S Y L L A B U S
For B.E. CIVIL V & VI Semester (2014-15)
## V SEMESTER

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Credits</th>
<th>Hours Per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Lecture</td>
</tr>
<tr>
<td>1</td>
<td>UMA501C</td>
<td>Design of RC structures</td>
<td>04</td>
<td>00</td>
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<tr>
<td>2</td>
<td>UCV502C</td>
<td>Structural Analysis II</td>
<td>04</td>
<td>03</td>
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<td>3</td>
<td>UCV503C</td>
<td>Geotechnical Engg –I</td>
<td>04</td>
<td>04</td>
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<tr>
<td>4</td>
<td>UCV514C</td>
<td>Hydraulics and Hydraulic Machines</td>
<td>03</td>
<td>03</td>
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<tr>
<td>5</td>
<td>UCV515H</td>
<td>Management and Entrepreneurship</td>
<td>04</td>
<td>03</td>
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<td>6</td>
<td>UCV516C</td>
<td>Environmental Engg I</td>
<td>03</td>
<td>00</td>
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<td>7</td>
<td>UCV516L</td>
<td>Computer Aided Design Laboratory</td>
<td>01</td>
<td>00</td>
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<tr>
<td>8</td>
<td>UCV517L</td>
<td>Fluid Mechanics Lab</td>
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<tr>
<td>9</td>
<td>UCV518L</td>
<td>Highway material Testing Lab</td>
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<td>10</td>
<td>UMA002A*</td>
<td>Advanced Mathematics- II</td>
<td>04</td>
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<td><strong>Total Credits</strong></td>
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## VI SEMESTER

<table>
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<td>Lecture</td>
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<tr>
<td>1</td>
<td>UMA601C</td>
<td>Design and Drawing of RC structures</td>
<td>04</td>
<td>03</td>
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<tr>
<td>2</td>
<td>UCV612C</td>
<td>Environmental Engg - II</td>
<td>04</td>
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<td>3</td>
<td>UCV603C</td>
<td>Geotechnical Engg –II</td>
<td>04</td>
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<td>4</td>
<td>UCV615C</td>
<td>Hydrology and Irrigation Engg</td>
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<td>UCV62XE</td>
<td>Elective - I</td>
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<td>UCV6XE</td>
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<td>7</td>
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<td>Geotech Lab</td>
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<td>8</td>
<td>UCV618L</td>
<td>Environmental Lab</td>
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<td><strong>Total Credits</strong></td>
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## ELECTIVES-1

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject Code</th>
<th>Subject</th>
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<tbody>
<tr>
<td>01</td>
<td>UCV623E</td>
<td>Matrix Method of Structural Analysis</td>
<td>04</td>
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<tr>
<td>02</td>
<td>UCV625E</td>
<td>Ground Water Hydrology</td>
<td>04</td>
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<td>03</td>
<td>UCV626E</td>
<td>Railway &amp; Airport Engineering</td>
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## ELECTIVES-2

<table>
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<th>Sl. No.</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>UCV631E</td>
<td>Alternative Building Materials &amp;Technologies</td>
<td>04</td>
</tr>
<tr>
<td>02</td>
<td>UCV631E</td>
<td>Geographic Information Systems</td>
<td>04</td>
</tr>
<tr>
<td>03</td>
<td>UCV633E</td>
<td>Matrix Method of Structural Analysis</td>
<td>04</td>
</tr>
</tbody>
</table>
1. GENERAL FEATURES OF REINFORCED CONCRETE
   1.1. Introduction
   1.2. Design loads
   1.3. Materials for reinforced concrete
   1.4. Code requirements of reinforcements
   1.5. Elastic theory of RC sections
   1.6. Moment of resistance of section
   1.7. Balanced, under reinforced and over reinforced section

2. PRINCIPLES OF LIMIT STATE DESIGN AND ULTIMATE STRENGTH OF RC SECTION
   2.1. Philosophy of limit state design
   2.2. Principles of limit states
   2.3. Factor of safety
   2.4. Characteristic and design loads
   2.5. Characteristic and design strength
   2.6. General aspects of ultimate strength
   2.7. Stress block parameters for limit state of collapse
   2.8. Ultimate flexural strength of rectangular sections
   2.9. Ultimate flexural strength of flanged sections
   2.10. Ultimate flexural strength of doubly reinforced sections
   2.11. Ultimate shear strength of RC sections
   2.12. Ultimate torsional strength of RC sections
   2.13. Concepts of development length and anchorage
   2.14. Analysis examples for rectangular sections, flanged sections, doubly reinforced sections, shear strength and development length

UNIT-II

3. SERVICEABILITY LIMIT STATE
   3.1. General aspects
   3.2. Deflection limits in IS: 456-2000
   3.3. Calculation of deflection (Theoretical method)
   3.4. Cracking in structural concrete members

UNIT-III

4. DESIGN OF BEAMS
   4.1. Practical requirements of an RCC beam
   4.2. Size of the beam
   4.3. Cover to the reinforcement
   4.4. Spacing of bars
   4.5. Design procedure

4.5.1. Critical sections for moments and shear
4.5.2. Anchorage of bars: check for development length
4.5.3. Reinforcement requirements
4.5.4. Slenderness limits for beams to ensure lateral stability
4.6. Design examples for simply supported and cantilever beams (rectangular and flanged sections)

UNIT-IV

5. DESIGN OF SLABS
   5.1. Introduction
   5.2. General consideration of design of slabs
   5.3. Rectangular slabs spanning in one direction
   5.4. Rectangular slabs spanning in two directions for various boundary conditions
   5.5. Design of simply supported slabs, cantilever slabs and continuous slabs

UNIT-V

6. DESIGN OF COLUMNS
   6.1. General aspects
   6.2. Effective length
   6.3. Loads on columns
   6.4. Slenderness limits for columns
   6.5. Minimum eccentricity
   6.6. Design of short axially loaded columns
   6.7. Design of column subject to combined axial load and uniaxial moment using SP16

UNIT-VI

7. DESIGN OF FOOTINGS
   7.1. Introduction
   7.2. Load for foundation
   7.3. Design basis (limit state method)
   7.4. Design of isolated rectangular footing for axial load and uniaxial moment
   7.5. Design of pedestal.

UNIT-VII

8. DESIGN OF STAIR CASE
   8.1. General features
   8.2. Types of stair case
   8.3. Loads on stair cases
   8.4. Effective span as per IS codal provisions
   8.5. Distribution of loading on stairs
   8.6. Design of stair cases

UNIT-VIII

9. DESIGN OF PIPES
   9.1. General requirements
   9.2. Load calculation
   9.3. Design of pipes

UNIT-IX

10. DESIGN OF SCAFFOLDS
    10.1. General aspects
    10.2. Design of scaffolds

UNIT-X

11. DESIGN OF FENCES
    11.1. General features
    11.2. Design of fences

UNIT-XI

12. DESIGN OF ROOF TERRACES
    12.1. General aspects
    12.2. Design of roof terraces

UNIT-XII

13. DESIGN OF TUNNELS
    13.1. General requirements
    13.2. Design of tunnels
TEXT BOOKS:

REFERENCE BOOKS:
1. Unnikrishnan and Devadas Menon, "Design of reinforced concrete structures," PHI, New Delhi
4. Park and Paulay, "Reinforced Concrete." John Wiley & Sons
(Note: Use of IS: 456-2000 is permitted and SP-16 to be used in design of columns only)

Question Paper Pattern for SEE:
1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than four sub divisions.
3. Any Five Full questions are to be answered choosing at least one from each unit.

UNIT-I
Introduction
Symmetry concepts-symmetry and anti-symmetry, concept of unsymmetrical bending and shear centre, 05 Hours

Rolling Loads and Influence Lines
Rolling load analysis of simply supported beams for single and several point loads, uniformly distributed loads.
Uses of Influence lines, Influence line diagram for reaction, shear force and bending moment at a section for simply supported beams due to point loads and uniformly distributed loads. 08 Hours

UNIT-II
Slope Deflection Method
Development of slope deflection equations, Analysis of continuous beams and rigid frames (non-sway and sway type). 07 Hours

Moment Distribution Method
Development of method, Analysis of continuous beams and rigid frames (non-sway type). 06 Hours

UNIT-III
Kani’s Method
Analysis of continuous beams and rigid frames (non-sway type) 07 Hours
Approximate Analysis of Building Frames
Introduction, Analysis of frames having vertical loads and lateral loads. 06 Hours

UNIT-IV
Matrix Methods of Structural Analysis by system approach
Flexibility method-Introduction, analysis of plane truss and rigid frames (Static indeterminacy less than three) 06 Hours
Stiffness method-Introduction, analysis of plane truss and rigid frames (Kinematic indeterminacy less than three) 07 Hours

Text Books:
Reference Books:

Question Paper Pattern for SEE:
1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus.
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3. Any Five Full questions are to be answered choosing at least one from each unit.

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<tbody>
<tr>
<td>1.</td>
<td>Students to understand the basic concepts, structure and application of Structural analysis.</td>
<td>This class will help the students develop an ability to apply knowledge of mathematics science and engineering.</td>
</tr>
<tr>
<td>2.</td>
<td>To work from the basis of mechanics, structural analysis-I to formulate the strength and stiffness methods of analysis of structures.</td>
<td>Acquire the knowledge of solution procedures &amp; hence analyze structures.</td>
</tr>
<tr>
<td>5.</td>
<td>Rolling load analysis for simply supported beams.</td>
<td>Use the techniques skills, modern engineering tools necessary for engineering practice.</td>
</tr>
<tr>
<td>6.</td>
<td>To utilize these models to analyze structural responses to variety of loads.</td>
<td>This helps the students in using modern structure analysis software &amp; forms a basis for learning advanced structural analysis.</td>
</tr>
</tbody>
</table>

UCV503C GEOTECHNICAL ENGINEERING-I
4 Credits (4-0-0)

UNIT - I

INTRODUCTION:
History of soil mechanics, Definition, origin and formation of soil. Phase Diagram, Voids ratio, Porosity, Percentage Air Voids, Air content, Degree of saturation, Moisture content, Specific gravity, Bulk density, Dry density, Saturated density, Submerged density and their inter relationships. 6 Hours

INDEX PROPERTIES OF SOILS AND THEIR DETERMINATION:
Index Properties of soils - Water content, Specific Gravity, Particle size distribution, Relative Density, Consistency limits and indices, in-situ density, Activity of Clay, Laboratory methods of determination of index properties of soils: Moisture content, Specific gravity, Particle size distribution (Sieve analysis and Hydrometer analysis only), Liquid Limit-Casagrande and cone penetration methods, Plastic limit and shrinkage limit determination. 7 Hours

UNIT II

CLASSIFICATION OF SOILS:
Purpose of soil classification, basis for soil classification, Particle size classification MIT classification and IS classification, Textural classification. Unified soil classification and IS classification - Plasticity chart and its importance, Field identification of soils. 4 Hours

CLAY MIERALOGY AND SOILSTUCTURE:
Single grained, honey combed, flocculent and dispersed structures, Valence bonds Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphus substitution. Common clay minerals in soil and their structures - Kaolinite, Illite and Montmorillonite. 7 Hours

UNIT - III

FLOW OF WATER THROUGH SOILS:
Darcy's law- assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, effective stress concept-total pressure and effective stress, quick sand phenomena, Capillary Phenomena. 7 Hours

COMPACTATION OF SOILS:
Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control, Proctor needle. Compacting equipments, Dynamic compaction, vibroflotation. 6 Hours
CONSOLIDATION OF SOILS:
Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations (no derivation), Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method. Consolidation characteristics of soil (Cc, av, mv and Cv), Time rate of consolidation. Determination of coefficient of consolidation by square root of time fitting method, logarithmic time fitting method

UNIT IV
SHEAR STRENGTH OF SOILS:
Concept of shear strength, Mohr’s strength theory, Mohr-coulomb theory, conventional and modified failure envelops, Total and effective shear strength parameters, Concept of pore pressure, factors affecting shear strength of soils, Sensitivity and Thixotropy of clay. Measurement of shear parameters- Direct shear test, unconfined compression test, triaxial compression test and vane shear test, Test under different drainage conditions.

TEXTBOOKS:

REFERENCE BOOKS:

Question Paper Pattern for SEE:
1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than four sub divisions.
3. Any Five Full questions are to be answered choosing at least one from each unit.
UNIT I
Viscous Flow: Reynolds’s experiments-Reynolds's number Laminar flow through circular pipes. Hagen Poiseuille's equation Relation between pipe friction factor and Reynolds number. Elements of Boundary layer theory-Thickness of boundary layer. Laminar and turbulent boundary layer-Boundary layer growth along smooth plate. Total drag force on a flat plate due to laminar and turbulent boundary layer. Force exerted a flowing fluid on a stationary body- Drag and Lift. 05 hrs

UNIT II
Flow in Open Channels: Difference between pipe flow and open channel flow Type of open channel flow - Uniform and non- Uniform flow. Chezy's and Manning's formulae. Most economical rectangular, trapezoidal and circular channel sections. 06 hrs

Flow in Open Channels: Specific energy, specific energy curve, critical depth, alternate depths. Froude's number and its significance. Hydraulic jump in horizontal rectangular channels and Energy losses due to the jump 05 hrs

UNIT III
Dimensional Analysis and Model Similitude: Introduction, Units and dimensions - Dimensional homogeneity - Rayleigh’s method - Buckingham's pi-theorem and its application. Model studies: Introduction, Similitude’s, Dimensionless parameters. 06 hrs

Water Hammer in Pipes: Definition and principle, Equation for pressure rise due to gradual closure of valves in rigid and elastic pipes and problems Pressure due to water hammer in Elastic pipes and rigid pipe material and problems, Surge Tanks: principle and types Pipe Network Analysis: Hardy-cross method of analysis Newton Rap son method problem on hardy cross method. 06 hrs

UNIT IV
Impulse Momentum Principal and Applications: Momentum equation, impact of jet, Force exerted by a jet on stationary and moving flat and curved plates. Force exerted by jet on series of vanes, work done and efficiency. Concept of inlet and outlet velocity triangles, work done and efficiencies. Hydraulic Turbines: General layout of hydroelectric plants, classification and working principles. Centrifugal Pumps: Definition, Classification, description and general principles of working -Work done and efficiencies. Priming and its methods Minimum starting speed. 08 hrs

Text Books:

Reference Books:

Question Paper Pattern for SEE:
1. Total ofEight Questions with two from each unit to be set uniformly covering the entire syllabus.
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<tr>
<td>1.</td>
<td>Students are made to understand viscous effect and to know the loss due to viscosity, for the flow which takes place through pipe.</td>
<td>Utilize principles of FM that are appropriate to produce the design component related to hydraulic structures.</td>
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<tr>
<td>2.</td>
<td>This knowledge can be used to calibrate the different hydraulic equipments.</td>
<td>The graduate will learn importance of FM, its functional elements and characteristics so as to use for design of structures against hydraulic forces.</td>
</tr>
<tr>
<td>3.</td>
<td>To analyze the boundary layer effect, development and growth of boundary layer due to viscous fluid.</td>
<td>Students will be exposed to engineering work that regulate the convergence of water in the pipes as well as open channels.</td>
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<tr>
<td>4.</td>
<td>To understand the dynamics of flow through open channel. Also to know the efficiency of different types of turbines and centrifugal pump due to the impact of jet.</td>
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<tr>
<td>5.</td>
<td>Also to analyze the models for the behavior of prototype structures in the field. To inculcate the knowledge of the water hammer effect due to valve closure for sudden and gradual closure in a pipe line.</td>
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UHS515H: MANAGEMENT & ENTREPRENEURSHIP
03 Credits (3-0-0)

UNIT - I

UNIT - II
Leading: Human Factors in Managing, Motivation and Motivators. Motivation: Content and Process Theories, Motivational Techniques, A Systems and Contingency Approach to Motivation, Leadership, Ingredients of Leadership, Trait Approaches to Leadership, Leadership Behaviour and Styles, Contingency Approaches to Leadership. 05 Hrs

UNIT - III
Communication Communication, The Communication Function in Organizations, The Communication Process, Communication in the Enterprise, Barriers and Breakdowns in Communication, Toward Effective Communication, Case studies. 05 Hrs
Controlling: The System and Process of Controlling, Control as a Feedback System, Feed forward Control, Requirements for Effective Controls, Control Techniques and Information Technology Control Techniques: The Budget, Traditional Non-budgetary Control, Information Technology, Productivity and Operations, Direct Control versus Preventive Control, Case studies. 05 Hrs

UNIT-IV

ENTREPRENEURSHIP
Entrepreneur: Meaning of an Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur - an Emerging Class. Concept of Entrepreneurship - steps in entrepreneurial process, Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship -Barriers 03 Hrs

Micro Small & Medium Enterprises (MSME): Definition; Characteristics; Need and rationale; Objectives; Scope; role of MSME in Economic Development. Advantages of MSME, Steps to start an MSME - Government policy towards MSME; Impact of Liberalization, Privatisation, Globalization on MSME; Effect of WTO/GATT. 03 Hrs

Institutional Support: Different Schemes; TECSOK, KIADB, KSSIDC, KSIMC, DIC single Window Agency; MSME, NSIC; SIDBI; KSFC. 02 Hrs

Preparation of Project: Meaning of Project, Project Identification, Project Selection, Project Report - Contents; Formulation; Project Appraisal. Identification of Business Opportunities; Market Feasibility studies; Technical Feasibility Studies; Financial Feasibility Studies and Social Feasibility studies (in brief). 02 Hrs

Reference Books:
5. Entrepreneurship Development - S S Khanka - S Chand & Co.

Question Paper Pattern for SEE:
* Total offEight Questions with two from each unit to be set uniformly covering the entire syllabus.
* Each Question should not have more than four sub divisions.
* Any Five Full questions are to be answered choosing at least one from each unit.

CE516L: COMPUTER APPLICATIONS IN CIVIL ENGINEERING
1 Credit (0-0-2)

INTRODUCTION TO AUTOCAD Basics of drafting:
How to use AUTOCAD for drafting. Basic commands, Draw Modify Tool bars, Coordinate systems, GUI familiarization. (06)

AUTOCAD: APPLICATION TO CIVIL ENGINEERING DRAWINGS

ANALYSIS AND Design SOFTWARES: Analysis and Design of structural Engineering components using commercially available Software's: Cantilevers, Simply supported beams, Propped Cantilevers, Fixed and Continuous Beams. 2D Portal frames - Single and Multistoried. (06)

MICROSOFT EXCEL: APPLICATION TO CIVIL ENGINEERING PROBLEMS
SFD and BMD for cantilever and simply supported beams subjected to UDL throughout the span. Design of singly and doubly reinforced beams, Computation of Earthwork, Design of Horizontal Curve by Offset method and Design of Super Elevation. (10)

LABORATORY ASSESSMENT:
1. Each Laboratory subject is evaluated for 100 marks ( 50 CIE and 50 SEE).
2. Allocation of 50 marks for CIE
   * Performance and journal write - up:
     Marks for each experiment = 30 marks/ No. of proposed experiments.
   * One Practical test for 20 Marks. (5write-ups, 10 conduction, calculation, results etc., 5viva-voce)
3. Allocation of 50 marks for SEE.
   * 25% write-up, 50% conduction, calculation, results etc., 25% viva-voce.
UCV517L FLUID MECHANICS LABORATORY
1 Credit (0-0-2)

2. Calibration of mouth piece.
5. Calibration of trapezoidal notches.
6. Calibration of weirs (Broad and Ogee).
7. Calibration of Venturimeter and Orificemeter.
8. Experiments on major and minor losses in the pipes.
9. Impact of jet on to the flat and hemispherical vanes.

Text books:
1. Fluid mechanics by R.K. Bansal
2. Fluid mechanics and Hydraulic Machines by Modi and Seth.

Laboratory Assessment Each Labrotary Subject is evaluated for 100 marks (50 CIE and 50 SEE)

1. Allocation of 50 marks for CIE "Performance and Journal write-up: Marks for each experiment = 30 marks / No. of proposed experiments. "One Practical test for 20 marks. (5 write-up, 10 conduction, calculation, results etc 5 viva-voice).
2. Allocation of 50 marks for SEE "25% write-up, 50% conduction, calculation, results etc 25 % viva-voice.

UCV518L HIGHWAY MATERIALS LAB
1 Credit (0-0-2)

1. AGGREGATES: Crushing, abrasion, impact and Shape tests (Flaky, Elongation, Angularity number) Specific gravity and water absorption
2. BITUMINOUS MATERIALS AND MIXES: Specific Gravity, Penetration, Ductility, Softening point, Flash and fire point, Viscosity Marshall Stability tests
3. SUBGRADE SOIL: CBRTest

REFERENCE BOOKS:
1. Relevant IS Codes & IRC Codes
2. High way Material Testing Lab Manual By New Chand & Brothers Note:
1. Minimum Ten Experiments are to be completed.
2. Candidate has to perform two experiments in the Semester Eng Examination

LABORATORY ASSESSMENT:
1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. Allocation of 50 marks for CIE * Performance and journal write up:
   Marks for each experiment = 30 marks/ No. of proposed experiments.
   * One Practical test for 20 Marks. ( 5 write-up, 10 conduction, calculation, results etc., 5 viva-voce)
3. Allocation of 50 marks for SEE.
   * 25% write-up, 50% conduction, calculation, results etc., 25% viva-voce.
**UNIT-I**

**Introduction:** Definition- Classification and Characterization of Air Pollutants, Emission Sources, Behavior and Fate of air Pollutants, Chemical Reactions in the Atmosphere, Photo-chemical Smog, Coal-induced smog, Air Pollution Inventories.  

**Effects of Air Pollution:** On Human Health, Animals, Plants and Materials- Major Environmental Air Pollution Episodes- London Smog, Los Angeles Smog & Bhopal Gas Tragedy.  

05 Hours

**UNIT-II**

**Meteorology:** Meteorological Variables, Primary and Secondary Lapse Rate, Inversions, Stability Conditions, Windrose, General Characteristics of Stack Plumes, Meteorological Models, Industrial Plant Location and Planning  

10 Hours

**UNIT-III**


10 Hours

**UNIT IV**

**Air pollution due to automobiles:** Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect Methods of control.  

04 Hours

**Burning environmental issues:** Acid Rain, Global Warming, Ozone Depletion in Stratosphere, Indoor Air Pollution  

03 Hours

**Standards And Legislation:** Air Quality and Emission Standards Legislation and Regulation, Air Pollution Index.  

03 Hours

**Reference Books:**
2. Air Pollution Sampling and Analysis APHA

**Scheme of Examination:** Student has to answer any five full questions out eight, selecting at least one question from each section.

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<tr>
<th>Sl. No.</th>
<th>Course Objectives</th>
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<tbody>
<tr>
<td>1.</td>
<td>To impart the basic knowledge about the classification and characterization of air-pollutants, Behavior and fate of air pollutants, reactions in atmosphere, To expose the students on the effects of air pollution on human health and major environmental air episodes.</td>
<td>The students will learn about the Classification and Characterization Behavior &amp; Fate of Air Pollutants, Reactions in atmosphere. The students will get knowledge about the fundamentals of Meteorological variables, Inversions, Stability conditions.</td>
</tr>
<tr>
<td>2.</td>
<td>To expose the students to the fundamentals of Meteorological variables, Inversions, stability conditions, To provide the information on characteristics of stack plumes, Meteorological models, Industrial plant location and planning.</td>
<td>Students will also learn about Meteorological models, Industrial plant location and Planning. They will learn about Air quality standards, Legislation and Regulations.</td>
</tr>
<tr>
<td>3.</td>
<td>To provide the necessary background information regarding sampling and measurement of gaseous and particulate matter, stack sampling, air pollution control methods including control of gaseous emissions.</td>
<td>The students will be exposed to the background information regarding Sampling and Measurements of Gaseous and Particulate matter, Stack Sampling.</td>
</tr>
<tr>
<td>4.</td>
<td>To make the students familiar with various aspects of air pollution due to automobiles, environmental issues like Acid rain, global warming, ozone depletion etc. Students will also get exposed to air quality standards, Legislation and Regulations and Air Pollution Index.</td>
<td>Air pollution control methods including control of gaseous emissions. Students will be exposed various aspects of air pollution due to automobiles, environmental issues like Acid rain, Global warming, Ozone depletion etc.</td>
</tr>
</tbody>
</table>
### UCV532E RAILWAY & AIRPORT ENGG
**03 Credits (3-0-0)**

#### UNIT-I
**Railways**: of railways in transportation - Historical development of railways in India - Selection of routes, preliminary and location surveys. **02 hrs**

**Permanent way**: Gauges in railways - railway track, cross sections, coning of wheels, rails, rail sections, ballast, sleepers, wear on rails, rail joints, welding of rails, creep of rails, rail fixtures, calculation of quantity of materials needed for laying of tracks. **8 hrs**

#### UNIT-II
**Traction and tractive resistances, tractive power, Hauling capacity** (Problems on above). **02 hrs**

**Geometric design of track**: grade, ruling grade, minimum gradient, pusher grade, speed of train, super elevation, cant deficiency, negative cant speed calculation based on IR formulae for high speed tracks only (Problems on above). **8 hrs**

#### UNIT-III
**Points and Crossing**: turnout, design of turnout, Stations and yards, signalling and interlocking, track defects, maintenance of permanent way, track maintenance, level crossing, Indian railway standards. **10 hrs**

#### UNIT-IV
**Airport planning**: site selection-Aircraft characteristics -Regional planning- A brief description of visibility, Wind characteristics and noise nuisance, High way maintenance and Drainage. **03 hrs**

**Runway Design**: Analysis of wind data by wind rose diagram to find out the best direction of runway. **03 hrs**

**Basic Patterns of runway**: Length of runway - Correction to runway length by ICAO and FAA specifications. Length of runway **05 hrs**

**Taxiway Design**: Factors affecting layout of taxiway Geometric of Taxiway, turning radius of taxiways as per ICAO Design of exit taxiways. **03 hrs**

**Text Books:**
3. Khanna, Arora and Jain - Airport Planning and Design- Nemchand Roorkee

**Scheme of Examination:** Students has to answer five questions out of eight selecting at least one question from each part.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Objectives</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>To give brief information’s to the students regarding Railway surveys.</td>
<td>After studying the course the student is able to Getting brief information regarding, rail surveys, different types of rails, sleepers, ballasts etc.</td>
</tr>
<tr>
<td>2.</td>
<td>Types of gauges, rails, rail fastenings, sleepers, Ballast.</td>
<td>Information regarding various types of stations, yards, points and crossings, signals and inter loading etc.</td>
</tr>
<tr>
<td>3.</td>
<td>Curvature of the track, stations and yards. Airport planning.</td>
<td>Select a proper location for an airport.</td>
</tr>
<tr>
<td>4.</td>
<td>Points and crossing, signals and inter loading. Runway and taxiway designing.</td>
<td>Design the runways and taxiways.</td>
</tr>
</tbody>
</table>
UCV601C: DESIGN & DRAWING OF RC STRUCTURES
4 CREDITS (3-0-2)

UNIT-A
1. Layout Drawing: General layout of building showing, position of columns, footings, beams and slabs with notations and abbreviations.
2. Beam and Slab floor system, continuous beams.
3. Staircase: Dog legged and Open well.
4. Column footing: Column and footing (Square and Rectangle).

UNIT-B
1. Rectangular Combined footing slab and beam type.
2. Retaining walls (Cantilever and counter fort type).
3. Simple Portal Frames (Single bay & Single storey)

REFERENCE BOOKS:

CIE Marks
10 marks for term work (Drawing Sheets)
40 marks for conducting 2 test of 4 hrs duration on the line of syllabus mentioned above

Term Works Details
Sheet No 1 to 8 from Unit A
Sheet No 9 to 14 from Unit B

Question paper pattern:
3 questions of 20 marks each from Unit-A & 2 questions of 60 marks from Unit-B
Answer any two questions from Unit A & one question from Unit B

<table>
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<tbody>
<tr>
<td>1.</td>
<td>To make the student to develop the knowledge of design and drawing of R.C structures.</td>
<td>Student will have the knowledge of detailing.</td>
</tr>
<tr>
<td>2.</td>
<td>Preparing all structural drawings</td>
<td>Student will develop the skill of</td>
</tr>
</tbody>
</table>

preparation of structural drawing and study prepared drawings.

3. Students are exposed to know the requirement of the fulfillment of the basics of the design and drawing of RC structures along with the basics learnt in the previous semester.

Student will have the knowledge of design of different R.C. Structures.

4. To make the student to develop the knowledge of design and drawing of R.C structures.

5. Also to train the students to prepare all structural drawings and detailing along with bar bending schedule as per SP-34.

6. This knowledge can be utilized for their further professional field.
UCV612C: ENVIRONMENTAL ENGINEERING I
4 Credits (4-0-0)

Unit-I

Introduction: Necessity, planning and execution of modern water supply scheme.

Water Demand and Quantity:

Unit-II

Sources, Collection and Conveyance of water:
Factors governing the selection of source for water supply, suitability of surface and subsurface source (quality and quantity). Intake structures submerged intake, intake towers, river intake, canal intake, dam intake. Pumps- necessity, power and selection of a pump, economical diameter of rising main.

Quality of Water
Potable and palatable water, waterborne diseases, Physical, Chemical and Microbiological water quality parameters using analytical and instrumental techniques. Health significance of all the quality parameters. Indicator organism, MPN, BIS and WHO drinking water standards

Unit-III

Water Treatment

Unit-IV

Miscellaneous Treatment Methods:
Removal of Iron and Manganese, Colour, odour and Taste removal, Activated carbon treatment, Use of copper sulphate, Fluoridation, Defluoridation and Desalination.

Distribution Systems:
System of supply, service reservoirs and their capacity determination, methods of layout of distribution systems.

Others: Pipe appurtenances, various values, types of fire hydrants, pipelighting. Layout of water supply pipes in buildings.

Text Books:

Reference Books:

Question Paper Pattern for SEE:
1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than four sub divisions.
3. Any Five Full questions are to be answered choosing at least one from each unit.

<table>
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<tbody>
<tr>
<td>1.</td>
<td>To impart the basic knowledge about the necessity, planning and execution of modern water supply schemes. To expose the students on the types of water demand, fire demand.</td>
<td>Learn about the necessity, planning and execution of modern water supply schemes. Learn to compute the water demand and fire demand.</td>
</tr>
<tr>
<td>2.</td>
<td>To expose the students to the methods of population forecasting and the design period.</td>
<td>Learn about methods of Population Forecasting and the design period/factors governing.</td>
</tr>
<tr>
<td>3.</td>
<td>To make the students understand about the sources, collection and conveyance of water. To bring the awareness regarding the necessity, power/selection of</td>
<td>Learn about the sources, collection and conveyance of water and the necessity, power/selection of</td>
</tr>
</tbody>
</table>
4. To make the students familiar with various aspects of physical, chemical and biological quality of water. Testing of water quality, Health significance and drinking water standards. Learn about various aspects of physical, chemical and biological quality of water, testing of water quality, health significance and drinking water standards.

5. To provide information regarding different types of water treatment unit and processes. Learn about different types of water treatment units and processes like sedimentation and coagulation, filtration and disinfection.

6. To expose the students to the methods of removal of iron, manganese, color, taste and odor, fluoridation/defluoridation and desalination and layout of water supplies in buildings. Learn about methods of removal of Iron, Manganese, Color, Taste and odor, Fluoridation/Defluoridation and Desalination and Learn about the system of supply and their reservoir capacity, types of fire hydrants and layout of water supplies in buildings.

UNIT - I

SUBSURFACE EXPLORATION:
Importance of exploration program, Methods of exploration: Boring, sounding tests, geophysical methods- Electrical resistivity and Seismic refraction methods. Types of samples- undisturbed, disturbed and representative samples Samplers, sample disturbance, area ratio, Recovery ratio, clearance Stabilisation of boreholes - Typical bore log. Number and depth of borings for various civil engineering structures, soil exploration report.

DRAINAGE AND DEWATERING:
Location of ground water table in fine and coarse grained soils. Determination of ground water level by Hvorseleev's method. Control of ground water during exavation: Dewatering- Ditches and sumps, well point system, Shallow well system, Deep well system, Vacumm method, Electro- Osmosis method.

UNIT - II

STRESSES IN SOILS:
Boussinesq's and Westergaard's theories for concentrated, circular, rectangular, line and strip loads. Comparison of Boussinesq's and westergaard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart.

FLOWNETS:
Laplace equation (no derivation) assumptions and limitations only, characteristics and uses of flownets, Methods of drawing flownets for Dams and sheet piles. Estimating quantity of seepage and Exit gradient. Determination of phreatic line in earth dams with and without filter. Piping and protective filter, graded filter.

UNIT - III

LATERAL EARTH PRESSURE:
Active and Passive earth pressures, Earth pressure at rest, Earth pressure coefficient. Earth pressure theories - Rankine's and Coulomb's assumptions and limitations, Graphical solutions for active earth pressure (cohesionless soil only) Culmann's and Rebhann's methods Lateral earth pressure in cohesive and cohesionless soils, Earth pressure distribution.

STABILITY OF EARTH SLOPES:

UNIT - IV

UCV603C: GEOTECHNICAL ENGINEERING-II
4 Credits-(4-0-0)
UNIT - IV

BEARING CAPACITY:
Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi’s and Brinch Hansen’s bearing capacity equations-assumptions and limitations Bearing capacity of footing subjected to eccentric loading. Effect of ground water table on bearing capacity. Plate load test, Standard penetration test, cone penetration test.

8 Hours

FOUNDATION SETTLEMENT:
Settlement Analysis, Data for settlement analysis, computation of settlement, Concept, immediate, consolidation and secondary settlements (no derivations), Tolerance. BIS specifications for total and differential settlements of footings and rafts.

5 Hours

TEXT BOOKS:

REFERENCES BOOKS:

Question Paper Pattern for SEE:
1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than four sub divisions.
3. Any Five Full questions are to be answered choosing at least one from each unit.

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<tbody>
<tr>
<td>1.</td>
<td>Students are exposed to know the requirement of the fulfillment of the basics of the design of pavement required for highway engineering etc.</td>
<td>Ready to face the basic problems related to foundation.</td>
</tr>
<tr>
<td>2.</td>
<td>To fulfill the requirements of a civil engineer like SBC, foundation details etc.</td>
<td>Able to design the foundation of the building independently.</td>
</tr>
<tr>
<td>3.</td>
<td>To achieve the knowledge of basic of soil mechanics &amp; foundation engineering which enable to use the knowledge in practical field.</td>
<td>In a position to investigate the soil properties and exploration.</td>
</tr>
</tbody>
</table>
UNIT-I

Introduction: Practical application of hydrology and water resources. Hydrological cycle, Concept of catchments and need for plan utilization of water resources.

Precipitation: Definition and forms of precipitation. Types of precipitation, seasons in India. Measurements of precipitation, non recording and recording types of rain gauges. Computation of average depth of precipitation over an area. Estimation of missing precipitation record.


11 Hours

UNIT-II


10 Hours

UNIT-III


Definition of conceptive use, duty, delta and base period, relationship between duty,delta and base period, factors affecting duty of water crops and crop seasons in india, irrigation efficiency, frequency of irrigation. Measurement of irrigation water: weir and parshall flume methods.

UNIT-IV


Definition, investigation for reservoir site, storage zones determination of storage capacity using mass curves, economical height of dam.

Definitions, Forces acting on gravity dam, methods of stability analysis, functions of drainage gallery.

Types of earthen dams, reason for failure of earthen dams( no problems), drainage arrangements(no problems), definition, types of spill ways, ogee spillway, types of energy dissipaters.

11 Hours

TEXT BOOKS

REFERENCE BOOKS:
5. A. B. Mical, Irrigation Engineering.

<table>
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<tr>
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<tbody>
<tr>
<td>1</td>
<td>To provide the necessary background information about hydrological cycle, its components, various hydrological process, watershed and water balance, different storages and design, analysis of irrigation systems which include dam’s weir or barrages and other supporting systems.</td>
<td>Students understand the concept of hydrological cycle, water budget. Learn to compute average rainfall of an area, missing rainfall etc. Understand various processes of water loses. Capable of computation of runoff and hydrograph theory.</td>
</tr>
</tbody>
</table>
2. Students will obtain an understanding of hydrological process, particularly the process of precipitation, evaporation, infiltration and surface run-off, stream flow and their measurement and estimation. Students will learn about of hydrological analysis including hydrograph theory.

Learn about the systems of irrigation and design.

3. Students are introduced to different types of irrigation, canal systems, types of dams and their stability aspects.

Learn about the different canals and their design aspects.

4. Students should understand application of theory to experimental and field data.

Learn about different types of dams, their stability and design.

UNIT I

Introduction:
Energy in building materials, Environmental issues concerned to building materials, Global warming and construction industry, Environmental friendly and cost effective building technologies, Requirements for building of different climatic regions, Traditional building methods and vernacular architecture.

6 Hours

Alternative Building Materials:
Characteristics of building blocks for walls, Stones and Laterite blocks, Bricks and hollow clay blocks, Concrete blocks, Stabilized blocks: mud blocks, steam cured blocks, Fal-G Blocks, stone masonry block.

7 Hours

UNIT II

Lime-Pozzolana Cements:

6 Hours

Alternative Building Technologies:
Alternative for wall construction, Types, Construction method, Masonry mortars, Types, Preparation, Properties, Ferrocement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications.

7 Hours

UNIT - III

Alternative Roofing Systems:
Alternative roofing systems, Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes

6 Hours

Structural Masonry:
Compressive strength of masonry elements, Factors affecting compressive strength, Strength of units, prisms / wallettes and walls, Effect of brick work bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry

7 Hours
UNIT -IV

Cost Effective Building Design:
Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives. 6 Hours

Equipment For Production of Alternative Materials:
Machines for manufacture of concrete-Hand mixing, automatic mixing, Concrete pumps, RMC Equipments for production of stabilized blocks, Moulds and methods of production of precast elements. 7 Hours

TEXTBOOKS:
2. Structural Masonry by Arnold W. Hendry.

REFERENCE BOOKS:
1. Relevant IS Codes.
2. Alternative building materials and technologies.
3. Proceedings of workshop on Alternative building material and technology from 9th to 20th December 2003 @ BVB College of Engineering. &Tech.,Hubli.

Question Pattern:
Answer any five full questions choosing at least one from each unit.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Objectives</th>
<th>Course Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>To learn- Energy in building materials, global warming and construction industry, alternative building materials.</td>
<td>The student would cores to know the different alternative building materials and techniques involved in planning, design and construction.</td>
</tr>
<tr>
<td>2.</td>
<td>Lime puzzulona cement, FRC, FRP alternative building techniques, alternative rooting systems, Structural masonry, cost effective building design, equipments for the production of alternative building materials.</td>
<td>Alternative techniques while construction of foundation, wall construction and slab construction.</td>
</tr>
</tbody>
</table>

UCV631E: GEOGRAPHIC INFORMATION SYSTEMS
3 Credits (3-0-0)

UNIT -I

Geographic information system: Introduction, History, components concepts and applications.

Types of data: Spatial Temporal nonspatial and metadata conceptual models of real world phenomenon, spatial and temporal information, representation of geographical data primitives in vector and raster approaches, procedure for handling data, data modelling with examples and spatial analysis.

Coordinate systems: Plane and Geodetic, Latitude and longitude Map projections: types of map projections, Spheroids, Datum and UTM Data input, verification, storage and output: Data sources and acquiring data, creating digital data sets, rasterisation and vectorisation, data entry verification and editing of attribute data, Linking spatial and non-spatial data Use of digitizers and scanners plotters etc 10 hrs

UNIT-II

GIS Data models and structures: Coding basic data models for input into the computer, database structures, file listing and data access, types of database structures, database management systems and their requisites Data organization and compression in raster and vector data structures Cartography Symbolisation, Types of Maps, Typography and Map Design Geo-relation vector model.

Data quality and sources of errors: Sources of errors in GIS data, obvious sources, natural variations and the processing errors and accuracy. 10 hrs

UNIT-III

Digital terrain mapping and analyses: DEMs, TINs, DLGs, DTM ,manipulating and moving between DTM, map slope, aspect, & curvature, profiles and view sheds perspectives, Watershed Analyses.

Spatial data analysis: overlay analysis, raster analysis, network analysis in GIS.

Spatial Overlays and Querying Location-related calculations Friction/Least Cost Paths, Simplification and ”clumping”.

Neighborhood Analyses: Density, Proximity, Filters, surface creation Planning Implementation and Management of GIS. 10 hrs

UNIT-IV

Remote sensing: Concepts and Basics, Electromagnetic spectrum, Spectral reflectance of earth surface features like Vegetation soil and water, Geologic and soil mapping and water resources and urban planning applications. An ideal remote sensing system.
Sensors: characteristics and types, Landsat Thematic mapper, LIDAR.

**Digital Image processing:** Introduction, Rectification and Restoration, Enhancement, Manipulations, Classification, Data merging and GIS Integration, Hyperspectral Image analysis, Biophysical modelling, Scale effects, Image Transmission and Compression and Visualization

**GPS System:** Global Navigation satellite System, Functional segments and working principles of GPS, Differential GPS and applications of GNSS.

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**Textbooks:**
1. Peter ABurroughReachael AMcDonnel, Principles of GIS (oxford)
2. Kang-tsung chang Introduction to Geographic Information systems, (Tata MCGravHill)
3. Tor Bernhardsen, Geographic Information Systems An Introduction (Wiley India)
4. Lillesand, Remote sensing and Image interpretation (John Wiley and Sons)

**Question Paper Pattern for SEE:**
1. Total of Eight Questions with two from each unit are set uniformly covering the entire syllabus.
2. Each Question should not have more than four sub divisions.
3. Any Five Full questions are to be answered choosing at least one from each unit.
Definitions and Concepts
Comparison of classical, matrix and approximate methods of structural analysis, Flexibility and displacement methods, System approach versus Element approach, degrees of freedom, coordinate systems, stiffness and flexibility coefficients.

Flexibility Method by element approach.
Introduction:
Element flexibility matrix, Principle of contragradience, Equilibrium matrix, Construction of member and structure flexibility matrix, matrix determination of displacement vector, determination of member forces. Procedure for analysis of indeterminate structures: analysis of plane trusses, continuous beams and plane frames.

UNIT II
Stiffness Method by element approach Contd…..
Introduction, member stiffness matrix, Principle of contragradience, Global or system stiffness matrix, member transformation, system stiffness matrix Analysis of indeterminate structures: continuous beams

UNIT III
Stiffness Method by Element approach Contd…. 
Analysis if interminate structures: Plane frames and plane trusses

Direct Stiffness Method
Introduction, transformation of variables, transformation of stiffness matrix of the member of a truss and rigid frame. Overall stiffness, boundary conditions, computation of internal forces, analysis of plane trusses and continuous beams.

Note:
Three questions from Unit-I, Three questions from Unit-II and Two questions from Unit-III to be set. Any FIVE questions to be answered choosing at least one from each Unit.

TEXT BOOKS:


Reference Books:

Sl. No. | Course Objectives | Course Outcomes |
--- | --- | --- |
1. | Students to understand the basic concepts, structure and application of matrix analysis of structures. | This class will help the students develop an ability to apply knowledge of mathematics science and engineering. Develops an ability to formulate stiffness and flexibility matrices & hence analyze structures. Develops ability to carry out force analysis & deformation analysis of beams, frame & trusses. |
2. | To work from the bases of mechanics and energy principle to formula of the stiffness and flexibility matrices. | Students develop an ability to identify formulate and solve an engineering problem. |
3. | To work on matrix based mathematical models of variety of structural elements and structural systems. | Students develop an ability to use the techniques skills, modern engineering tools necessary for engineering practice. |
4. | To utilize these models to analyze structural response to variety of wads. | This helps the students in using modern structure analysis software & forms a basis for learning finite element method. |
UNIT -I
INTRODUCTION: Importance, vertical distribution of sub surface water, Occurrence in different types of rocks and soils. Definition aquifers, aquifuge, aquitard and aquiclude. Confined and unconfined aquifer 7 Hrs
Fundamentals of ground water flow: Aquifer parameters-specific yield and specific retention, porosity, storage coefficient: derivation of the expression. 6 Hrs

UNIT -II
Darcy’s law. Hydraulic conductivity, coefficient of permeability and intrinsic permeability. Transmissibility. Permeability isotropic unisotropic layered soils. Steady one dimensional flow-different cases with recharge 7 Hrs
Well Hydraulics Steady flow: Radial flow in confined and unconfined aquifers. Pumping tests. 6 Hrs

UNIT -III
Well Hydraulics Un-Steady flow: General equations- derivation; theiss method, Cooper and Jacob method, Chow’s method. Solution of unsteady flow equation. Leaky aquifers (only introduction); Interference of well- Image well theory. 13 Hrs

UNIT -III
Ground Water Development: Types of wells. Methods of construction. Tube well design. Dug wells. Pumps for lifting water-working principles, power requirements. Conjunctive use- necessity techniques and economics. 09 Hrs
Ground water exploration: Seismic method. Electrical resistivity method-principles 4 Hrs

Text Books:

Reference Books:
4. R Vaidyanathan P Perumal, Structural Analysis vol I, Laxmi Publisher New Delhi.
1. Tests for determination of specific gravity and moisture content.
2. Grain size analysis of soil sample (sieve analysis).
3. In situ density by core cutter and sand replacement methods.
4. Consistency Limits Liquid Limit (Casagrande and Cone Penetration Methods), plastic limit and shrinkage limit
6. Coefficient of permeability by constant head and variable head methods.
7. Strength Tests
   a. Unconfined Compression Test
   b. Direct Shear Test
   c. Triaxial Compression Test (undrained)
8. Consolidation Test- Determination of compression index and coefficient of consolidation.
9. Laboratory vane shear test
10. Determination of CBR value
11. a) Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid Moisture meter, Proctor’s needle.
    b) Demonstration of Hydrometer Test.
    c) Demonstration of Free Swell Index and Swell Pressure Test
       * Performance and journal write up:
         Marks for each experiment = 30 marks/ No. of proposed experiments.
         *One Practical test for 20 Marks. (5 write-up, 10 conduction, calculation, Results etc., 5 viva-voce)
3. Allocation of 50 marks for SEE.
   
   *25% write-up, 50% conduction, calculation, results etc., 25% viva

**REFERENCE BOOKS:**

**LABORATORY ASSESSMENT:**
1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. Allocation of 50 marks for CIE
I) Tests on Water Quality
   A) Physical Parameters
      1) Colour
      2) Turbidity
      3) Conductivity
      4) Temperature
   B) Chemical Parameters
      1) Solids-Total, dissolved and suspended
      2) Ph
      3) Acidity
      4) Alkalinity
      5) Chlorides
      6) Hardness- Carbonate and Non carbonate
      7) Sulphate
      8) Fluoride
      9) Iron
      10) Chlorine demand & Residual chlorine
      11) Nitrate
   C) Bacteriological Parameters
      1) MPN
      2) Membrane Filter Technique

II) Tests on Sewage
   1) Solids-Total, dissolved, suspended, volatile and fixed
   2) Biochemical oxygen Demand
   3) Chemical oxygen Demand

III) Other Tests
   1) Optimum Alum dose (Jar Test)
   2) Percentage of chlorine in Bleaching Powder

Reference:
1. Manual of Water and Wastewater Analysis- NEERI Publication
2. Standard methods for Examination of Water and Wastewater Analysis
   APHA, AWWA.

Laboratory assessment:
1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. Allocation of 50 marks for CIE
   * Performance and journal write up:
     Marks for each experiment = 30 marks/ No. of proposed experiments.
   * One Practical test for 20 Marks. (5 write-up, 10 conduction, calculation, results etc., 5 viva-voce)
3. Allocation of 50 marks for SEE.
   * 25% write-up, 50% conduction, calculation, results etc., 25% viva-voce.
1 Solid Geometry:
Distance formula (without proof), Division formula, direction cosines and direction ratios, planes and straight lines angle between the planes.

2 Vector Difference:

3 Laplace Transforms:

Resources:
1. Elementary Mathematics by B. S. Grewal.

Question paper pattern for SEE:
1. Total of eight question to be set, covering the entire syllabus
2. Each question should not have more than 4 sub divisions.
3. Any five full questions are to be answered.