International Edition, New York, 1995.

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)
### SEMESTER - II
*Elective - CEE 504*
### AIR POLLUTION AND CONTROL

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Introduction:**

Definition, Sources and classification of Air Pollutants, Photochemical smog, Effects of air pollution on health, vegetation & materials, air quality, Global effects of air pollution.

**Unit 2: Meteorology:**

The atmosphere, zones of atmosphere, scales of meteorology, meteorological parameters, Heat, Wind, Pressure, Moisture and humidity, Rainfall and precipitation, Temperature lapse rate, Maximum mixing depth (MMD), Plume behavior, Effect of topography on pollutant dispersion, effect of air pollutant on meteorology, Air pollution modeling, Minimum stack height.

**Unit 3: Modeling of Dispersion of Air Pollutants:**

Dispersion of Air pollutants. Theories on modeling of Air pollutants. Gaussian model etc. Equations of the estimation of pollutant concentrations. Plume Rise – Equations for estimation. Effective stack height and mixing depths.

**Unit 4: Particulate Pollution Control Methods:**

Dilution, Source control,Control by using equipments such as Settling chambers, Cyclones, Fabric Filters, Electrostatic precipitators Wet Scrubbers/Wet Collectors, design and principle of these air pollution control units. **Gaseous pollution control:** Types of gaseous pollution control methods – absorption, adsorption and combustion processes. $SO_x$ Control Technology, Desulfurization of flue gas emissions, $NO_x$ Control Technology, Automobile pollution, sources of pollution, composition of auto exhausts, Control methods

**Unit 5: Air pollution Monitoring and Management:**

Environmental guidelines for sitting of Industries, Environment Management plan, stack emission standard, ambient air quality standards, stack emission monitoring, ambient air quality monitoring, ambient air quality survey.

**Unit 6:**

**Automobile Pollution:** Vehicular emissions, Motor fuel combustion, Automobile emission control.

**Odour pollution:** Theory of Odour, Sources of Odour, Measurement of Odour, Odour

control method.

**Indoor Air Pollution:** Causes of air pollution, Sources and effects of indoor air pollutants, changes in indoor air quality, Control of indoor air pollutants, air cleaning systems, Cigarette smoke.

**Reference Books**


1. H. C. Perkins, Air Pollution.
2. Peavy and Rowe, Environmental Engineering, Mc-Graw Hill Publication.
3. N.D. Nevers, Air Pollution Control Engineering, Mc-Graw Hill Publication.
4. M. N. Rao et al. Air Pollution, Tata Mc-Graw Hill Publication.
5. Noel de Nevers, Air Pollution control Engineering, Mc-Graw Hill Publication, New York.
6. Richard W. Boubel et al., Fundamentals of Air Pollution, Academic Press, New York.
7. KVSG Murali Krishna. Air pollution and control, Kaushal and Company, Jagannaickpur, Kakinada-2.
8. Davis. Environmental Engineering, Mc-Graw Hill Publication.
9. C.S. Rao., Environmental Pollution Control Engineering, Wiley Eastern Limited, New Delhi (1991).
10. John H. Seinfeld, Air Pollution: Physical and Chemical Fundamental, Mc-Graw Hill book Co. 1988.
11. Paul N. Cheremisinoff, Richard A. Young, Air Pollution Control and Design Handbook, Part-I, Marcel Dekker Inc., New York 1977).
12. Paul N. Cheremisinoff (ed.), Encyclopedia of Environmental Control Technology, Vol. 2, Air Pollution Control, Guld Publishing Company. (1989).

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# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 505*

## EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1:**

Engineering Seismology, Elastic rebound theory, Theory of plate tectonics and movement of Indian plate. Seismic waves. Seismic intensity, Richter scale, Tsunami. Seismic zoning maps of India and comparison study. Response spectra. Strong motion characteristics.

**Unit 2:**

Earthquake effects on the structures, classification of loads, Seismic methods of analysis, seismic design methods. Seismic damages during past earthquakes and effect of irregularities and building architecture on the performance of RC structures. Mathematical modelling of multi-storeyed RC buildings with modelling of floor diaphragms and soil-foundation, Winkler model.

**Unit 3:**

Design of multi-story RC structure with foundation as per latest IS: 1893 by Equivalent static lateral load method and Response Spectrum Method. Introduction to Time history method. Capacity based design of soft story RC building, design of Shear Walls. Ductile detailing as per latest IS: 13920.

**Unit 4:**

Seismic design of multi-storeyed steel structures with various bracing systems. Lateral load analysis and design of two- storied masonry buildings. P-delta analysis.

**Unit 5:**

Seismic design of Elevated RC Circular Water Tanks. Ductility requirements, types of ductility, factors affecting ductility. IS code provisions

**Unit 6:**

Seismic retrofitting, Sources of weakness in RC framed buildings, Classification of retrofitting techniques, Conventional and non-conventional methods, Comparative study of various methods and case studies. Introduction to Base Isolation systems. IS code provisions for retrofitting of masonry structures, failure modes of masonry structures and repairing techniques.

**Lab Practice**

Modelling of multi-storeyed structures including shear walls and diaphragms using standard software for all load combinations.

**Reference Books**


1. P. Agarwal and M. Shrikhande – Earthquake Resistant Design of Structures, Prentice-Hall Publications.
2. IS:1893 – Indian Standard Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
3. IS:13935 – Repair and Seismic Strengthening of Buildings – Guidelines, 1993
4. IS:4326 – Earthquake Resistant Design and Construction of Buildings – Code of Practice, 1993
5. IS:13828 – Improving Earthquake Resistance of Low Strength Masonry Buildings, 1993
6. IS:13827 - Improving Earthquake Resistance of Earthen Buildings, 1993
7. IS:13920 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Force, 1993
8. IS: 3370- Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.
9. Clough and Penzin – Dynamics of Structures, Mc-Graw Hills Publications.
10. Jai Krishna, A.R. Chandrashekharan and B Chandra – Elements of Earthquake Engineering, South Asian Publishers Pvt. Ltd.
11. Joshi P S et al. - Design of Reinforced Concrete Structures for Earthquake
12. Resistance Published by Indian Society of Structural Engineers, 2001

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 506*

## DESIGN OF PRECAST COMPONENTS AND FERROCRETE

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

### Unit 1: INTRODUCTION

History and Development of Precast concrete construction, Advantages and disadvantages of precast concrete construction; different types of units involved in general building construction, including residential, factory and industrial framed structure; their general principles of design; mechanical handling of large projects like stadium, bridges etc.

### Unit 2:

Materials viz. Concrete, Self Compacting Concrete, Grout, Reinforcement and structural welded wire cages. Requirements of industrialized buildings, standardization of precast elements and unification of building design. Influence of manufacture, transport and erection technologies on design solution (Modular and Tilt-Up); expansion and contraction joints.

### Unit 3: PREFABRICATED COMPONENTS AND ITS BEHAVIOUR

Design of Precast Concrete Components and Behaviour of structural components, large panel constructions, Construction of roof and floor slabs, Wall panels, Beams, Columns, Shear walls.

Design for Flexure: Strength Design (Depth of Stress block, Flanged Elements, Strength reduction factor, Limitations on reinforcement, Critical sections), Service load design.

Design for Shear: Horizontal and vertical shear resistance.

### Unit 4: JOINTS AND CONNECTIONS

Joints and connections in precast construction; classification and their requirements.

Design of Concrete bracket and corbels; Cantilever beam-design method, Strut-and-tie method. Introduction to Hanger Connections. Design of bearing pads, column bases and moment connections. Typical connection designs for lateral load resisting systems.

### Unit 5: DESIGN OF FERROCRETE STRUCTURES

Design, analysis and optimization, Special design considerations, Typical features of ferrocrete affecting design, Design criteria, Rational method of design ferrocrete structure.

## Unit 6: DESIGN OF FERROCRETE STRUCTURES

Strength through shape, Shape and form of a structure, various structural forms and their behaviour, Comparative study of various forms

### Text Books


1. CBRI, Building materials and components, India, 1990

2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994


### Reference Books


1. PCI Design Handbook – Precast and Prestressed Concrete (6th Edition), ISBN – 0-937040-71-1.

2. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.

3. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.

# UNIVERSITY OF PUNE

## M. Tech. (Civil and Environmental Technology)

## SEMESTER - II

*Elective - CEE 507*

## HYDROLOGY

**Teaching Scheme:**

**Lectures: 4 Hrs. /Week**

**Credits: 4**

**Examination Scheme:**

**In-semester: 50 Marks**

**End-semester: 50 marks**

**Unit 1: Introduction:**

Hydrologic Cycle, Precipitation, Evaporation, Infiltration, Interception and Depression, Depth area duration analysis, Unit hydrograph theory, IUH. Stochastic processes-classification, time series & it's components

**Unit 2: Flow Generation**

Various statistical distributions like binomial, normal, log-normal, Poisson, Beta B, gamma, Pearson type I, II and III & their uses in hydrology, Chi square test, plotting, position, frequency factors, extreme value theory, synthetic generation of yearly and monthly flows in hydrology.

**Unit 3: Frequency analysis of hydrologic events**

Frequency analysis, Frequency distribution models Flood estimation by various methods, forecasting of floods, flood frequency analysis, Gumbel's, Pearson type I, II, and III distribution, Log-normal method, design flood for various hydraulic structures and flood routing.

**Unit 4: Groundwater Hydraulics and its Development:**

Introduction of Ground Water Hydraulics, aquifers, vertical distribution of subsurface water, Darcy's Law-it's range of validity, Dupuit's assumption, application of Darcy's law to simple flow systems governing differential equation for confined and unconfined aquifers.

**Unit 5: Well hydraulics:**

Definition of wells, types of wells, differential equation for fully & partially penetrating wells, interference of wells, pumping test with steady & unsteady flow, method of image. Well Exploration, well construction & design, screens, perforations & gravel Packs.

**Unit 6: Groundwater Conservation and modeling techniques**

Ground water budget, seepage from surface water artificial recharge, Porous media models, Analog models, Electric analog models, Digital computer models and their applications

**Reference Books**

1. Applied Hydrology-Linsley Kolhar & Paulhas (Mc-Graw Hill)

2. Water Resource & Hydrology-S.K. Garg.
3. Engineering Hydrology-K. Subramanya, Tata Mc-Graw Hill.
4. Elementry Engineering Hydrology—M.J.Deodhar--- Pierson Edution
5. Hydrology- H.M. Raghunath, Wily Eastern, New Delhi.
6. Stochastic Hydrology-Jaya Rami Reddy, Laxmi Pub., New Delhi.
7. Applied Hydrology-V.T. Chow, McGraw-Hill Book Company.
8. A text book of Hydrology- Jaya Rami Reddy, University Science Press
9. Ground water Hydrology---D.V.Todd---Wieley,India.
10. Numerical Groundwater Hydrology-----A.K.Rastogy.---Penram Internal Publishing(India).

## UNIVERSITY OF PUNE

### M. Tech. (Civil and Environmental Technology)

**SEMESTER - II**

*Elective - CEE 508*

**REMOTE SENSING AND GIS IN WRE**

**Teaching Scheme:** **Examination Scheme:**

**Lectures: 4 Hrs. /Week** **In-semester: 50 Marks**

**Credits: 4** **End-semester: 50 marks**

**Unit 1: Concept of remote sensing:**

Electromagnetic energy, Interaction of EMR with Atmosphere and earth material, atmospheric windows, EMR spectrum, platform, sensor types, MSS. Aerial Remote Sensing: Flight planning, types of Aerial photographs, Photogrammetry: stereoscopic vision, scale, relief displacement, parallax, vertical exaggeration

**Unit 2: Satellite Remote Sensing:**

LANDSAT and IRS characteristics, products and FCC, Interpretation Techniques, visual and digital in brief, Recognition of photo elements and terrain elements like size, shape, tone, texture, pattern, shadow etc, Different products of digital photogrammetry, radial line method, Digital Image processing, Terrain analysis: Relief, landform, drainage pattern

**Unit 3: Applications of RS:**

Different applications of RS- (Land use and land cover mapping, Disaster management Flood & Earth Quake, and Resource Inventory management,) Use of remote sensing in Lithology, structure and Geomorphology, Application of Remote Sensing in Ground Water and Mineral Exploration, Digital Image processing, its objectives and different methods.

**Unit 4: GIS Introduction:**

Basic Concept of GIS, components, history and applications, Hardware and Software requirements for GIS, Map features, Scale, Resolution, accuracy and data base extent

**Unit 5: Map projection and parameters:**

Geographical Coordinate system, types of projection and parameters, projection transformation and mapping in GIS. Geospatial data models: Spatial and non-spatial data, VECTOR and RASTER models.

**Unit 6: GIS Analysis:**

Digitalization, editing and structuring of map data, overlay analysis, Digital elevation and terrain model (DEM / DTM), Raster analysis, buffer analysis and query analysis, Applications of GIS in Water resources and Environmental Engineering with limitations

**Reference Books**


1. Remote sensing methods & applications – R. Michael Hord, Wily Interscience Publication.

2. Remote sensing & image interpretation – Lilleson J.T.M. & Krefer R.W. Wiely, New York.

3. Photogrammetry by – Sheford

4. Remote sensing in Civil Engineering – J.M. Kennie & M.C. Mathews.