# COURSE STRUCTURES

## I SEMESTER

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B.Tech. (Civil Engineering)  R17 Regulations (w.e.f. 2017-18)  Page 5 of 150
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## OPEN ELECTIVE – I  (VI Semester)

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<td>Industrial Engineering and Management</td>
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<td>Project Management</td>
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<td>17MB82</td>
<td>Logistics and Supply Management</td>
<td>MBA</td>
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<td>4</td>
<td>17MB83</td>
<td>Banking and Insurance Management</td>
<td>MBA</td>
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## OPEN ELECTIVE – II  (VII Semester)

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<td>Principles of Flight</td>
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<td>Basic Civil Engineering</td>
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<td>4</td>
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<td>Basic Control Systems</td>
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<td>Utilization of Electrical Energy</td>
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<td>Elements of Automobile Engineering</td>
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<tr>
<td>1</td>
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<td>Space Technology</td>
<td>AE</td>
<td>CE, CSE, ECE, EEE, EIE, IT &amp; ME</td>
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<td>Disaster Management</td>
<td>CE</td>
<td>AE, CSE, ECE, EEE, EIE, IT &amp; ME</td>
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<td>3</td>
<td>17CS82</td>
<td>Internet Technologies</td>
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<td>4</td>
<td>17CS83</td>
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<td>ECE</td>
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<td>Computer Networks</td>
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<td>11</td>
<td>17ME82</td>
<td>Robotics and Automation</td>
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<td>AE, CE, CSE, ECE, EEE &amp; IT</td>
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<tr>
<td>12</td>
<td>17ME83</td>
<td>Mechanical Handling Systems and Equipments</td>
<td>ME</td>
<td>AE, CE, CSE, ECE, EEE, EIE &amp; IT</td>
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Pre-requisites: Basics in English Grammar & Vocabulary

Course Educational Objective:
To improve the proficiency of students in English with an emphasis on Vocabulary & Grammar for better communication in formal and informal situations; Develop listening skills required for thorough understanding and analysis to face interviews with confidence.

Course Outcomes: At the end of the course, the student will be able to
CO1: Use English vocabulary & grammar effectively while speaking and writing.
CO2: Comprehend the given text and Communicate confidently in formal and informal contexts.
CO3: Draft E-mails & Memos
CO4: Understand the written and spoken information thoroughly.
CO5: Face interviews with confidence.

UNIT – I
Presidential Address – Dr. A.P.J. Abdul Kalam
Vocabulary: Word formation: Prefixes, suffixes & Compound Collocations
Grammar: Punctuation; Parts of Speech
Reading: Double Angels, David Scott
Writing: Sentence structure; Paragraph writing & Dialogue writing

UNIT – II
SatyaNadella’s E-Mail to his Employees
Vocabulary: Homonyms, Homophones, Homographs (Words often confused)
Grammar: Types of verbs; Types of sentences
Reading: The Road Not Taken – Robert Frost
Writing: Letter Writing: Official Letters

UNIT – III
Technology with a Human Face – E.F. Schumacher
Vocabulary: Synonyms & Antonyms, commonly misspelt words
Grammar: Tenses: Types & Uses
Reading: Extract from ‘Preface’ to Lyrical Ballads – William Wordsworth
Writing: E-mails; Memo drafting

UNIT – IV
Listening Skills: The boy who broke the bank – Ruskin Bond; Importance of active listening; understanding the people; understanding places & events; expanding the proverbs on listening & listening at work place.

UNIT – V
Interview Skills: The lighthouse keeper of Aspinwall – Henryk Sienkiewicz; Interview skills from the story; expanding proverbs on Interview skills; Tips for attending an Interview - Covering letters for job applications & Writing a CV/Résumé
TEXT BOOKS

REFERENCE
Pre-requisites: Basics of Differential Calculus and Matrix Algebra

Course Educational Objective:
The objective of this course is to introduce the first order and higher order differential equations, functions of several variables. The students will also learn Matrix Algebra.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Apply first order and first degree differential equations to find Orthogonal trajectories and to calculate current flow in a simple LCR circuit.
CO2: Discriminate among the structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients.
CO3: Developing continuous functions as an infinite series and compute the Jacobian to determine the functional dependence.
CO4: Distinguish among the pros and cons between the Row operation methods and Iterative methods in solving system of linear equations.
CO5: Compute the Eigen values and Eigen vectors and powers, Inverse of a square matrix through Cayley – Hamilton theorem.

UNIT – I
Differential Equations of First Order and First Degree

UNIT – II
Higher Order Differential Equations
Linear differential equations of second and higher order with constant coefficients, method of variation of parameters.

UNIT – III
Functions of Several variables
Generalized Mean Value Theorem (without proof), Maclaurin’s series, Functions of several variables, Jacobians (polar, cylindrical, spherical coordinates), Functional dependence.
Partial Differential Equations.

UNIT – IV
System of Linear Equations.
Matrices - Rank- Echelon form, Normal form, PAQ form– Solution of Linear Systems – Homogeneous system of equations and Non Homogeneous system of equations

UNIT – V
Eigen Values and Eigen Vectors
TEXT BOOKS

REFERENCE
Pre-requisites: Basics in Light, Crystals, Magnetism, Conductivity etc.,

Course Educational Objective: To make students learn the basic concepts of Optics such as Interference, Diffraction, Polarization and Lasers; the principle of quantum mechanics, different types of crystals, magnetic materials and the concept of super conductivity.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Define the nature of Interference and Diffraction.
CO2: Describe the polarization and LASER, types of lasers and their applications.
CO3: Analyze the dual nature of matter waves and the crystal structures.
CO4: Identify the different types of magnetic materials and their applications.
CO5: Propose the different superconducting materials.

UNIT – I
INTERFERENCE AND DIFFRACTION

UNIT – II
POLARIZATION AND LASERS
POLARIZATION: Introduction – Polarization of light, Brewster’s law-Double refraction, Quarter wave plate – Half wave plate - Polarimeter.

UNIT – III
PRINCIPLES OF QUANTUM MECHANICS, CRYSTALLOGRAPHY AND X-RAY DIFFRACTION
PRINCIPLES OF QUANTUM MECHANICS
De Broglie waves, Experimental verification- Schrodinger wave equation-time independent wave equation, physical significance of the wave function – particle in a box.
CRYSTALLOGRAPHY AND X-RAY DIFFRACTION
Fundamental terms of crystallography, Types of crystals, Miller Indices, Relation between Inter planar and atomic distance, simple cubic crystal structure, Body centred cubic structure, Face centred cubic structure, Bragg’s law, Laue’s method .

UNIT – IV
MAGNETIC MATERIALS
UNIT – V
SUPER CONDUCTIVITY
Introduction- General properties of super conducting material, Meissner effect, Effect of electric current, Types of super conductors- Type I super conductors, Type II super conductors, DC and AC Josephson Effect, London Equations Applications of super conductors- SQUID , Cryotron, Magnetic levitation.

TEXT BOOKS

REFERENCES
B.Tech. (I Sem.) | 17CI01 - COMPUTER PROGRAMMING

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**Pre-requisites**: NIL

**Course Educational Objective**: In this course student will learn about
The basic elements of C programming structures like data types, expressions, control statements, various I/O functions and how to solve simple mathematical problems using control structures. The derived data types like arrays, strings, various operations on them. Modular programming using functions and Memory management using pointers. User defined structures and various operations on it. The basics of files and its I/O operations.

**Course Outcomes**: At the end of the course, the student shall be able to:
- **CO1**: Identify basic elements of C programming structures like data types, expressions, control statements, various functions and in view of using them in problem solving.
- **CO2**: Apply various operations on derived data types like arrays and strings in problem solving.
- **CO3**: Design and Implement Modular Programming and memory management using pointers.
- **CO4**: Implement user defined data structures used in specific applications.
- **CO5**: Compare different file I/O operations on text and binary files.

**UNIT – I**
**Introduction to Problem solving through C-Programming**: Problem Specification.
Algorithm / pseudo code, flowchart, examples.

**C-Programming**: Structure of C program, identifiers, basic data types and sizes, Constants, variables, Input-output statements, A sample C program, operators: arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence of operators and order of evaluation.

**Conditional statements**: if, if else, else if ladder and switch statements, continue, goto. Loops: while, do-while and for statements, break, programming examples.

**UNIT – II**
**Arrays**: one dimensional arrays-concept, declaration, definition, accessing elements, storing elements, two dimensional and multi-dimensional arrays.

**Character Strings**: declaration, initialization, reading, writing strings, arithmetic operations on characters, string handling functions, programming examples

**UNIT – III**
**Functions**: basics, category of functions, parameter passing techniques, recursive functions-comparison with Iteration, Functions with arrays, storage classes- extern, auto, and register, static, scope rules, Standard library functions, dynamic memory management functions, command line arguments, programing examples.

**Pointers**: concepts, declaring & initialization of pointer variables, pointer expressions, pointer arithmetic, pointers and arrays, pointers and character strings, pointer to pointer, Pre-processor Directives and macros.
UNIT –IV
Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, array of structures, structures and functions, pointer to structure, self-referential structures, unions, typedef, programming examples.

UNIT – V
Files – concept of a file, text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling, and programming examples.

TEXT BOOKS

REFERENCE
Pre-requisites: NIL

Course Educational Objective:
This course aims to provide study of the properties, making and applications of basic civil engineering materials such as stones, bricks, lime, cement and wood. The course also provides an insight into the different types masonry work used in construction practice, various building components and building finishing activities.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify suitability of stones and bricks as building materials
CO2: Recognize the importance of lime and cement as building materials
CO3: Make out the appropriate masonry and mortar to be used for building construction
CO4: Pick up the appropriate building components for comfortable construction
CO5: Identify the appropriate type of finishing techniques to be used in buildings

UNIT-I
STONES & BRICKS
Introduction-classification of rocks- common rock forming minerals – characteristic of good building stone-dressing of stones- common building stones, their properties- compositions- uses-quarrying of building stone
Bricks: Composition of brick, constituents of brick earth- manufacturing process of bricks, characteristics of good building bricks, classification of bricks, special bricks- Fly ash bricks, hollow bricks - uses.

UNIT-II
LIME AND CEMENT

UNIT-III
MORTAR AND MASONRY
Introduction-classification of motors-characteristics of good mortar-Types of mortars - Preparation of mortar-Uses-Precautions in the uses of mortars-selection of mortars for different Engineering works. Types of masonry-joints in stone masonry, different bonds in bricks-tools for brick laying-English and Flemish bonds-defects in brick masonry-, importance of Cavity and Partition walls.

UNIT-IV
BUILDING COMPONENTS
Components of a building – Substructure and superstructure-Importance of foundation-functions of foundations-requirements of good foundations - different types of foundations –Purpose of foundation.
Basic details of Lintels, Arches, walls, vaults, stair cases - types of floors - types of roofs - flat, curved, trussed;
UNIT-V
TIMBER AND FINISHINGS IN BUILDINGS
Classification of timber trees, cross section of exogenous tree, hard wood and soft wood, seasoning of timber, important types of timber and their uses, ply wood and its uses.

Finishings: Paints: Functions of paints-types of paints - constituents of paints - characteristics of good paint-General precautions-defects in painting.
Varnishes: Composition, types and uses- Distempering

TEXT BOOKS
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain-“Building Construction”- Laxmi Publications (P) Ltd.

REFERENCES
3. P.C Varghese “Building Construction” Prentice-Hall of India Private Ltd.
4. http://nptel.ac.in/courses/105102088/
Pre-requisites: Students should have fundamental knowledge in making sentences and be with readiness to speak

Course Educational Objective:  
To improve the proficiency of students in English with an emphasis on better communication in formal and informal situations; Develop speaking skills required for expressing their knowledge and abilities and to face interviews with confidence.

Course Outcomes: At the end of the course, the student will be able to
CO1: Articulate English with good pronunciation.
CO2: Manage skilfully through group discussions.
CO3: Communicate with the people effectively.
CO4: Collect and interpret data aptly.

Syllabus: English Communication Skills Lab (ELCS) shall have two parts:
- Computer Assisted Language Learning (CALL) Lab for 60 students with 60 systems, LAN facility and English language software for self-study by learners.
- Interactive Communication Skills (ICS) Lab. with movable chairs and audio-visual aids with a P.A System, a T.V., a digital stereo – audio & video system and camcorder etc.

Exercise – I
CALL Lab: Understand: Sentence structure, written language.

Exercise – II
CALL Lab: Understand: Usage of various words in different parts of speech.
ICS Lab: Practice: Ice-Breaking Activity and JAM Session – Introducing Oneself.

Exercise – III
CALL Lab: Understand: Features of Good Conversation – Strategies for Effective Communication
ICS Lab: Practice: Situational Dialogues – Role-Play – Expressions in various situations – Making Requests and seeking permissions.

Exercise – IV
CALL Lab: Understand: Data collection strategies – Interpretation of collected data.
ICS Lab: Practice: Data interpretation – Information transfer from flow charts, pie charts, bar graphs, pictograms etc.
Exercise – V
CALL Lab:
ICS Lab:
Practice: Introduction to Group Discussions

Lab Manual:

SUGGESTED SOFTWARE:
1. Digital Mentor: Globarena, Hyderabad, 2005
4. Dorling Kindersley Series of Grammar, Punctuation, Composition, USA, 2001
5. Oxford Talking Dictionary, the Learning Company, USA, 2002
Pre-requisites: Awareness about the usage of Vernier callipers, Screw Gauge etc.,

Course Educational Objective:
To make students learn the theoretical concepts, analytical techniques and graphical analysis through completing a host of experiments with the procedures and observational skills using simple and complex apparatus.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Analyze the wave characteristics of light.
CO2: Estimate the wave length and width of the slit with Laser light source.
CO3: Evaluate the specific parameters in electrical circuits.
CO4: Analyze the characteristics of Torsional Pendulum, Thermister, Stewart and Gee’s.

List of Experiments
(ANY 8 EXPERIMENTS)

GENERAL EXPERIMENTS:
1. Determine the frequency of AC supply by using Sonometer.
2. Determine the frequency of a tuning fork by using Melde’s arrangement.
3. Study the characteristics of L.C.R Circuit.
4. Study the magnetic field along the axis of a current carrying circular coil using Stewart’s & Gee’s apparatus and to verify Biot - Savart’s law.
5. Determine the rigidity modulus of a given material using Torsional pendulum.
6. Study the characteristics of Thermister.
7. Determination of time constant of a RC Circuit.

OPTICS LAB EXPERIMENTS:
8. Determine the wavelength and divergence of a laser radiation.
9. Determine the width of a single slit by forming diffraction pattern.
11. Find the specific rotation of sugar solution by using a polarimeter.
12. Determine the Refractive index of a material of the given prism.
13. Determine the Wavelengths of various spectral lines by using diffraction grating.
14. Determination of a thickness of thin wire by using wedge shaped film.

TEXT BOOKS
Lab Manual Prepared by the LBRCE.
Pre-requisites: NIL

Course Educational Objective: In this course student will learn about Software development tools like algorithm, Pseudo codes and programming structure. Basic elements C programming structures like data types, expressions, Control statements, various I/O functions and how to solve simple mathematical Problems using control structures. Design and implementation of various software components which solve real world problems.

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

CO1: Apply and practice logical formulations to solve some simple problems leading to specific applications.

CO2: Demonstrate C programming development environment, compiling, debugging, linking and executing a program using the development environment.

CO3: Design effectively the required programming components that efficiently solve computing problems in real world.

Mandatory: All Programs must have Algorithms and Flow Charts

LAB CYCLESYLLABUS

I) Exercise Programs on Basics of C-Program
Write a program in ‘C’ language to cover the following problems.

a) Example program which shows the usage of various preliminary Data types available in C Language.

b) Example program which shows the usage of various Operators available in C Language.

c) Example programs to illustrate the order of evaluation.

II) Exercise Programs on Control Structures:

a) To check whether the given year is leap year (or) not
b) Roots of Quadratic Equation.

(c) Finding smallest& biggest number from the given set of 4 numbers using ‘if’ statement.

d) Calculate the student grade in the examination – assume suitable Constraints.

e) Prepare electricity bill for the consumed units – assume suitable Constraints.

f) Converting given two digit number into words using switch statement

g) To illustrate the usage of ‘goto’ statement.

III) Exercise Programs on Loops:

a) To Display first N natural numbers
b) To find whether the given number is Armstrong (or) not

(c) To find reverse of the given number and to check whether it is palindrome (or) not.

d) To find whether given number is strong number (or) not.

e) To check whether given number is Prime (or) not

f) To display prime numbers with in the given range (Nesting of Loops).

g) To display the following structure (Nesting of Loops)
IV) Exercise Programs on Arrays & Strings:
Write example programs in C Language to perform following operations:
   a) Finding the sum and average of given numbers using Arrays.
   b) To display elements of array in reverse order
   c) To search whether the given element is in the array (or) not using linear search & binary search.
   d) Write a C program to perform the following operations
      i) Addition, subtraction and multiplication of Matrices
      ii) Transpose of given matrix
(The above operations are to be exercised using functions also bypassing arguments)
   e) Write a C program to find whether the given string is palindrome (or) not.
   f) To accept line of text and find the number of characters, number of vowels and number of blank spaces in it.
   g) Write an example program to illustrate the use of any 5 string handling functions.

V) Exercise Programs on Functions & Pointers:
   a) Example program to bring clarity on pointer declaration & initialization and Pointer arithmetic.
   b) Write an example program to describe the usage of call by reference.
   c) Write a program to find sum of the elements of the array using functions.

VI) Exercise Programs on Functions:
Write example programs in C Language:
   a) To find factorial of a given number using functions.
   b) Swap two numbers using functions.
   c) To find GCD of two numbers using recursion
   d) Write a recursive function to solve Towers of Hanoi problem.
   e) Write an example program to illustrate use of external & static storage classes.
   f) Write an example program to illustrate the usage of command line arguments.
   g) Program to illustrate the usage of dynamic memory management functions.

VII) Exercise Programs on Derived data types:
   a) Write an example program using structures to process the student record. Assume suitable fields for student structures (Different kinds of initialization of structure variables are to be exercised)
   b) Write a program to read records of 10 employees and find their average salary (Exercise array of structures & Nested structures concepts through this program).
   c) Write a program to handle a structure variable using pointers and implement self referential structure (i.e. A structure variable having a pointer to itself)

VIII) Exercise Programs on Files:
Write an example program on file to perform following operations:
   a) Accessing content from files and writing content in to it.
      (Exercise different file operation modes)
   b) Copy the contents of one file into another.
      (Exercise different file operation modes)
PRE-REQUISITES: Knowledge in dimensions and units, Usage of geometrical instruments and analytical ability

COURSE EDUCATIONAL OBJECTIVE:
The objective of this course is to get familiarized with various trades used in Engineering Workshop and learn the safety pre-cautions to be followed in the workshops, while working with the different tools.

COURSE OUTCOMES: After completion of the course students are the able to:
CO1 : Design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint.
CO2 : Fabricate and model various basic prototypes in the trade of fitting such as Straight fit, V- fit.
CO3 : Produce various basic prototypes in the trade of Tin smithy such as rectangular tray, and open Cylinder.
CO4 : Perform various basic House Wiring techniques.
(Conduct at least 4 Trades with 2 exercises from each Trade and demonstrate about 2 Trades)

Trade –1: CARPENTRY SHOP
1.1. Introduction to various types of wood such as Teak, Mango, Sheesham, etc. (Demonstration and their identification).
1.2. Demonstration, function and use of commonly used hand tools.
1.3. Introduction to various types of wooden joints, their relative advantages and uses.
1.4. Care maintenance of tools and safety precautions in carpentry shop.
Job I- Marking, sawing, planning and chiselling & their practice
Job II -Preparation of half lap joint
Job III -Preparation of Mortise and Tenon Joint

Trade –2: FITTING SHOP
2.1. Introduction to fitting shop tools, common materials used in fitting shop.
2.2. Description and demonstration of simple operation of hack-sawing, various types of blades and their specifications, uses and method of fitting the blade.
2.3. Care and maintenance of tools & safety precautions in fitting shop.
   Job I-Making a L-Fit from a rectangular piece of MS
   Job II-Making a T-Fit from a rectangular piece of MS
   Job III-Making a V-Fit from a rectangular piece of MS
   Job IV-Making a Half round Fit from a rectangular piece of MS

Trade -3: TIN- SMITHY SHOP
3.1. Introduction to tin -smithy shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material and specifications.
3.2. Introduction and demonstration of various raw materials used in sheet metal shop e.g. M.S. sheet, galvanized-iron plain sheet, galvanized corrugated sheet, aluminium sheets etc.
3.3. Care and maintenance of tools & safety precautions in Tin-Smithy shop.
   Job I - Preparation of a rectangular tray.
   Job II- Preparation of an open scoop/ funnel.
   Job III - Preparation of a Single Seam Joint and Double Seam Joint.
   Job IV - Preparation of a Corner Seam Joint.
Trade 4: PLUMBING SHOP
4.1. Introduction to plumbing – use of hand tools and accessories e.g. pipe vice, Die sets, adjustable spanners, pipe wrench, pipe cutter and pipes and pipe fittings - various raw materials used in plumbing such as PVC Pipes, CI Pipes, MS pipes, Brass Pipes, Copper Pipes, Aluminium Pipes.
4.2. Demonstration of hand tools used in plumbing – preparation of pipe layout and pipe threading.
4.3. Care and maintenance of tools & safety precautions in Plumbing.
Job I – preparation of pipe layout.
Job II – Pipe threading.

Trade 5: BLACK SMITHY
5.1. Introduction to Black smithy – use of tools and equipments e.g.
5.2. Demonstration of forging operations.
5.3. Care and maintenance of tools & safety precautions in Black smithy.
Job II – preparation of Chisel

Trade 6: HOUSE WIRING
6.1. Study, demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVC Conduits.
6.2. Study of electrical safety measures and demonstration about use of protective devices such as fuses, and relays including earthing.
Job I - Two lamps in series and parallel connection with one way switch
Job II – Florescent lamp and calling bell circuit.
Job III - One lamp connection with two 2-way switches (stair case connection).
Job IV – House wiring circuit.

REFERENCE
1. LBRCE Workshop Lab Manual
**Pre-requisites:** Students should have basics in English vocabulary and Grammar & they should write error free sentences

**Course Educational Objective:** To Improve vocabulary, Grammar, Verbal – Non verbal Communication; to develop adaptability, assertive skills and Team spirit for skillful management in work place; and to Interpret technical data given in the form of charts, graphs & pictograms for writing technical reports.

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

- CO1: Use appropriate vocabulary to interpret data thoroughly and to write reports effectively.
- CO2: Face any situation with confidence and voice opinions/decisions assertively.
- CO3: Use English Language effectively in spoken and written forms.
- CO4: Work effectively in teams for better result.
- CO5: Communicate effectively using verbal and non-verbal dimensions aptly.

**UNIT – I**
**Good Manners – J.C. Hill**
Vocabulary: Idioms; One-word substitutes
Grammar: Subject-Verb agreement (Concord)
Reading: If – Rudyard Kipling
Writing: Information transfer: Tables, Bar graphs, Line graphs, Pie charts, Flow charts, Tree Diagrams, Pictograms; Note-making & Abstract/Summary writing

**UNIT – II**
**Assertive Skills:** Verger – Somerset Maugham; Assertive skills from the story; Assertive skills at personal level & at workplace; Expanding proverbs & their Significance
Team work skills: White washing the fence – Mark Twain; Teamwork skills from the story; Teamwork at work place & its Importance

**UNIT – III**
**Oh Father, Dear Father – Raj Kinger**
Vocabulary: Foreign Languages and their Influence on English
Grammar: Conditional Sentences; Degrees of Comparison; Question Tags
Reading: Basic Education – M.K. Gandhi
Writing: Report Writing: Nature, Significance & Types of Reports

**UNIT – IV**
**Adaptability:** Sen’or Payroll – W E Barrett; Understanding the Organizational Communication; Adaptability skills from the story; Expanding proverbs on Adaptability skills; Importance at work place & Real life - Active & Passive Voice; Direct & Indirect Speech.
UNIT – V
Non-Verbal Communication Skills: A real good smile – Bill Naughton; ‘Wh’ & ‘Yes’ or ‘No’ questions; Working on articulation and gestures; Non-Verbal Communication Skills from the story; Expanding the proverbs on Non-Verbal Communication; enhancing skills through real life experiences - Common Errors.

TEXT BOOKS

REFERENCES
Pre-requisites: Basics of Integral Calculus and Vector Calculus

Course Educational Objective: In this course the students are introduced to Integral transformations which includes Laplace Transforms and Z – Transforms. They will also learn Multiple Integrals in different coordinate systems and Vector Calculus.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Apply the concepts of Laplace Transforms to solve ordinary differential equations.
CO2: Apply Z - Transforms to solve difference equations
CO3: Discriminate among Cartesian, Polar and Spherical coordinates in multiple integrals and their respective applications to areas and volumes.
CO4: Evaluate the directional derivative, divergence and angular velocity of a vector function.
CO5: Apply Vector Integration for curves, surfaces and volumes and relationship among themselves.

UNIT – I
Laplace Transforms
Laplace transforms of standard functions – Linear Property - Shifting Theorems, Change of Scale Property – Multiplication and Division by ‘t’ - Transforms of derivatives and integrals – Unit step function –Dirac’s delta function.
Inverse Laplace Transforms
Inverse Laplace transforms – Linear Property - Shifting Properties - Convolution theorem, Applications of Laplace transforms to ordinary differential equations.

UNIT – II
Z-Transforms

UNIT – III
Multiple Integrals
Multiple integrals - double and triple integrals (Cartesian, polar, spherical coordinates) – Changing of order of Integration and applications to areas and volumes.

UNIT – IV
Vector Differentiation
Vector Differentiation: Gradient- Directional Derivatives -Divergence – Solenoidal fields- Curl – Irrotational fields-potential surfaces - Laplacian and second order operators and related properties of sums and products

UNIT – V
Vector Integration
Vector Integration - Line integral – work done –area - surface and volume integrals. Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (Without proof) and related problems
TEXT BOOKS

REFERENCES
Pre-requisites: Knowledge of atomic weights, molecular weights, equivalent weights, galvanic cell, working principle of battery, concept of polymerization.

Course Educational Objectives
In this course, students will learn the concepts and applications of chemistry in engineering. It aims at strengthening the students with the fundamental concepts of chemistry. It provides them with the knowledge of water specification for different industries along with solutions to the problems that arise due to hardness of water.

It enables the students to know analysis of fuels and alternate fuels used in diverse fields. It makes the students to effectively use the knowledge of electrochemistry, battery technology, and corrosion science in engineering applications. It enables the students to identify the role of polymers and lubricants in various fields.

Course Outcomes: After completion of course, students will be able to
CO1: Identify the troubles due to hardness of water and its maintenance in industrial applications.
CO2: Analyze issues related to conventional fuels and apply the concepts of advanced fuels like bio, nuclear and rocket fuels in energy production.
CO3: Analyze different types of electrodes and batteries for technological applications.
CO4: Apply principles of corrosion for design and effective maintenance of various equipments.
CO5: Identify the important applications of engineering materials like plastics, rubbers and lubricants.

UNIT – I: WATER TECHNOLOGY
Introduction: Sources of water and quality.
Hardness: Hardness of Water - Temporary and permanent hardness, units and their inter relation, problems on hardness and disadvantages of hard water in industries.
Boiler troubles: Reasons, disadvantages and methods of prevention for scale and sludge formation, caustic embrittlement, boiler corrosion and carryover(priming and foaming).
Desalination of brackish water: Electro dialysis and reverse osmosis.

UNIT – II: CONVENTIONAL FUELS
Introduction: Definition and classification of fuels(solid, liquid and gaseous fuels, merits and demerits) and characteristics of a good fuel.
Calorific value: Definition, gross and net calorific values (definition only).
Solid fuels: Coal – Origin, proximate analysis of coal and significance.
Liquid Fuels: Petroleum-origin, types of crude oil and refining of petroleum. Cracking – moving bed catalytic cracking and synthetic petrol – Fischer Tropsch’s process.
ADVANCED FUELS
Bio fuels: Characteristics of bio fuels, sources of bio mass and advantages, - Production of bio diesel from rape seed oil.
Nuclear fuels: Nuclear fission, fusion, differences between chemical and nuclear fuel, Characterstics of fuel elements.
Rocket propellants: Characteristics of good propellants, classification, examples and mechanism of propulsion.
UNIT – III : ELECTRO CHEMISTRY & BATTERIES


**Nernst equation:** Derivation and problems.

**Reference Electrode:** Standard hydrogen electrode (S.H.E), calomel electrode, measurement of electrode potential, electro chemical series and applications.

**Types of batteries:** Primary, secondary and reserve batteries, dry battery(Leclanche cell), Nickel-Cadmium battery, Magnesium - Copper reserve battery.

**Fuel Cells:** Hydrogen- Oxygen fuel cells.

UNIT – IV : SCIENCE OF CORROSION

**Introduction:** Definition, examples.

**Dry Corrosion (Direct Chemical corrosion):** Types of dry corrosion-oxidative corrosion, Pilling Bed worth rule, corrosion by other gases and liquid metal corrosion.

**Wet Corrosion (Electro Chemical corrosion):** Mechanism - Oxygen absorption, Hydrogen evolution, Types of wet corrosion, galvanic corrosion, concentration cell corrosion, passivity, galvanic series.

**Factors Influencing Corrosion:** Nature of metal (purity, position in galvanic series, relative area of cathode and anode, nature of surface film) and nature of environment (temperature, humidity, atmospheric pollution and nature of ions in the medium).

**Control of Corrosion:** Cathodic protection (sacrificial anode and impressed current methods), electro plating and metal cladding.

UNIT – V : CHEMISTRY OF ENGINEERING MATERIALS

**Polymers:** Definition, basic terminology, differences between thermosets & thermoplasts, types of polymerization(addition, condensation and co-polymerisation), preparation, properties and engineering applications of Teflon and bakelite, conducting polymers-extreinsic and intrensic conducting polymers.

**Rubbers:** Definition, processing of natural rubber, draw backs, vulcanization and advantages, preparation, properties and applications of BUNA-S and thiokol.

**Lubricants:** Characteristics of a good lubricant and properties of lubricants (viscosity, flash and fire points, cloud and pour points, aniline point) and applications.

**TEXT BOOKS**


**REFERENCES**

Pre-requisites : Physics

Course Educational Objective :
This course provides a basic knowledge of rigid-body mechanics, elasticity and structural analysis. In particular, the principles of statics and their applications in engineering, the methods of static analysis, and techniques of engineering computation are expounded.

Course Outcomes : At the end of the course, the student will be able to:
CO1: Acquire the knowledge of analyzing force and couple systems with regards to practical applications.
CO2: Analyze and solve the engineering problems for different types of forces acting on rigid bodies in equilibrium conditions.
CO3: Solve the problems associated with frictional forces in different applications.
CO4: Locate centroid and determine moment of inertia for composite areas and various cross sections.
CO5: Acquire the knowledge to deal with kinematic analysis of particle both in translation and projectile motions.

UNIT – I: BASIC CONCEPTS
RESULTANT OF SYSTEMS OF FORCES : Parallelogram law-forces and components-
Resultant of Coplanar Concurrent Forces – Components of forces in Space – Moment of Force-
principle of moments-Varignon’s theorem-Application – Couples and Resultant of Force Systems.

UNIT – II: EQUILIBRIUM OF SYSTEMS OF FORCES
Free Body Diagrams- Equations of Equilibrium- Lami’s Theorem - equilibrium of planar systems -
Equilibrium of spatial Systems.

UNIT-III: FRICTION
Introduction-Theory of Friction-Angle of friction-Laws of friction-coefficient of friction-cone of
friction-impending motion of connected bodies-Ladder friction –Wedge friction

UNIT: IV: CENTROID AND MOMENT OF INERTIA
CENTROID: Centroids of simple figures (from basic principles)– Centroids of Composite Figures.
CENTRE OF GRAVITY: Centre of gravity of simple bodies (from basic principles) - centre of
gavity of composite plane figures- Pappus theorem.
AREA MOMENT OF INERTIA: Definition-Polar Moment of Inertia- Transfer Theorem,
Moments of Inertia of composite figures.
MASS MOMENT OF INERTIA: Moment of inertia of masses-Transfer formula for mass
moment of inertia-simple problems.

UNIT –V: KINEMATICS OF RECTILINEAR TRANSLATION
Introduction,-displacement- velocity and acceleration- Motion with Uniform acceleration, Motion of projectiles.
TEXT BOOKS

REFERENCES
1. RK Rajput “Engineering. Mechanics” Dhanpat Rai and Sons, New Delhi
Pre-requisites : NIL

**Course Educational Objective:** The course aims to teach the basic principles of surveying and various methods for measuring linear and angular measurements. The coverage of the course enables the students to differentiate the available surveying equipments suitable for a specific purpose.

**Course Outcomes:** At the end of the course, the student will be able to:
CO1: Apply the basic principles in surveying for the computations using chain and compass survey.
CO2: Generate the elevations and contours of different points in the field.
CO3: Compute the area and volume of a given field.
CO4: Discriminante the appropriate usage of theodolite and tacheometry in civil engineering applications
CO5: compute the requirements of a simple curves and acquainted to the basic principles of total station.

**UNIT-I**
**INTRODUCTION:** Definition-Types and applications of Surveying- Overview of Plane Surveying (Chain, Compass and Plane Table), Objectives, Principles and Classifications.
**LINEAR AND ANGULAR MEASUREMENTS:** Linear Measurements Using Tape and Chain- Errors and Corrections to Linear Measurements – Compass Survey-prismatic compass- Bearings, Declination, Local Attraction, Computation of Angle. Traversing - Purpose-Types of Traverse- Traverse Computation - Traverse Adjustments by Bowditch’s rule

**UNIT II**
**LEVELING:** Concept and Terminology, Temporary and Permanent Adjustments – Height of Instrument Method, Rise and Fall Method.
**CONTOURING:** Characteristics and applications of Contours- plotting Contours by Grid Method.

**UNIT III**
**COMPUTATION OF AREAS:** Area from field notes, Computation of areas along irregular boundaries and Area consisting of regular boundaries.
**COMPUTATION OF VOLUMES:** Embankments and Cutting for a level section and two level sections with and without transverse slopes, determination of the capacity of reservoir, Volume of borrow pits.

**UNIT IV**
**THEODOLITE:** Theodolite, Description, applications – Temporary and Permanent adjustments, Measurement of horizontal and vertical angles.
**TACHEOMETRIC SURVEYING:** Stadia and Tangential Methods of Tachometry - Distance and Elevation Formulae for Staff Vertical Position.

**UNIT V**
**SIMPLE CURVES:** Introduction- Types of Curves- Elements of a simple circular curve; Degree of curve relationship between radius and degree of curve; Calculation of various elements of curve. Introduction to Total Station, Global Positioning System.
TEXT BOOKS

REFERENCES
1. R. Subramanya – “Surveying and Leveling” - Oxford Publication
**Pre-requisites**: Knowledge of volumetric titration.

**Course Educational Objectives:**
The primary objective of Applied Chemistry is to make the students analyze water sample for hardness and alkalinity. It makes the students to perform and distinguish different types of volumetric titrations. It also provides them with an overview of preparation of polymers. It makes the students to find important properties of fuels and lubricants for their effective use.

**Course Outcomes:** After completion of the course, the students will be able to

- **CO1**: Assess quality of water based on the procedures given.
- **CO2**: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus.
- **CO3**: Acquire practical knowledge related to preparation of polymers.
- **CO4**: Exhibit skills in performing experiments based on theoretical fundamentals.

**Introduction**
1. Introduction to Chemistry laboratory – Molarity, Normality, Primary, secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis, etc.
2. Preparation of standard solutions, concept of standardisation of solutions, dilution to get solution of required normality.
3. Model experiment - Determination of amount of HCl using standard Na₂CO₃ solution.

**Water analysis**
4. Determination of alkalinity of water sample.
5. Determination of total hardness of water by EDTA method.
6. Determination of permanent hardness of water by EDTA method.

**Preparation of polymers**
7. Preparation of Urea Formaldehyde resin.
8. Preparation of Phenol Formaldehyde resin.

**Redox titrations**
9. Estimation of Mohr’s salt by using potassium permanganate.
10. Estimation of Mohr’s salt by using potassium dichromate.
11. Estimation of KMnO₄ by using Oxalic acid.

**Demonstration Experiments**
13. Determination of turbidity of the given sample water.

**Fuels**
14. Determination of flash and fire points of a given fuel/lubricant.
15. Determination of cloud and pour point of a given fuel/lubricant.
16. Determination of Aniline point of a given lubricant.

**REFERENCES**
Lab manual
Pre-requisites: Nil

Course Educational Objective:
The course aims to teach developing and drawing of engineering objects using AutoCAD. The student will be taught the fundamentals of AutoCAD and then asked to develop the projections of objects related to straight lines, planes, solids, orthographic and isometric views, development of surfaces using principles of engineering drawing.

Course Outcomes: At the end of the course, the student will be able to-
CO1: Draw simple objects using functional tools in AutoCAD.
CO2: Develop and draw the positions and views of points, lines, planes and solids using AutoCAD.
CO3: Develop and draw the orthographic and isometric projections of simple objects using Auto-CAD.
CO4: Develop and draw the projections of the solids by developing the surfaces using AutoCAD.

BASIC AUTOCAD COMMANDS
1. Basic drawing commands (line, circle, arc, ellipse, polygon, and rectangle).
2. Edit commands (copy, move, erase, zoom).
3. Array commands (polar array, rectangular array, P-edit, divide, pline, offset).
4. Hatching & line commands (hatching with different angles& different types of lines).
5. Mirror & trim commands (mirror an object, trim, extend a line, chamfer &fillet, explode).
6. Dimensioning & text commands (linear, angular, radius, diameter& text).

PROJECTION OF POINTS, LINES AND PLANES
2. Projection of lines parallel to both reference planes.
3. Projection of lines parallel to one reference plane & inclined to other reference plane.

PROJECTION OF SOLIDS
1. Projection of solids in simple position and transfer of points.
2. Projection of solids with axes inclined to one reference plane & parallel to other.
3. Sections of solids: Simple sections

ORTHOGONOGRAPHIC PROJECTIONS
1. Conversion of plane figures to orthographic views.
2. Conversion of circular figures to orthographic views.
3. Conversion of combination of plane figures and circular figures to orthographic views.

ISOMETRIC PROJECTIONS
1. Conversion of plane figures to isometric views.
2. Conversion of circular figures to isometric views.
3. Conversion of combination of plane figures and circular figures to isometric views.
DEVELOPMENT OF SURFACES
1. Parallel-line development (prism, cylinder) for objects in simple position.
2. Radial-line development (cone, pyramid) for objects in simple position.

TEXTBOOK

REFERENCE
Pre-requisites: Nil

Course Educational Objective:
The course aims to teach fundamental free hand civil engineering drafting techniques using conventional drawing tools. The student is asked to develop and draw simple geometrical constructions used in engineering drawing. The student is then exposed to ArchiCAD fundamentals and is asked to develop and draw few civil engineering elements.

Course Outcomes: At the end of the course, the student will be able to-
CO1: Draw simple objects based on principles of geometry.
CO2: Develop the projections of an object based on the angles of projection.
CO3: Draft simple objects using ArchiCAD software
CO4: Develop, draw and edit simple objects related to civil engineering applications using ArchiCAD.

Part A: BASIC PRINCIPLES OF ENGINEERING DRAFTING
1. Fundamentals: Basic tools and instruments used in conventional drawing
2. Geometrical construction: Bisection of a line, draw perpendiculars of line, draw parallel lines, divide a line, divide a circle, bisect an angle, trisecting an angle, finding center of an arc, constructing equilateral triangles, polygons, polygons inscribed in circles, draw tangents, length of arcs, circle and lines in contact, inscribed circles.
3. Curves used in engineering practice: Ellipse, parabola
4. Projections: First and third angle projections, front view, top view, side view of some simple objects

Part B: ARCHICAD FUNDAMENTALS
1. Introduction to ArchiCAD
2. Basic tools (document tools)-line, circle, poly line, dimensional tools, text, fill, etc.
3. Design tools- wall, window, column, beam, slab, stair, roof, sheet, etc.
4. Drawing some simple objects

TEXT BOOKS/REFERENCES:
2. Lecture material prepared by department faculty.
3. Video material based on topics covered.
Pre-requisites : Surveying

Course Educational Objective:
The course teaches the basic principles of surveying, various methods of linear and angles measuring instruments through hands-on practice sessions and enable the students to use surveying equipments.

Course Outcomes: At the end of the course, the student will be able to-
CO1  : Compute linear and angular measurements in the field using chain and compass.
CO2  : Plot a given area using plane table in the field.
CO3  : Determine the elevations of different points in the field.

CHAIN SURVEYING
1. Chaining of a line using chain/tape and recording of details along the chain line.

COMPASS SURVEYING
5. Compass Surveying – Distance between Two Inaccessible Points.

PLANE TABLE SURVEYING
8. Intersection method of plane table survey.
8. Two Point Problem

LEVELING
11. Elevation difference between two points by Reciprocal levelling method.
13. Contouring of a small area by method of blocks.

Text Book/Reference
Laboratory Manual prepared by Civil Engineering Department.
Pre-requisites : None

Course Educational Objective : The main objective of this course is to enable the students learn Numerical Techniques for solving the equations, interpolation, differential equations and fitting of various curves. They will also learn about the Fourier analysis of single valued functions.

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

CO1: Compare the rate of accuracy between various methods in approximating the root of the equation and Distinguish among the criteria of selection and procedures of various Numerical Integration Rules.

CO2: Estimate the best fit polynomial for the given tabulated data using the methods of Newton’s Interpolation formulae and Lagrange’s Interpolation.

CO3: Apply various Numerical methods in solving the initial value problem involving the ordinary differential equation.

CO4: Estimate the unknown dependent variables using curve fitting methods.

CO5: Generate the unknown dependent variables using curve fitting methods.

UNIT – I
Solution of Algebraic and Transcendental Equations and Numerical Integration
Solutions of Algebraic and Transcendental Equations – Regula Falsi method and Newton Raphson Method in one variable.

Numerical Integration

UNIT – II
Interpolation and Finite Differences
Interpolation: Introduction – Finite differences- Forward Differences- Backward Differences-Central differences – Symbolic relations and separation of symbols-Differences of a polynomial-
Newton’s formulae for interpolation – Lagrange’s Interpolation formula.

UNIT – III
Numerical solution of Ordinary Differential Equations

UNIT – IV
CURVE FITTING
Curve fitting by the principle of Least Squares: Fitting of a straight line – Second degree parabola-
other polynomial curves-Fitting of exponential curves –Fitting of a power curve

UNIT – V
Fourier Series and Fourier Transforms
Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval– Half-range sine and cosine series

Fourier Transforms
Fourier integral theorem (only statement) – Fourier transform – sine and cosine transforms – properties.
TEXT BOOKS

REFERENCES
Pre-requisites : -

Course Educational Objective: This course enables the student to understand the basics of network theory, construction and working principles of AC equipment. It also deals with basics of applied electricity for every engineer.

Course Outcomes : At the end of the course, the student will be able to :
CO1: Analyse AC and DC circuits
CO2: Analyze the performance of AC machines
CO3: Identify the wiring system and safety measures used in a building/ Industry
CO4: Choose illumination schemes based on application

UNIT – I: DC Circuits
Basic definitions, Types of elements-active and passive, Ohm’s Law, Kirchhoff’s Laws Network reduction techniques-series, parallel, star to delta, delta to star transformations, source transformations (for resistive networks). Numerical problems.

UNIT – II: AC Fundamentals
Peak, R.M.S, average, instantaneous values, Form factor and Peak factor for Periodic waveforms, Phase and Phase difference-concepts of Reactance, Impedance, Susceptance and Admittance, Real, Reactive and Apparent powers, Power factor. Numerical problems.

UNIT – III: Single Phase Transformers and Induction Motors

UNIT – IV: Electrical Installation &Safety
Introduction, systems of distribution of electrical energy-distribution board systems, tree system, Methods of wiring, types of internal wiring-advantages and disadvantages, choice of wiring, industrial wiring, and electrical safety measures.

UNIT – V: Illumination
Introduction, terms used in illumination, laws of illumination, incandescent fluorescent tube, and mercury vapour lamp, neon lamp, Lighting schemes-direct lighting, semi direct, Semi indirect, indirect lighting, Design of Lighting schemes-, methods of lighting calculations, Aviation and transport lighting, lighting for displays and signalling- neon signs, LED, LCD displays beacons and lighting for surveillance.
TEXTBOOKS

REFERENCES
Pre-requisites: Applied Mechanics, Engineering Mathematics

Course Educational Objective:
The course teaches about engineering properties of materials such as tensile, compression strength, torsion & bending strength. The behavior of beam/frame elements with different support conditions and loading system will be discussed.

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

CO1: Assess the stresses and strains in a member subjected to different loadings
CO2: Analyze the various beams subjected to different loads using shear force and bending moment diagrams.
CO3: Compute the shear and bending stress distribution in several members of different sections.
CO4: Compute the twisting moment and shear stress induced in shafts and evaluate the pull component in springs.
CO5: Interpret the stresses in thick and thin cylindrical and spherical shells under different loads and directions and member forces in a truss.

UNIT-I: STRESSES AND STRAINS
Mechanical Properties of Solids-Stress and Strain-Hooke's Law-Tensile Test Diagram-Bars of Varying Sections and Tapering Sections-Temperature Stresses-Elastic Constants-Poisons Ratio-Upper Limit of Poissons Ratio-Complementary Shear Stress-State of Simple Shear-Shear Strain-Relation between Elastic Constants
Strain Energy-Introduction-Resistance Deformation Diagram-Proof Resilience-Gradual-Sudden and Impact Loadings

UNIT-II: SHEAR FORCE AND BENDING MOMENT
Basic Concepts- Shear Force and Bending Moment- SFD and BMD- Relation Between BM and SF-Freely Supported Beam With End Couples- Beam With Intermediate Couple-Loading and BMD from SFD.

UNIT-III: BENDING AND SHEARING STRESSES IN BEAMS
Bending Stresses in a Beam Section: Theory of Simple Bending- Design Criterion and Section Modulus-Strength of Section- Strain Energy Due To Bending
Shearing Stresses in Beams: Introduction-Distribution of Shearing Stresses -Shear Stress Distribution across Rectangular, Triangular and Circular Cross Section.

UNIT-IV: TORSION OF SHAFTS AND SPRINGS
Torsion of Shafts Introduction-Relation between Twisting Moment, Twist and Shear Stress-Design of Shafts-Combined Bending and Torsion-Shafts in Series and Parallel
Springs: Introduction-Closely Coiled Helical Spring under Axial Pull, Axial Couple- Open Coiled Helical Spring under Axial Force and Axial Torque

UNIT-V: THIN AND THICK CYLINDERS
Thick Cylindrical Shells: Lame's Theory-Special Cases-Design-Compound Cylinders-Necessary Difference of Radii for Shrinkage-Thick Spherical Shells.
Analysis of Trusses: Analysis of Trusses by Method of Joints, Method of Sections and Tension Coefficient Method
TEXT BOOKS

REFERENCE
Pre-requisites: Nil

Course Educational Objective:
The course introduces the concepts of Geology in civil engineering perspective. The student is exposed to properties of different minerals and rocks. The importance of structural geological features and geophysical principles will be addressed for their interpretation in civil engineering designs.

Course Outcomes: At the end of the course, the student will be able to-
CO1: Demonstrate the importance of geological principles
CO2: Differentiate minerals based on physical properties
CO3: Distinguish various types of rocks based on their characteristic features
CO4: Interpret geological structures
CO5: Judge geophysical and geological considerations

UNIT – I: GENERAL GEOLOGY
Geology in Civil Engineering – Branches of geology – Earth’s structure and composition – Continental drift, Plate tectonics, Weathering – types, products and soil profile,– Geological work of Rivers, Wind and Sea -Seismic zones of India

UNIT – II: MINEROLOGY
Physical properties of Minerals – Crystallographic systems – Silicate structures - Study of following families of rock forming minerals- Quartz, Feldspar, Pyroxene, Amphibole, Mica, Calcite, Gypsum and Clay

UNIT – III: PETROLOGY
Classification of Rocks – Igneous, Sedimentary and Metamorphic Rocks – Origin, Structure, texture and Classification – Study of physical properties, distribution and occurrence of important rock types viz. Granite, Diorite, Gabbro, Dolerite, Basalt, Limestone, Conglomerate, Breccia, Sandstone, Quartzite, Marble, Gneiss, and Schist etc.

UNIT – IV: STRUCTURAL GEOLOGY
Outcrop, Dip and Strike, Study of common structures associated with rocks such as Folds, Faults, Unconformities and Joints, their classification, types, their relevance and importance in civil engineering.

UNIT - V: ENGINEERING APPLICATIONS IN GEOLOGY
Importance of Geophysical studies, Brief introduction of principles of geophysical studies - Gravity method, Magnetic methods, Electrical methods, Seismic methods, Radio metric methods and geothermal method.
Geological considerations in construction of Dam, Reservoir, Tunnel
TEXT BOOKS

REFERENCES
Pre-requisites: Applied Mechanics

Course Educational Objective:
The course teaches the fluid properties and fundamental relations based on conservation of mass, energy and momentum in fluid flow. Applications of these basic equations are highlighted for flow measurements through orifice, mouth piece, weirs, Venturimeter, sluice gates etc.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Exposed to basic principles of fluid properties, pressure measurement for various devices and calculate the hydrostatic forces for submerged conditions.
CO2: Apply the principles of conservation of mass for fluid flow problems.
CO3: Apply the momentum and energy equation to fluid mechanics and laminar flow problems and flow measurement applications.
CO4: Compute the energy losses in pipes, flow parameters in laminar flow conditions and exposed to the basics of boundary layer theory.
CO5: Apply dimensional analysis as a tool in solving problems in the field of fluid mechanics and apply the laws of similarity.

UNIT – I PROPERTIES OF FLUIDS:
Specific mass-specific weight- specific volume- specific gravity- compressibility- viscosity- surface tension- capillarity- vapour pressure and their influences on fluid motion.
Hydrostatic Forces: Hydrostatic forces on submerged plane- horizontal, vertical, inclined and curved surfaces-centre of pressure-Derivations and problems.

UNIT-II FLUID KINEMATICS:
Description of fluid flow-Stream line- path line and streak lines and stream tube. Classification of flows: Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity for one, two, three dimensional flows – stream and velocity potential functions.

UNIT- III FLUID DYNAMICS:
Euler’s equation of motion, Bernoulli’s equation, simple applications of Bernoulli’s equation, Momentum equation. Kinetic energy and Momentum correction factors.
Measurement of Flow: Pitot tube, Venturi meter and Orifice meter, flow over notches.

Boundary Layer Theory: Boundary Layer thickness, Displacement thickness, Momentum thickness, Energy thickness, Boundary layer growth and separation.
UNIT–V HYDRAULIC SIMILITUDE: Dimensional analysis-Rayleigh’s method and Buckingham’s π theorem-study of Hydraulic models – Geometric, kinematic and dynamic similarities-dimensionless numbers – model and prototype relations.

TEXT BOOKS

REFERENCES
Pre-requisites: Building Materials

Course Educational Objective:
This course aims to teach the basic properties of concrete making materials, various tests on concrete and different admixtures to be used in concrete. The course also provides insight on various types of special concrete and their usage, determination of mix proportions as per IS codes.

Course Outcomes: At the end of the course, the student will be able to:
CO1: State the concept of concrete and the component materials.
CO2: Assess the required properties of concrete.
CO3: Know the importance of various tests to determine strength of concrete.
CO4: Comprehend the various types of special concrete.
CO5: Compute the mix proportions for design as per IS code.

UNIT – I: CONCRETE MAKING MATERIALS

UNIT – II: PROPERTIES OF CONCRETE

UNIT- III: QUALITY CONTROL AND ADMIXTURES IN CONCRETE

UNIT – IV: SPECIAL CONCRETES

UNIT- V: CONCRETING PLANT AND MIX DESIGN
TEXT BOOKS

REFERENCES
2. K.T. Krishnaswamy, “Concrete Technology” Dhanpat Rai Publications

Code book: IS 10262-2009 “Concrete Mix Design”
Pre-requisites: Engineering Geology

Course Educational Objective:
This course aims to illustrate the student the physical examination and characterization of the rocks and minerals existing in nature for evaluation and application as civil engineering materials. The students will appropriate the necessary geophysical principles and structural geological features essential for civil engineering designs.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Demonstrate the importance of geological principles
CO2: Differentiate minerals based on physical properties
CO3: Distinguish various types of rocks based on their characteristic features
CO4: Interpret geological structures
CO5: Judge geophysical and geological considerations

LIST OF EXPERIMENTS
1) Description of Minerals by physical properties.
2) Description and Engineering uses of Rocks
3) Description and engineering consideration of Structural Models
4) Microscopic study of minerals
5) Microscopic study of rocks
6) Interpretation and drawing of sections for geological maps showing tilted beds, faults, uniformities etc.

LAB EXAMINATION PATTERN
1. Description and identification of FOUR minerals
2. Description and identification of FOUR (including igneous, sedimentary and metamorphic rocks)
3. ONE Interpretation of a Geological map along with a geological section.
4. TWO Simple strike and Dip problems.

TEXT BOOK/REFERENCE
Laboratory manual prepared by Civil Engineering Department.
**Pre-requisites**

Building Materials, Strength of Materials

**Course Educational Objective:**
The course aims for providing hand on practice to material behaviour subjected to tensile, compressive, torsion and shear loadings. The course also deals with material hardness and impact resistance.

**Course Outcomes:** At the end of the course, the student will be able to:
- CO1: Perform necessary experiments to determine the mechanical properties of materials under different loading conditions.
- CO2: Analyze the experimental results for assessment of the strength of the given material

Note: A minimum of 8 experiments to be performed from the following

**List of Experiments**

1. Study of stress-strain characteristics of mild steel bars by UTM.
2. Study of stress-strain characteristics of HYSD bars by UTM.
3. Determination of modulus of elasticity of the material of the beam by conducting bending test on simply supported beam.
4. Determination of modulus of elasticity of the material of the beam by conducting bending test on Cantilever beam.
5. Determination of modulus of elasticity of the material of the beam by conducting bending test on simply supported beam with one end overhang.
6. Determination of modulus of rigidity by conducting torsion test on solid circular shaft.
7. Determination of hardness of the given material by Brinnel’s/Vicker’s/
8. Determination of hardness of the given material by Rockwell hardness test.
9. Determination of impact strength of the given material by conducting Charpy/Izod test
10. Determination of ultimate shear strength of steel by conducting direct shear test.
11. Determination of modulus of rigidity of the material of closely coiled helical spring.
12. Determination of compressive strength of wood/ brick with grain parallel / perpendicular to loading.

**TEXT BOOK/REFERENCE**

Laboratory manual prepared by Civil Engineering Department.
Pre-requisites: Surveying, Survey Field Work Lab

Course Educational Objective:
The course allows the student to gain practical exposure in taking angular measurements, horizontal distances and vertical heights of objects by advanced surveying equipments.

Course Outcomes: At the end of the course, the student will be able to:
CO1 : Obtain angular measurements in the field using theodolite.
CO2 : Determine the elevations of different points in the field using theodolite and total stations.
CO3 : Operate the total station to take out the measurements for desired objectives.
CO4 : Establish the setting out of works in the field.

LIST OF EXPERIMENTS:

THEODOLITE
1. Determining the Horizontal and Vertical Angles by the method of repetition method.
2. Finding the distance between two inaccessible points.

TACHEOMETRY
4. Tacheometry – Constants of Tacheometer & Stadia Tachometry
5. Tangential Tacheometry
6. Tacheometric contouring – Radial method

TOTAL STATION
8. Determination of Boundaries of a Field and computation of area.
9. Finding the distance between two inaccessible points.

SETTING OUT
10. Setting of simple circular curve using tape and theodolite.
11. Setting of a simple circular curve using Total Station.
12. Setting out for Building.

TEXT BOOK/REFERENCE
Laboratory Manual prepared by Civil Engineering Department.
Pre requisite: Basic Sciences and Humanities

COURSE EDUCATIONAL OBJECTIVES:
1. To create an awareness on engineering ethics and human values.
2. To adumbrate the inevitability of different intellectual property rights like patents, copyrights, trademarks, and trade secret.
3. To give an impetus on achieving higher positions in profession, with ethical and human values as a base and support for the growth.
4. To explicate the professional and societal responsibilities of the engineers.
5. To make the student realize the sensitiveness associated with experimentation process

COURSE OUTCOMES: At the end of the course, the student
CO1: Acquires the basic concepts of human values & also gain the connotations of ethical theories.
CO2: Knows the basic concepts of Professional ethics and handling Dilemma in decision making.
CO3: Knows the duties and rights towards the society in an engineering profession
CO4: Would realize the importance and necessity of intellectual property rights.
CO5: Can take all the necessary precautions while conducting the experiments, which may reduce the risk.

UNIT –I: ETHICS

UNIT - II: HUMAN VALUES

UNIT – III: ENGINEERING AS SOCIAL EXPERIMENTATION
Engineering as experimentation- Engineering Projects VS. Standard Experiments - Engineers as responsible experimenters – Codes of ethics - Industrial Standards - A balanced outlook on law- The challenger case study.

UNIT – IV: SAFETY AND RESPONSIBILITIES

UNIT – V: GLOBAL ISSUES
Multinational Corporation’s - Environmental ethics-computer ethics - weapons development Engineers as managers - consulting engineers-engineers as expert witnesses and advisors, Moral leadership - sample code of Ethics (Specific to a particular Engineering Discipline).
TEXT BOOKS

REFERENCES
2. Charles D. Fleddermann, "Engineering Ethics", Pearson Education/ Prentice Hall, New Jersey, 2004 ( Indian Reprint now available )
Pre-requisites: None

Course Educational Objective:
To provide a general background on developing an understanding of systems and cycles on the earth and how individual organisms live together in complex communities.
To enable the students in understanding how human activities influence our air, water and soil and it also helps in developing a right attitude about our use of fossil fuels and effect on climate and sustainable management of natural resources.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify environmental problems arising due to engineering and technological activities that help to be the part of sustainable solutions.
CO2: Evaluate local, regional and global environmental issues related to resources and their sustainable management.
CO3: Identify the importance of ecosystem and biodiversity for maintaining ecological balance.
CO4: Acknowledge and prevent the problems related to pollution of air, water and soil.
CO5: Interpret the significance of implementing environmental laws and abatement devices for environmental management.

UNIT – I
Nature and scope of Environmental Problems
- Introduction, components of Environment
- Scope and importance of environmental studies
- Population explosion, variations among nations
- Resettlement and Rehabilitation - Issues and possible solutions
- Environment and human health
- HIV-AIDS
- Environmental ethics
- Role of Information Technology in environmental management and human health

UNIT – II
Natural Resources and Conservation
- Introduction and classification of Natural Resources
- Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people
- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, interlinking of rivers, dams-benefits and problems. Rain water harvesting, watershed management
- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources
- Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, soil salinity
- Energy resources: Growing energy needs renewable, non-renewable and alternate energy resources

UNIT – III
Ecology and Biodiversity
- Definition, structure and functions of an ecosystem
- Food chains and Food webs, Ecological succession, Ecological pyramids
- Biogeochemical cycles, Major Types of Ecosystems – Forest, Grassland, Desert Land & aquatic Ecosystem, Ecological Niche and Keystone Species
- Definition and levels of measuring biodiversity - genetic, species, community and ecosystem diversity
- Bio geographical classification of India
- India as a mega diversity nation
- Values of biodiversity- Direct and Indirect values
- Threats to biodiversity; Man and wild life conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation methods

UNIT – IV
Environmental Pollution
- Introduction to Environmental Pollution Causes, effects and control measures of:
  - Air pollution
  - Water pollution
  - Soil pollution
  - Noise pollution
  - Nuclear hazards
- Solid Waste Management – Sources, Classification, effects and control measures of Municipal solid waste, Biomedical waste & Hazardous and e-waste
- Environmental Issues relating to Climate change, global warming, acid rain, ozone layer depletion
- Disaster Management- Floods, Cyclones, Earthquakes, Landslides and Tsunamis.

UNIT – V
Environmental Management
- Sustainable development and unsustainability
- Stockholm and Rio Summit
- Environmental Impact Assessment (EIA)
- Green building
- Consumerism and Waste products
- Carbon credits and carbon trading
- Environmental Law- Air, Water, Wild life, Forest, and Environmental protection act

TEXT BOOKS

REFERENCES
Pre-requisites: None

Course Educational Objective: The objective of this course is to introduce the probability and its distributions, sampling methods and estimation. They also learn various tests of hypothesis and evaluation of correlation and regression analysis.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Predict various probabilistic situations based on the laws of probability and random variables.
CO2: Distinguish among the criteria of selection and application of Binomial, Poisson, Normal and Exponential distributions.
CO3: Estimate the point and interval estimators of mean and proportion for the given Sample data.
CO4: Apply various sample tests like Z-test, t-test, F-test and χ2-test for decision making regarding the population based on sample data.
CO5: Estimate the level of correlation, the linear relationship using the regression lines for the given bivariate data.

UNIT - I:
PROBABILITY AND RANDOM VARIABLES
Conditional probability – Multiplication theorem-Baye’s theorem.

UNIT –II
PROBABILITY DISTRIBUTIONS

UNIT –III
SAMPLING DISTRIBUTION AND ESTIMATION
Population and sample, Sampling distribution of mean (with known and unknown variance), and variances. Sampling distribution of sums and differences. Point estimation and interval estimation for mean and proportions.

UNIT –IV
TESTS OF HYPOTHESIS
Null and Alternative Hypothesis, One tail and two tailed tests, Type I and Type II errors. Testing of hypothesis concerning means, proportions and their differences using Z-test. Tests of hypothesis using Student’s t-test, F-test and χ2-test. Applications of decision making using the above tests.

UNIT –V
CORRELATION AND REGRESSION
Simple Bivariate Correlation: Karl Pearson’s coefficient of correlation, Spearman’s Rank correlation coefficient. Linear Regression: Regression lines, Regression coefficients, properties of Regression coefficients.
TEXT BOOKS

REFERENCES
**Pre-requisites:** Applied Mechanics, Strength of Materials-1

**Course Educational Objective:** The student will learn about analysis of compound stress and failure theories. The student will study the behavior of beam/frame elements under loading system using moment distribution method.

**Course Outcomes:** At the end of the course, the student will be able to:
- CO1 : Analyze the compound stresses and failure theories.
- CO2 : Analyze and evaluate the stresses in columns.
- CO3 : Compute deflections in beams due to different loading conditions.
- CO4 : Analyze the fixed beams subjected to different loading three moment equation method.
- CO5 : Compute stress in unsymmetrical bending and shear centre for a different sections.

**UNIT-I: COMPOUND STRESSES AND THEORIES OF FAILURES**
Introduction-Stress Components on Inclined Planes-Two Perpendicular Normal Stresses-Biaxial Stress System Accompanied By Shear-Mohr's Circle-Principle Stresses and Principle Planes

**Theories of Failure:** Introduction-Maximum Principle Stress Theory- Maximum Principle Strain Theory-Maximum Shear Stress Theory-Maximum Strain Energy Theory-Maximum Shear Strain Energy Theory

**UNIT-II: COLUMNS-COMBINED DIRECT AND BENDING STRESSES**

**Combined Direct and Bending Stresses:** Introduction-Eccentric Loading-Middle Third Rule-Core of A Section

**UNIT-III: DEFLECTION OF BEAMS**
Introduction-Equation for the Deflected Shape of Axis of Beam-Double Integration and Macaulay's Methods-Moment Area Method- Fixed Beams-Moment Area Method

**UNIT-IV: FIXED BEAMS**
Analysis of Fixed Beams-Area moment Method-UDL-Central Point Load-Eccentric Point Load-uniformly varying load - effect of Sinking-Effect of Rotation of a Support-Partially Fixed Beam

**Three Moment Equation Method:** Derivation of Clapeyran’s Theorem of Three Moments Application to Fixed Beams

**UNIT-V: UNSYMMETRICAL BENDING AND SHEAR CENTRE**
Unsymmetrical Bending: Introduction-Centroidal Principle Axes-MI Referred To Any Set of Rectangular Axes Unsymmetrical Bending Of Beams-Resolution of BM into Any Two Rectangular Axes the Centroid-Location of Neutral Axes

**Shear Centre:** Definition-Location of Shear Centre for Unsymmetrical I-Section, Channel Section, Rectangular Section and Circular Arc
TEXT BOOKS

REFERENCE
Pre-requisites: Mechanics of Fluids

Course Educational Objectives: The course allows the student to get insight into open channel hydraulics, and the various theories dealing with the flow phenomenon of fluid in an open channel. The student is exposed to the basics, components, and working of the hydro machinery, applications of different types of turbines and pumps.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Solve the open channel problems for uniform flows.
CO2: Analyze various forms of non-uniform flows and to estimate formation of hydraulic jump and subsequent energy losses
CO3: Determine the impact force and work done for different types of vanes.
CO4: Analyze suitability of turbines for different types for different applications
CO5: Identify the suitability of centrifugal and reciprocating pumps for different applications and calculate their efficiencies.

UNIT – I: OPEN CHANNEL FLOW:
Uniform Flow: Introduction, Classification of flows and channels; Chezy, Manning's, Bazin, Kutter's Equations; Hydraulically efficient channel sections - Rectangular, Trapezoidal and Circular channels; Hydraulic Design of open channel; Velocity distribution; Pressure distribution.

UNIT – II: NON – UNIFORM FLOW:
Concept of specific energy; Specific energy curves; Critical flow; Critical flow in a rectangular channel; Critical slope; Different slope conditions; Channel transitions; Momentum principle applied to open channel flow, Surges in open channels.
Gradually Varied Flow: Dynamic equation; Surface Profiles; Computation of surface profiles by single step method; Back water Curves and Draw down curves; Examples of various types of water surface profiles; Control section.
Rapidly Varied Flow: Hydraulic jump; Elements and characteristics of hydraulic jump; Types of hydraulic jumps; Location and applications of hydraulic jump; Energy loss in a hydraulic jump.

UNIT-III: BASICS OF TURBO MACHINERY:
Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity triangles at inlet and outlet, expressions for work done and efficiency-Angular momentum principle, Applications to radial flow turbines.

UNIT-IV: HYDRAULIC TURBINES:
Layout of a typical Hydropower installation – Heads and efficiencies - classification of turbines - Pelton wheel - Francis turbine - Kaplan turbine - working, working proportions, velocity diagram, work done and efficiency, hydraulic design, draft tube – theory and function efficiency. -Surge tanks - unit and specific turbines - unit speed - unit quantity - unit power - specific speed performance characteristics-geometric similarity- cavitation.
UNIT-V: PUMPS

Centrifugal Pumps: Classification, work done, minimum starting speed, losses and efficiencies, specific speed, multistage pumps, specific speed, characteristic curves, NPSH, Cavitation in pumps.

Reciprocating Pumps: Types, working, Work done, coefficient of discharge and slip, effects of acceleration and frictional resistance, indicator diagrams, separation.

TEXT BOOKS

REFERENCES
Pre-requisites:  Applied Mechanics, Strength of materials.

Course Educational Objectives: In this course, the student is exposed about analytical approach, study of different structural components and their structural behaviour due to applied external loads. Kani’s method is used to analyze the frames of different end conditions.

Course outcomes: At the end of the course, the student will be able to:
- CO1: Analyze conjugate beams
- CO2: Analyze propped cantilevers, fixed beams.
- CO3: Analyze continuous beams subjected to different loads
- CO4: Perform calculations using slope deflection method for structural analysis
- CO5: Analyse different structural components using Castigliano’s theorem for indeterminate structures.

UNIT-I: CONJUGATE BEAM METHOD
Introduction-Conjugate Beam-Sign Conventions-Simply Supported Beams-Cantilevers-Propped Cantilevers-End Conditions and Internal Conditions of a Conjugate Beam

UNIT-II: CABLES AND SUSPENSION BRIDGES
Cables: Introduction-General Cable Theorem-Uniformly Loaded Cable-Anchor Cable-Temperature Stresses in Suspension Cable-Three Hinged and Two Hinged Stiffening Girders

UNIT-III: SLOPE DEFLECTION AND MOMENT DISTRIBUTION METHOD
Moment Distribution Method: Introduction- Sign Conventions-Fundamental Propositions-Continuous Beams With or Without Sinking of Supports-Portal Frames with or Without Sway

UNIT-IV: KANI’S METHOD
Introduction-Application to Continuous Beams and Frames without Joint Translation-Symmetrical Frames-Frames with Side Sway

UNIT-V: STRAIN ENERGY METHOD
Castigiano's First Theorem-Application to Statically Determinate Structures
Castigiano's Second Theorem-Application to Statically Indeterminate Beams and Portal Frames

TEXT BOOKS

REFERENCES
Pre-requisites : NIL

Course Educational Objective: The course aims to teach the different properties and classifications of soil. The course coverage includes the various procedures for determining index and engineering properties of soils.

Course Outcomes: At the end of the course, the student will be able to:
CO1 : Compute and analyze different classifications and properties of soil.
CO2 : Determine consistency and compaction parameters of soils.
CO3 : Determine permeability and effective stresses in soil.
CO4 : Analyze shear behavior of soils under different load/drainage conditions
CO5 : Determine the stress distribution in soils under different loading conditions and analyze consolidation properties of soils.

UNIT –I: TYPES AND PHYSICAL PROPERTIES OF SOIL
Types of soil – Physical properties of soil and their determination – Important definitions related to three phase diagram and relationships – Field identification of soils – Classification of soils based on grain size distribution – Hydrometer analysis.

UNIT –II: CONSISTENCY AND COMPACTION OF SOIL
Consistency and plasticity characteristics of Soil: Determination of consistency limits and their significance to the field behaviour of soil –Classification of soils based on grain size and plasticity characteristics of soils.
Soil Compaction: Concept of compaction – Methods of laboratory compaction of soils – Factors affecting compaction – Zero air voids curve and its significance – Field compaction control.

UNIT –III: PERMEABILITY & EFFECTIVE STRESS OF SOILS
Permeability: Concept-Darcy’s Law and its validity – Factors affecting permeability – Laboratory determination of permeability for cohesive and cohesion less soils – Permeability of layered deposits Concept of effective stress in soils: Terzaghi’s effective stress concept for saturated soil deposits – seepage flow and seepage pressure – Quick sand condition and critical hydraulic gradient

UNIT- IV: SHEAR STRENGTH OF SOILS
Shear Strength: Analysis of shear failure – shear and normal stress at a point – Mohr’s stress circle – Relationship that can be obtained from Mohr’s circle – Mohr’s strength theory – Mohr’s coulomb failure criterion Laboratory methods of determination of shear strength parameters of cohesive and non-cohesive soils – Direct shear test – Triaxial shear test – Unconfined compression test and Laboratory vane shear test – Advantages of triaxial test over other tests – Classification of shear test based on drainage conditions.

UNIT-V:
STRESS DISTRIBUTION AND COMPRESSIBILITY CHARACTERISTICS OF SOILS
Stress Distribution: Boussinesq and Westergaard theories for point loads and their comparison – Approximate methods of determination of stresses and its validity – Computation of stresses beneath circular and square loaded areas – Concept of pressure bulb – Newmark's chart and its applications. Compressibility Characteristics of Soils: Terzaghi’s theory of one-dimensional consolidation – Concept of consolidation – Determination of coefficient of consolidation from consolidometer test data by Square root of time method and log time method – Calculation of consolidation settlement.
TEXT BOOKS

REFERENCES
Pre-requisites: Mechanics of Fluids, Hydraulics and Hydraulic Machinery Systems

Course Educational Objective: The student is given hands on training in working on fluid flow hydraulic machinery equipment and performs experiments to verify the principles of fluid mechanics and hydraulics based on laws of conservation of mass, energy and momentum.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Develop knowledge on the fundamental principles of fluid flow
CO2: Apply the laws of conservation of mass, energy and momentum to solve practical problems in fluid mechanics.
CO3: Practically visualize the functioning and performance of hydraulic turbines and pumps

List of experiments
Note: A minimum of twelve (12 No) shall be done and recorded
1. Verification of Bernoulli's theorem.
2. Venturimeter: Determination of Coefficient of discharge.
3. Orificemeter: Determination of Coefficient of discharge.
4. Mouthpieces: Determination of Coefficient of discharge by steady and unsteady flow methods.
5. Characterization of laminar and turbulent flows by Reynold's apparatus.
7. Determination of loss of head in pipes due to bend /sudden contraction/ sudden expansion.
8. Determination of Coefficient of discharge for rectangular notch / V-notch.
9. Determination of Manning's and Chezy's coefficients in open channel.
10. Study on Characteristics of Hydraulic Jump
11. Measurement of force due to impact of jets on vanes of different types.
13. Performance studies on Kaplan turbine.
14. Performance studies on single stage centrifugal pump.
15. Performance studies on Reciprocating pump.

TEXT BOOK/REFERENCE
Laboratory manual developed by Civil Engineering Department.
**Pre-requisites:** Building Materials, Concrete Technology

**Course Educational Objective:** The course aims to train the students in performing laboratory experiments to find the basic properties of bricks, tiles, concrete materials and concrete.

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

- CO1: Find the properties of bricks and cement.
- CO2: Determine the properties of aggregates.
- CO3: Identify the properties of concrete.

*Note: A minimum of twelve (12No) shall be done and recorded*

**TESTS ON BRICKS AND TILES:**

1. Classification of bricks by determination of Water absorption, shape test, soundness, warping, colour and compressive strength.
2. Water absorption, soundness, compressive strength of clay tiles.

**TESTS ON CEMENT:**

1. Determination of (a) Normal consistency of cement (b) Fineness of cement using 90 microns IS sieve.
2. Determination of Initial setting and final setting time of cement.
3. Determination of (a) Specific gravity of cement (b) soundness of cement.

**TESTS ON AGGREGATES:**

1. Determination of Fineness modulus of (a) Fine aggregate (b) Coarse aggregate.

**TESTS ON CONCRETE:**

1. Determination of workability of concrete by conducting Slump cone test.
2. Determination of workability of concrete by conducting Compaction factor/Vee-Bee consistometer test
3. Determination of (a) Cube compressive strength (b) Split tensile strength of concrete.
4. Determination of modulus of elasticity of concrete by conducting compression test on concrete cylinder
5. Determination of Bulk density and Specific gravity of (a) fine aggregate (b) coarse aggregates.
6. Determination of Bulking of fine aggregate.
7. Non-destructive test on concrete using Rebound Hammer / Ultrasonic Tester

**TEXT BOOK/REFERENCE**

Laboratory manual developed by Civil Engineering Department.
**Pre-requisites:** Computer based engineering drawing lab and Building materials.

**Course Educational Objective:** The course aims to draw different types of doors, windows and trusses using AutoCAD. The student is asked to develop and draw plan, elevation and section for different types of buildings. The student will draw a few 3D civil engineering elements.

**Course Outcomes:** At the end of the course, the student will be able to:
- CO1: Sketch the different sign conventions used in building drawing
- CO2: Draw different views of buildings with a suitable scale
- CO3: Develop 3-D view of building & staircase.

**LIST OF EXPERIMENTS**

To draw any 10 plates
1. Conventional symbols
2. English bond and Flemish bond
3. Fully Panelled Door & Window
4. Panelled and glazed door with wooden panel
5. King post and Queen post trusses
6. Single floor residential building - Plan, Elevation and Cross section
7. Storied residential building - Plan, Elevation and Cross section
8. Public building - Plan, Elevation and Cross section
9. Institutional building - Plan, Elevation and Cross section
10. Foundations - Footings
11. Steel roof truss
12. 3D view of a single floor residential building
13. 3D view of a dog legged stair case
14. 3D view of a spiral stair case

**REFERENCES**


**IS Codes**

1. IS: 962 – 1967 Code of Practical for Architectural and Building Drawing
3. IS: 6523 – 1983 Specification for Precast Reinforced Concrete Door and Window Frames
Prerequisite: Basic Sciences and Humanities

Course Objective: The objective of this course is to inculcate basic knowledge to students relating to concepts of Engineering Economics and Accountancy to make them effective business decision makers.

Other course educational objectives of this course:
1. To know the concepts of engineering economics and to make them effective business decision makers.
2. To understand the concepts of production and cost for various business decision.
3. To understand the different types of market, market structures & pricing strategies and their applications in business decision making.
4. To explain the strategies of raising and utilization of business capital.
5. To understand the Fundamental of accounting and analysis of accounting statements for managerial decision making.

Course Outcomes: After completion of the course, students will be able to
CO1: Capable of analyzing fundamentals of economics concepts which helps in effective business administration.
CO2: Discuss cost-output relationship in business operations.
CO3: Analyze the features of market structures and present the pricing policies.
CO4: Identify the types of Business organization of the company and the implementation requirements of each one.
CO5: Financial position of the company can be analyzing with the help of financial statements.

UNIT - I
Demand Forecasting-Types- Factor governing - Methods of demand Forecasting.

UNIT - II
Cost Analysis: Cost concepts, Cost & output relationship in short run & long run, Break-even Analysis (BEA)-Determination of Break-Even Point - Significance and limitations.

UNIT – III
Markets & Pricing Policies:
Market structures: Markets-Types of markets - Features and price out determinations under Perfect competition, Monopoly, Monopolistic Competition, oligopoly markets.
Pricing –Pricing polices & its Objectives – Pricing Methods and its applications in business.

UNIT - IV
Capital and Capital Budgeting: Capital and its significance-Types of Capital-Estimation of Fixed and Working capital –working capital -Components of working capital & Factors determining the need of working capital.- Sources of raising capital
UNIT - V


Financial Statement Analysis through ratios: Ratio-analysis of financial statement using different ratios (Liquidity -Profitability- Solvency -Activity ratios).

TEXT BOOK

REFERENCES
Pre-requisites: Applied Mechanics, Strength of materials, Structural Analysis-I

Course Educational Objective: To familiarize students with various methods of analysis of indeterminate structures such as analysis of two hinged arches, moving loads, influence lines for statically indeterminate structures, calculation of deflection for determinate beams and frames by using Portal and Cantilever load method, introduction to matrix methods of structural analysis.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Analyze the three-hinged and two-hinged arches
CO2: Estimate the impact of cables and suspension bridges on structures.
CO3: Assess the impact of moving loads on structures.
CO4: Draw influence lines for analysis purpose and analyse the continuous beams and portal frames
CO5: Describe the basics of stiffness and flexibility methods for structural loads analysis

UNIT - I
TWO HINGED ARCHES: Determination of horizontal thrust bending moment, normal Thrust and radial shear – Rib shortening and temperature stresses, tied arches – Fixed arches – (No analytical question).

UNIT-II: CABLES AND SUSPENSION BRIDGES
Cables: Introduction-General Cable Theorem-Uniformly Loaded Cable-Anchor Cable-Temperature Stresses in Suspension Cable-Three Hinged and Two Hinged Stiffening Girders

UNIT-III:
MOVING LOADS: Introduction maximum SF and BM at a given section and absolute Maximum S.F. and B.M due to single concentrated load U.D load longer than the span, U.D load shorter than the span, two point loads with fixed distance between them and several point loads- Equivalents uniformly distributed load

UNIT-IV
INFLUENCE LINES: Definition of influence line for SF, Influence line for BM- load position for maximum SF at a section-Load position for maximum BM at a section single point load, U.D.load longer than the span, U.D.load shorter than the span.
BUILDING FRAMES-ANALYSIS:
Introduction-Substitute Frames-Types of Substitute Frames-Analyis for Vertical Loads-Analyis of Frames for Horizontal Forces A) Portal Method B) Cantilever Method

UNIT - V: INTRODUCTION TO MATRIX METHOD
Flexibility methods, Introduction, application to continuous beams including support Settlements. Stiffness method: Introduction, application to continuous beams including support Settlements.
TEXT BOOKS

REFERENCES
4. Structural Analysis, NPTEL video lectures.

Course Educational Objectives: Learn the design principles of Working stress and Limit state designs as per IS: 456-2000, Identify the procedures of shear design parameters, Understand the design aspects of beams, slabs and columns as per IS: 456-2000.

Course outcomes: At the end of the course, the student will be able to:
CO1: Analyze and design the RCC structures using working stress methods.
CO2: Design the singly and doubly reinforced RC beams in limit state method.
CO3: Illustrate the shear reinforcement for different elements of a building.
CO4: Design the one way and two way slabs with different end conditions.
CO5: Design the columns subjected to axial load, uni-axial and bi-axial moments.

UNIT – I: INTRODUCTION TO WORKING STRESS METHOD
Concept of Working Stress Method – analysis and design of flexural member using working stress method – design of singly and doubly reinforced section. Deflection calculation – short term and long term deflection – crack width calculation - Design codes and handbooks, loading standards – Dead, live, wind and earthquake loads, design constants, modular ratio, neutral axis depth and moment of resistance,

UNIT – II: INTRODUCTION TO LIMIT STATE METHOD

UNIT – III: DESIGN OF SHEAR REINFORCEMENT

UNIT – IV: DESIGN OF SLABS
Design of slabs - one way and two way – simply supported, continuous and restrained, using coefficients given in IS code Reinforcement details in one way and two way slabs – serviceability requirements.

UNIT – V: DESIGN OF COLUMNS

TEXT BOOKS
REFERENCES

3. Design of Reinforced Concrete Structures, NPTEL video lectures.

IS CODES:

- IS 456-2000
- SP – 16 (Interaction charts- rectangular & circular sections)

NOTE: These codes are permitted in the End Examinations
Pre-requisites: NIL

Course Educational Objective: The course aims to explore the students with elements of highway engineering like geometric elements, sight distances and gradients, properties of various highway materials and construction. The student will able to design the various types of pavements and can easily control traffic generate on the highways.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Discriminate the studies of highway planning, development, surveys and alignment.
CO2: Design the geometric elements of highway.
CO3: Identify the suitability of appropriate highway materials based on their properties.
CO4: Design the Flexible and Rigid pavement using IRC codes.
CO5: Interpret the elements of traffic management.

UNIT-I: HIGHWAY PLANNING AND ALIGNMENT
History of road development in India – Jayakar committee recommendations - Institutions for Highway planning design and implementation at different levels – Road patterns - Engineering Surveys for Alignment – IRC classification of urban and rural roads – Preparation of detailed Project report-- Highway cross sectional elements – Right of way, Carriage way, Camber, Kerbs, Shoulders and Footpaths.

UNIT-II: GEOMETRIC ELEMENTS

UNIT-III: HIGHWAY MATERIALS AND CONSTRUCTION
Sub grade soil - Aggregates - Bituminous materials – Desirable properties – California Bearing Ratio Test and Field Density Test for soil – Crushing, Abrasion and Impact Test for aggregates – Penetration, Ductility, Viscosity, Binder content and Softening point Test for bitumen Construction of Earth, Gravel, WBM, Bituminous and Cement Concrete roads as per IRC and MORTH specifications.

UNIT-IV: HIGHWAY DESIGN AND MAINTENANCE

UNIT-V: TRAFFIC ENGINEERING AND MANAGEMENT
Basic Parameters of Traffic-Volume, Speed and Density- Traffic Volume Studies- Data Collection and Presentation-Speed studies- Data Collection and Presentation- Parking Studies and Parking characteristics- Road Accidents-Causes and Preventive measures- Accident Data Recording – Condition Diagram and Collision Diagrams - Road Traffic Signs – Types and Specifications – Road markings-Need for Road Markings-Types of Road Markings.
TEXT BOOKS

REFERENCES
3. Introduction to Transportation Engineering, NPTEL video lectures and web notes.

### Pre-requisites:
Mechanics of Fluids, Hydraulics and Hydraulic Machinery Systems

### Course Educational Objective:
The course is designed to understand the physical processes in hydrology and know the measurement of rainfall. Learn measurement of water losses and runoff in hydrological process. Understand the Unit Hydrograph theory and its analysis and flood routing. Estimate the ground water potential based on theoretical principles.

### Course Outcomes:
At the end of the course, the student will be able to:
- **CO1:** Estimate the average rainfall over a basin and identify the various methods to determine the water losses.
- **CO2:** Compute direct run off from total rain fall.
- **CO3:** Develop unit hydrograph and storm hydrograph.
- **CO4:** Assess the flood magnitude and carry out flood routing.
- **CO5:** Determine aquifer parameters and yield of wells.

### UNIT I: HYDROLOGY AND PRECIPITATION
**Introduction:** Engineering Hydrology and its Applications, Hydrologic Cycle.

**Precipitation:** Types and Forms of Precipitation, Rainfall Measurement, Types of Rain Gauges, Rain Gauge Network, Average Rainfall over a Basin, Presentation of Rainfall Data.


### UNIT-II: RUN OFF

### UNIT-III: HYDROGRAPH ANALYSIS
Components of Hydrograph, Separation of Base Flow, Effective Rainfall, Direct Runoff Hydrograph, Unit Hydrograph, Assumptions, Derivation of Unit Hydrograph, Unit Hydrographs of Different Durations, Principle of Superposition and S-Hydrograph Methods, Limitations and Applications of Unit Hydrograph, Synthetic Unit Hydrograph.

### UNIT-IV: FLOODS AND FLOOD ROUTING
**Floods:** Causes and Effects, Frequency Analysis- Gumbel’s and Log-Pearson Type III Distribution Methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), Flood Control Methods and Management.

**Flood Routing:** Hydrologic Routing, Channel and Reservoir Routing- Muskingum and Puls Methods of Routing.
UNIT-V: GROUNDWATER HYDROLOGY

**Ground Water:** Occurrence, Types of Aquifers, Aquifer Parameters, Porosity, Specific Yield, Permeability, Transmissivity and Storage Coefficient, Types of Wells, Darcy’s Law, Dupuit’s Equation- Steady Radial Flow to Wells in Confined and Unconfined Aquifers, Yield of an Open Well-Recuperation Test.

**TEXT BOOKS**

**REFERENCES**
4. Ground Water Hydrology and Advanced Hydrology, NPTEL video lectures and web notes.
Pre-requisites: Concrete Technology

Course Educational Objective: The primary objective of this course is to introduce the concept of Rehabilitation as a precise concept, and study how to overcome the defects in regular construction practices, establish their effectiveness in overcoming the problems faced, study their efficiency and memory needs. The course consists of Retrofitting components in addition to adapting new techniques in construction practices

Course Outcomes: At the end of this course the student will be able to
CO1: Identify the various cracks in buildings and structures
CO2: Analyse the probable reasons for deterioration of concrete in structures
CO3: Conduct NDT analysis for structural failures
CO4: Categorize the suitable materials for repair and rehabilitation of structures
CO5: Perform physical investigation and suggest the approaches to repair the damaged structure.

UNIT-I: CRACKS AND MAINTENANCE
Introduction: Maintenance, rehabilitation, repair, retrofit and strengthening, need for rehabilitation of structures.
Cracks in R.C. buildings: Various cracks in R.C. buildings, causes and effects
Maintenance: Maintenance importance of maintenance, routine and preventive maintenance.
Damages to masonry structures: Various damages to masonry structures and causes, Damage diagnosis and assessment

UNIT- II: DETERIORATION OF CONCRETE IN STRUCTURES
Physical processes of deterioration like Freezing and Thawing, Wetting and Drying, Abrasion, Erosion, Pitting, Chemical processes like Carbonation, Chloride ingress, Corrosion, Alkali aggregate reaction, Sulphate attack Acid attack, temperature and their causes, Mechanism, Effect, preventive measures. - Cracks: Cracks in concrete, type, pattern, quantification, measurement & preventive measures.

UNIT-III: NON DESTRUCTIVE TESTING
Non destructive test methods for concrete including Rebound hammer, Ultrasonic pulse velocity, Rebar locator, Corrosion meter, Penetration resistance and Pull out test, Core cutting-Corrosion: Methods for corrosion measurement and assessment including half-cell potential and resistivity, Mapping of data.

UNIT-IV: MATERIALS FOR REPAIR AND REHABILITATION
Materials for repair and rehabilitation -Admixtures- types of admixtures purposes of using admixtures- chemical composition- Natural admixtures-Fibres- wraps- Glass and Carbon fibre wraps- Steel Plates-Concrete behaviour under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods

UNIT: V: INVESTIGATION AND REPAIR OF STRUCTURES
Investigation of structures: Distress, observation and preliminary test methods. Case studies: related to rehabilitation of bridge piers, dams, canals, heritage structures, corrosion and erosion damaged structures.
Repair techniques: Grouting, Jacketing, Shotcreting, externally bonded plates, Nailing, Underpinning and under water repair; Materials, Equipments, Precautions and Processes.
TEXT BOOKS:

REFERENCES:
4. "Handbook on Repair and Rehabilitation of Buildings”, Published by Central Public Works Department, Govt of India, New Delhi, 2002.
Pre-requisites: Nil

Course Educational Objectives: The course aims to study the historical background of town planning, and analyze the modern town-planning and zoning system. The principles of planning as per building bye-laws and history of architecture with different ages are addressed. The basic principles of architecture are introduced.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Enumerate the historical background of town planning
CO2: Perceive the modern town-planning and zoning system.
CO3: Describe the principles of planning as per building bye-laws
CO4: Categorize the history of architecture with different ages
CO5: Describe the principles of architecture.

UNIT-I: HISTORICAL BACKGROUND OF TOWN PLANNING
Town planning in India – Town plans of mythological Manasa-Town plans of ancient towns: Harappa, Mohenjodaro, Pataliputra, Delhi, Acropolis (Greece), Jerusalem, Mecca, Rome, London.

UNIT-II: MODERN TOWN PLANNING
Zoning- Roads and road traffic- Housing- Slums, Parks, Play grounds- Public Utility Services-Surveys and maps for planning- Neighbour-hood Planning. Standards of Town planning: Planning new towns, planning standards and specifications, national and regional planning, town planning and legislation- planning regulations and limitations.

UNIT-III: PRINCIPLES OF PLANNING
Principles of planning - site selection, site orientation- aspect, prospect, grouping, circulation, privacy, furniture requirements, services and other factors.
Post-classic Architecture: Introduction of post-classic architecture contribution of eminent architects to modern period

UNIT-IV: HISTORY OF ARCHITECTURE
Western Architecture: Egyptian, Greek, Roman Architectures- Orders. Indian Architecture: Vedic age, Indus valley civilization– Buddhist period: Stambas, Stupa, Toranas, Chaityas, Viharas – Hindu temples: Dravidian and Indo Aryan Styles-Temple of Madurai, Bhuvaneshwar,

UNIT-V: ARCHITECTURAL DESIGN
Principles of designing – Composition of Plan – relationship between plan and elevation- building elements, form, surface texture, mass, line, color, tone- Principles of Composition: Unity, contrast, proportion, scale, balance, circulation, rhythm, character, expression, Smart Cities.

TEXT BOOKS:
2. Hiranmay Biswas, “Principles of town planning and architecture”; Vayu Education of India”; 1st Edition

REFERENCE:
**Pre-requisites:** Building Materials and Constructions

**Course Educational Objective:** This course aims to get exposure to management of various projects and financial facilities, and to plan and organize for any project. The course also provides proper utilization of equipments, materials and labor, the procedure of scheduling, the programming of any project by network analysis.

**Course Outcomes:** At the end of the course, the student will be able to:
- CO1: Identify the key aspects of Project Management
- CO2: Plan and schedule the project.
- CO3: Utilize both labour and materials effectively.
- CO4: Perform detailed network analysis to complete project within schedule.
- CO5: Deal contracts and bidding processes.

**UNIT-I: CONSTRUCTION PROJECT MANAGEMENT**
Introduction – Project Life Cycle – Major Types of construction – Selection of professional services – Construction contractors – Financing of constructed facilities – Legal & Regulatory requirements – Role of project managers

**UNIT-II: PROJECT PLANNING & ORGANIZATION**
Development of project plan, objective and conception– Programming – Scheduling – Project Organization – Project budget fund flow statement – Controlling system

**UNIT-III: LABOUR, MATERIAL & EQUIPMENT UTILIZATION**

**UNIT-IV: NETWORK ANALYSIS**
Introduction – Basic concepts of network analysis – CPM and PERT – Use of CPM & PERT Techniques – Problems, and prospects and applications of CPM & PERT – Introduction to software applications in project Management

**UNIT-V: CONTRACTS**

**TEXT BOOKS**

**REFERENCES**
3. Construction Planning and Management & Construction and Contract Management, NPTEL video lectures and web notes
Pre-requisites: NIL

Course Educational Objective:
This course aims to follow a systematic and coordinated methodology, including research, analysis and integration of knowledge into the creative process, whereby the needs and resources of the client are satisfied to produce an interior space that fulfils the project goals.

Course Outcomes: At the end of the course, the student will be able to:
- CO1: Interpret the safety concepts involved in interior designing.
- CO2: Apply the anthropometry study for design development.
- CO3: Design different furniture elements for residential and commercial projects.
- CO4: Recognize different interior services required for any building.
- CO5: Deliberate the different concepts and design elements in interior spaces

UNIT-I: HISTORY OF INTERIOR
Significance of Furniture, Prehistoric and Indigenous design, History of furniture in the Ancient world. History of furniture in the middle ages, Furniture development in 20th century, Eclecticism, Neoclassicism, Recent directions, Late modernism, High loch, Post modernism, Non-European Traditions

UNIT II: ANTHROPOMETRY:
Anthropometric data and special requirements for human needs with relation to movement, functions, furniture and space. - Process of design - Interior accessories design - Design of simple furniture with activities – Seating, Working, Sleeping, Storages. - Design development including case studies

UNIT III: FURNITURE DESIGN
Single items (Residential & Commercial). - Furniture design –group of furniture elements along with the surroundings. - Design of multi activity residential single room, Case study.

UNIT IV: INTERIOR SERVICES
Basic concepts and system components in air conditioning air-conditioning system and applications, fire safety acoustics and sound insulation electrical systems.

UNIT V: INTERIOR SPACE
Space – definition; Interior space – spatial qualities: form, scale, outlook; structuring space with interior design elements; spatial form; spatial dimension – square, rectangle, curvilinear spaces; height of space; spatial transitions – openings within wall planes, doorways, windows, stairways.

TEXT BOOKS:

REFERENCES:
Course Educational Objective: The course aims to identify the properties of different materials used in highway construction and makes students to identify the grades of materials.

Course outcomes: At the end of the course, the student will be able to:
CO1: Categorize and analyze the properties of road aggregates.
CO2: Determine and analyze the properties of bitumen.
CO3: Determine the suitability of aggregates and bitumen for pavement designs.

Note: A minimum of twelve (12No) shall be done and recorded.

**TESTS ON ROAD AGGREGATES:**
1. Aggregate Crushing value.
2. Aggregate Impact Test.
4. Attrition Test.
5. Abrasion Test.
6. Shape tests.

**TESTS ON BITUMINOUS MATERIALS:**
1. Penetration Test.
2. Ductility Test.
3. Softening Point Test.
4. Flash and fire point tests.
5. Bitumen content by centrifugal extractor
6. Specific gravity of bitumen.
7. Viscosity of bitumen.

**TEXT BOOK/REFERENCES**
Laboratory Manual developed by Civil Engineering Department.
**Pre-requisites:** Geo technical Engineering-I

**Course Educational Objective:** The course focuses on determination of index and engineering properties of soil and other important parameters based on basic principles of soil mechanics.

**Course Outcomes:** At the end of the course, the student will be able to-

- CO1: Determine the index and engineering properties of soils
- CO2: Perform field tests for soil investigations.
- CO3: Apply field conditions for computing and analyzing the experimental data.
- CO4: Analyze the results and infer the validity of the results.

Note: A minimum of twelve (12No) shall be done and recorded

1. Determination of water content by oven drying method.
2. Determination of specific gravity by
   - a) Density bottle method
   - b) Pycnometer method.
3. Gradation analysis
   - a) Mechanical Sieve analysis
   - b) Hydrometer analysis.
4. Determination of Atterberg limits
5. Determination of free swell index
6. Determination of field unit weight by
   - a) Core cutter method.
   - b) Sand replacement method.
7. Determination of permeability by
   - a) Constant head permeameter.
   - b) Variable head permeameter.
8. Direct shear test.
9. Vane shear test.
10. Unconfined compression test
11. IS - Light compaction test
12. IS - Heavy compaction test
15. California bearing ratio test.

**Text Book/Reference Books**
Laboratory Manual developed by Civil Engineering Department.
Pre-requisites: Nil

Course Educational Objective: This course aims to provide study of appropriate materials for constructing a green building and planning for energy and resource conservation in green building. The course also provides the practices of optimum use of the renewable energy resources, the principles of the designing the building using climatic factors and planning for effective green building rating system.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Categorize the benefits of a green building.
CO2: Assess the impact of climate in the design of a green building
CO3: Identify appropriate materials for constructing a green building
CO4: Plan the various options for energy and resource conservation in a green building.
CO5: Optimally use renewable energy resources and Plan the building for best green building rating system.

UNIT-I: GREEN BUILDINGS CONCEPT
Definition of Green Buildings, typical features of green buildings, benefits and environmental impacts of Green Buildings, Brown field and green field development, sustainable site selection and planning of buildings to maximize comfort, day lighting, ventilation.

UNIT-II: CLIMATE DESIGN
Local climatic conditions – solar radiation, temperature, humidity, wind speed and direction-impact of deforestation and climate change on built environment, desirable conditions, Fresh air requirements, standards, sick building syndrome and indoor air pollutants.

UNIT-III: GREEN MATERIALS
Recycling of building materials, Advantages in usage of natural local materials such as bamboo, timber, rammed earth, stabilized mud blocks, hollow blocks, lime & lime-pozzolana cements, materials from agro and industrial waste, ferro-cement and ferro-concrete, alternative roofing systems, various paints reducing the heat gain of the building, etc.

UNIT-IV: ENERGY AND RESOURCE CONSERVATION
Building envelope – its parts and types, Active and passive energy systems, need for energy conservation, Various forms of energy used in buildings, energy used in transportation and construction processes- Building automation and building management systems.
Water conservation systems in buildings- planning for storm water drainage, water harvesting in buildings – recycling of sewage, waste to energy management in residential complexes or gated communities, Modular wastewater treatment systems for built environment
UNIT-V: RENEWABLE ENERGY AND GREEN BUILDING RATING SYSTEMS
Wind and Solar Energy Harvesting, Potential of solar energy in India and world, construction and operation of various solar and wind energy based appliances, Geothermal energy usage in buildings, Case studies.
Introduction to Leadership in Energy and Environment Design (LEED), Green rating systems for Integrated Habitat Assessment – GRIHA, IGBC ratings, Salient features of Green buildings constructed in India.

TEXT BOOKS:

REFERENCES
Prerequisite: NIL

Course Educational Objective (CEO): This course will make students proficient in Quantitative techniques, language & communication skills to qualify in placement tests, demonstrate industry-readiness skills by applying concepts and tools that will serve as building blocks for analytical thinking and professional development.

Course Outcomes (COs): After the completion of this course, student will be able to:
CO1: Apply Quantitative techniques and logical thinking to qualify in recruitment tests and other professional tasks.
CO2: Communicate effectively in various professional and social contexts.
CO3: Apply Verbal skills effectively in Job Interviews as well other professional contexts.
CO4: Demonstrate various principles involved in Quantitative problem solving, thereby reducing the time taken for performing job functions.
CO5: Practice lifelong learning through personal effectiveness as well as leadership.

UNIT – I
Quantitative Aptitude: Numbers, L.C.M & H.C.F of numbers, Decimal Fractions, Simplification, Square root & cube root-Practice tests.
Verbal Ability: Introduction to Vocabulary-Root words (Prefixes, Suffixes) - Practice tests

UNIT – II
Quantitative Aptitude: Averages, Problems on Ages, Problems on Numbers, Surds and Indices-Practice tests.
Verbal Ability: Advanced vocabulary- Model tests for GRE/TOEFL/IELTS

UNIT – III
Quantitative Aptitude: Percentages, Profit and Loss- Practice tests
Verbal Ability: Synonyms & Antonyms, Idiomatic expressions-Practice tests

UNIT – IV
Quantitative Aptitude: Ratio And Proportion, Partnership, Chain rule- Practice tests
Verbal Ability: Words often confused & misused, One-word substitutes & Flash card activity-Practice tests

UNIT – V
Quantitative Aptitude: Number Series, Letter Series, Blood Relations, Coding and Decoding, Direction sense test- Practice tests
Verbal Ability: Phrasal verbs, Word analogies, Reading Comprehension-Practice tests

TEXT BOOKS
REFERENCES
2. Baron’s Guide on GRE
5. Quantitative Aptitude by Arun Sharma

Course Educational Objectives: This course serves as introduction to the concepts of structural steel design through the use of the Indian Standard IS 800 design code. It deals with the design of individual members and connections, such as, the design of tension members, compression members, beams, and beam columns; roof trusses and bolted, welded, and connections. The primary objective is to equip the students with the tools necessary for designing steel structures and to familiarize them with the relevant national design codes.

Course outcomes:
CO1: Identify the different structural steel elements and their connection system
CO2: Design the compression and tension members.
CO3: Analyse and design the beams.
CO4: Design the column bases and built up columns.
CO5: Design the roof trusses.

UNIT- I: DESIGN OF STEEL CONNECTIONS
Introduction: Fundamental Concepts of design of structures, Different types of rolled steel sections available to be used in steel structures. I.S specifications, Stress Strain relationship for steel.
Bolted Connections: Failure of a joint, Strength and efficiency of a joint and Design of Bearing type bolted joints subjected to axial load, Eccentric bolted connections.
Welded Connections: Types of welds, stresses in welds, Design of welded joints subjected to axial load, Eccentric welded connections.

UNIT- II: DESIGN OF TENSION AND COMPRESSION MEMBERS
Design of Tension Members: Introduction, types of tension members, net sectional areas, design of tension members, lug angles and splices.
Design of Compression Members: Introduction, effective length and slenderness ratio, various types of sections used for columns, design of eccentrically loaded compression members.

UNIT- III: DESIGN OF BEAMS
Introduction, types of sections, general design criteria for beams, design of laterally supported and unsupported beams, Design of built up sections, Curtailment of flange plates, web buckling, web crippling.

UNIT- IV: BUILT UP COLUMNS AND COLUMN BASES
Built Up Columns: Necessity, design of built up columns, laced and battened columns including the design of lacing and battens.
Column Bases: Introduction, types of column bases, design of slab base and gusseted base, design of gusseted base subjected to eccentrically loading.

UNIT- V: ROOF TRUSSES
Types of trusses, Economical spacing of roof trusses, loads on roof trusses, Estimation of wind load on roof trusses as per IS:875. Design of members of roof truss and joints, Design of purlins.
TEXT BOOKS

REFERENCES
3. Design of Steel Structures, NPTEL video lectures and web notes

IS CODES
- IS -800 – 2007
- IS -875 (Part-III)
- Steel Tables.

These codes and steel tables are permitted in the examinations.
Pre-requisites: Mechanics of Fluids, Hydraulics and Hydraulic Machinery Systems, Hydrology

Course Educational Objective: The course is designed to know the concepts of analysis and design of Storage and Diversion Head Works and introduce the types of Irrigation Systems. It also addresses the concepts of planning and design of Irrigation water requirements, design methods of erodible and non-erodible canals.

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

CO1: Analyze the stability of Gravity dams
CO2: Design the impervious floors for Diversion Head Works.
CO4: Design the erodible and non-erodible canals.
CO5: Interpret the design principles of Cross Drainage Works

UNIT-I: DAMS
Types of dams, selection of type of dam, selection of site for a dam.
Gravity dams: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a dam, stability analysis, drainage galleries, grouting.

UNIT-II: DIVERSION HEAD WORKS
Types of diversion head works, weirs and barrages, layout of diversion head works, components. Causes and failures of weirs on permeable foundations, Bligh’s creep theory, Khosla’s theory, design of impervious floors for subsurface flow, exit gradient.
Spillways: Types, design principles of Ogee spillways, types of spillways crest gates. Energy dissipation below spillways-stilling basin and its appurtenances.

UNIT III: IRRIGATION
Necessity and Importance of Irrigation, advantages and ill effects of Irrigation, types of Irrigation, methods of application of Irrigation water, water logging and drainage, principal crops and crop seasons, crop rotation. Soil-water-plant relationship, estimation of consumptive use, duty and delta, factors affecting duty, depth and frequency of Irrigation, irrigation efficiencies.

UNIT-IV: CANALS AND REGULATORS
Canals: Classification, design of non-erodible canals - methods of economic section and maximum permissible velocity, economics of canal lining, design of erodible canals -Kennedy’s silt theory and Lacey’s regime theory.
Regulators: Head and cross regulators, design principles.

UNIT-V: CANAL FALLS AND CROSS DRAINAGE WORKS
Canal Falls: Types and location, design principles of Sarda type fall and straight glacis fall.
Cross Drainage Works: Types, selection, design principles of aqueduct, siphon aqueduct and super passage.
TEXT BOOKS:

REFERENCES:
3. Water Resources Engineering, NPTEL video lectures and web notes
Prerequisites: Nil

Course Objectives: The course deals with concepts of water demand and water quality parameters, design of water treatment units, sewage quality parameters, sewage treatment units, sludge handling in sewage treatment.

COURSE OUTCOMES:
CO1: Estimate the water demand for the community and assess the significance of water quality parameters
CO2: Design the sedimentation based water treatment systems
CO3: Design the filtration and disinfection based water treatment systems
CO4: Interpret the importance of sewage quality parameters and design the primary treatment units
CO5: Design the secondary treatment and sludge handling aspects of sewage treatment plant

UNIT - I: WATER DEMAND AND WATER QUALITY
Water demand: Importance and need for protected water supply - Water demands - Factors affecting per capita demand - Types of demand - fluctuations in demand – Population forecasting- Different methods
Water quality: Sources of water- Quality of water - Physical, chemical and bacteriological parameters of water

UNIT - II: WATER TREATMENT - SEDIMENTATION
Treatment of water: Objectives of water treatment - Methods of treatment - Screening – Concept of aeration of raw water

UNIT - III: WATER TREATMENT – FILTRATION & DISINFECTION
Filtration: Filtration mechanism - Slow sand filters - Rapid sand filters –Design and Operation
Disinfection: Objective - Forms of disinfection - Chlorination - Types of chlorination

UNIT - IV: SEWAGE QUALITY & PRIMARY TREATMENT
Primary Treatment: Treatment of sewage - Primary treatment - Screening - Grit chamber – Design - Skimming tanks - Primary sedimentation tank and its design

UNIT - V: SECONDARY TREATMENT & SLUDGE HANDLING
Biological filtration of sewage: Trickling filters – Design of low rate and high rate trickling filters
Sludge handling: Sludge characteristics-Sludge digestion –Mechanism – Factors affecting - Design of digester - Disposal of digested sludge- Sludge drying beds
TEXT BOOKS

REFERENCES
7. Manual on sewerage and sewage treatment, CPHEEO, Ministry of urban affairs and employment, Govt. of India, New Delhi, 2001
8. Water and Wastewater Engineering, NPTEL video lectures and web notes
Pre-requisites: Geo technical engineering-1

Course Educational Objective: The course aims to teach the different conditions of site investigation for soil exploration. The course coverage includes the various procedures for determining the bearing capacity of various soils and get acquainted with the principles of soil mechanics in design of retaining walls.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Interpret the principles of soil exploration.
CO2: Design different types of foundations.
CO3: Determine safe bearing capacity for design of buildings.
CO4: Design different types of retaining walls.
CO5: Design the special foundations and perform stability analysis of slopes.

UNIT –I: SITE INVESTIGATION AND SELECTION OF FOUNDATIONS

UNIT –II: SHALLOW FOUNDATIONS AND BEARING CAPACITY OF SOILS

UNIT –III: DEEP FOUNDATIONS AND GROUP CAPACITY OF PILES
Group Capacity of Piles: Pile group efficiency – Downward drag phenomenon on piles and its significance in the design of pile foundations – Pile load test (Constant rate penetration test only) and its interpretation – Impact of pile driving (within the site and neighbouring area)

UNIT- IV: EARTH PRESSURE THEORIES AND RETAINING WALLS
Earth Pressure Theories: Rankine’s and Coulomb’s earth pressure theories and their comparison – Earth pressure at rest – Active and Passive earth pressures for cohesive and non cohesive soils and their determination by analytical methods only (No graphical procedures)
Retaining Walls: Different types of Retaining Walls – Design principles of Cantilever and Counterfort Retaining walls (Structural Design not included).
UNIT-V: SPECIAL FOUNDATIONS AND STABILITY OF SLOPES


TEXT BOOKS

REFERENCES
5. Geo Technical Engineering-II, NPTEL video lectures.
B.Tech. (VI Sem.)

17CE24 - MATRIX METHODS IN STRUCTURAL ANALYSIS

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Course Educational Objective: The course familiarizes the students with various methods of analysis of indeterminate structures such as analysis of matrix methods mainly flexibility and stiffness matrix approaches, their applications for simple pin jointed, rigid jointed frames. Development of transformation matrix by force and displacement methods is discussed.

Course Outcomes:
CO1: Identify the basics of matrix methods of analysis
CO2: Generate element stiffness matrix and flexibility matrix
CO3: Generate stiffness matrix for beams and calculate displacements
CO4: Generate stiffness matrix for plane trusses and single bay plane frames and calculate displacements
CO5: Generate flexibility matrix for analysis of beams and plane frames and solve problems

UNIT-I : FLEXIBILITY AND STIFFNESS MATRICES
Flexibility and stiffness-Axial displacement-Transverse displacement-Bending or flexural displacement-Torsional displacement
Flexibility Matrix: Properties
Stiffness Matrix: Properties, relationship between flexibility and stiffness matrix
Development of flexibility and stiffness matrices

UNIT-II: FORCE METHOD AND DISPLACEMENT METHODS
Force method and displacement method – Similarities between them-Applications to two and three span continuous beams with and without sinking of supports

UNIT-III: RIGID JOINTED PLANE FRAMES
Introduction-Force method-Shear equations for rigid jointed plane frames
Stiffness of a rigid joint-rotational stiffness and translational stiffness
Stiffness matrix for rectangular frames-Displacement method

UNIT-IV: PIN JOINTED FRAMES
Introduction-Displacement of pin jointed plane frame-Force method-Stiffness of a pin-joint, Member forces-Displacement method

UNIT-V: TRANSFORMATION MATRICES _ ELEMENT APPROACH
Introduction-Force method-Static analysis by method of joints
Displacement method-Effect of axial deformation of members

TEXT BOOKS:

REFERENCES:
2. Advanced Structural Analysis, NPTEL Web Notes
Pre-requisites:  NIL

Course Educational Objective: The course aims to introduce the different transportation systems available around the world. It further addresses the aspects of analysing the different components of railways, airways and water ways.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Illustrate the rail network development and railway planning in India.
CO2: Analyse different technical aspects of railway junctions.
CO3: Characterise the concepts of railway Interlocking and signalling systems.
CO4: Identify the technical issues related to planning and design of airports
CO5: Describe the technical components of harbour.

UNIT-I: RAILWAY PLANNING AND PERMANENT WAY

UNIT-II: TRACK JUNCTIONS
Points and crossings – Devices and layouts - Most commonly employed layouts – Special fittings and safety devices – Station and yard – Different types and their typical layouts – General equipments – Track junction – Movable diamond crossing

UNIT-III: SIGNALS AND INTERLOCKING
Signals – Different types and their working – Location of signals – Principles and mechanism of interlocking – Safety devices – Different system of control on movement of trains Introduction to modern trends in Indian railways in the design of high speed tracks.

UNIT-IV: AIRPORT ENGINEERING
Importance of Airports in National Transportation Sector – Airport Planning - Standards for planning of airports as per ICAO – Site selection survey – Airport Zoning – Runway – Orientation – Geometric design – Different types, pattern and layout Taxiways and Aprons – Holding Aprons – Planning and layout of Terminal Buildings, Hangars and Parking area

UNIT-V: HARBOUR COMPONENTS
Harbours and Ports – Requirement and classification – surveys – Breakwaters and pier heads – Docking platforms – Piers, wharves, jetties and quays – Fender mooring accessories – Entrance channels
DOCKS AND NAVIGATIONAL AIDS
TEXT BOOKS

REFERENCES
Pre-requisites: Building materials and Geo–technical Engineering

Course Educational Objective: The course familiarizes students with various construction techniques suitable for different site works. The course also deals with the equipment planning in addition to introducing new techniques in construction practices.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify the best construction equipment for site work and heavy civil projects
CO2: Choose the construction equipment based on their capabilities
CO3: Categorize the different types of cranes for field use
CO4: Classify the pile driving equipment for construction purpose
CO5: Plan the form work and usage of miscellaneous equipment.

UNIT-I: HISTORY OF CONSTRUCTION EQUIPMENT

UNIT-II: DOZERS- SCRAPERS- EXCAVATORS
Scrapers: Types-operation-performance chart-production cycle-operation Consideration-scraper safety.

UNIT-III: CRANES
Cranes: Major types-Mobile cranes- crawler cranes-Telescoping – Boom truck- Mounted Cranes-Crane Booms-Lifting capacities of cranes-Tower cranes- classification-selection-safety-crane accidents

UNIT-IV: PILE AND PILE DRIVING EQUIPMENT

UNIT-V: FORM WORKS AND OTHER EQUIPMENT
TEXT BOOKS

REFERENCES
Pre-requisites: Mechanics of Fluids, Hydraulics and Hydraulic Machinery Systems, Hydrology

Course Educational Objective: The course is designed to know the impact of urbanization on catchment hydrology. It aims to understand the importance of short duration rainfall runoff data for urban hydrology studies to estimate peak flow for storm water drainage system design.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Develop intensity duration frequency curves for urban drainage systems.
CO2: Identify the techniques for peak flow estimation for storm water drainage system design.
CO3: Develop design storms to size the various components of drainage systems.
CO4: Apply best management practices to manage urban flooding.
CO5: Prepare master drainage plan for an urbanized area.

UNIT I: PRECIPITATION ANALYSIS
Precipitation Analysis: Importance of short duration of rainfall and runoff data, methods of estimation of time of concentration for design of urban drainage systems, Intensity-Duration - Frequency (IDF) curves, design storms for urban drainage systems.

UNIT II: APPROACHES TO URBAN DRAINAGE
Time of concentration, peak flow estimation approaches, rational method, NRCS curve number approach, runoff quantity and quality, wastewater and storm water reuse, major and minor systems.

UNIT III: ELEMENTS OF DRAINAGE SYSTEMS
Open channel, underground drains, appurtenances, pumping, and source control.

UNIT IV: ANALYSIS AND MANAGEMENT
Storm water drainage structures, design of storm water network- Best Management Practices–detention and retention facilities, swales, constructed wetlands, models available for storm water management.

UNIT V: MASTER DRAINAGE PLANS
Issues to be concentrated upon – typical urban drainage master plan, interrelation between water resources investigation and urban planning processes, planning objectives, comprehensive planning, and use of models in planning.

TEXT BOOKS

REFERENCES
LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS), MYLAVARAM

B.Tech. (VI Sem.) 17FE61 - PRESENTATION SKILLS LAB

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**Pre-requisites:** Students should have fundamental knowledge in making Conversations in English and be with readiness to speak.

**Course Educational Objective:** To help students make oral presentations, power point presentations, participate in group discussions and Write project/research reports/technical reports/ formal letters by gathering information and organizing ideas relevantly and coherently.

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

- **CO1:** Make power point presentations and oral presentations.
- **CO2:** Use standard vocabulary contextually.
- **CO3:** Manage skilfully through group discussions.
- **CO4:** Negotiate skilfully for better placement.

**Syllabus:** English Communication Skills Lab (ELCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab** for 60 students with 60 systems, LAN facility and English language software for self-study by learners.
- **Interactive Communication Skills (ICS) Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo – audio & video system and camcorder etc.

**Exercise – I**

**CALL Lab:**
Understand: synonyms and antonyms, one-word substitutes, analogy, idioms and phrases.

**ICS Lab:**

**Exercise – II**

**CALL Lab:**

**ICS Lab:**
Group Discussion

**Exercise – III**

**CALL Lab:**

**ICS Lab:**
Practice: Poster Presentation – Power Point Presentations.

**Exercise – IV**

**CALL Lab:**
Understand: Types of Résumé – Letter Writing.

**ICS Lab:**
Practice: Writing Résumé & Letters

**Exercise – V**

**CALL Lab:**
Understand: Reading comprehension – Listening Comprehension – scanning, skimming, reading between lines and critical reading.

**ICS Lab:**
Practice: Reading comprehension - Listening Comprehension – scanning, skimming, reading between lines and critical reading.
Exercise - VI
CALL Lab:
Understand: Interview Skills
ICS Lab:
Practice: Mock Interviews

Lab Manual:

SUGGESTED SOFTWARE:
1.  Digital Mentor: Globarena, Hyderabad, 2005
4.  Dorling Kindersley Series of Grammar, Punctuation, Composition, USA, 2001
Prerequisites: Nil

Course objectives: This course deals with the laboratory approaches of determining certain major parameters related to water and wastewater quality and analyzing the laboratory data with respect to permissible limits and field conditions.

COURSE OUTCOMES
CO1: Perform the different laboratory techniques for examining the water quality parameters.
CO2: Perform the different laboratory techniques for examining the wastewater quality parameters.
CO3: Analyze the laboratory data and comment with respect to permissible limits and field conditions.

List of Experiments
Note: A minimum of twelve (12No) shall be done and recorded

The following tests are to be performed on a water/wastewater sample.

1. Determination of pH value and Conductivity.
2. Determination of Turbidity of water sample.
3. Determination of TDS in water sample.
4. Determination of Total, temporary and permanent hardness of water sample.
5. Determination of Total, Calcium and Magnesium hardness of water sample.
6. Determination of Chloride concentration of water sample.
7. Determination of Acidity of water sample.
10. Determination of Sulphates in water sample.
11. Determination of Residual chlorine in water sample.
15. Determination of Suspended, fixed and volatile solids in sewage sample.
16. Determination of Total, fixed and volatile solids in sewage sample.
17. Determination of Biochemical Oxygen Demand (BOD) of sewage.
18. Determination of Chemical Oxygen Demand (COD) of sewage.

TEXTBOOK/REFERENCES
Laboratory Manual developed by Civil Engineering Department.
Pre-requisites: Reinforced concrete structures, Design of steel structures, Auto CAD

Course Educational Objective: To impart hands on experience in design and preparation of structural drawings for concrete / steel structures normally encountered in Civil Engineering practice.

Course outcomes:
CO1: Apply structural analysis software to analyze and design the beams, 2D and 3D frames.
CO2: Design of retaining walls and foundations using STAAD Pro
CO3: Analyze, design and draw the details of RCC and steel structural elements.

EXCERCISES
Part-A
SOFTWARE: STAAD Pro or Equivalent
Note: A minimum of 6 no. shall be done and recorded
1. Analysis and Design of different beams.
2. 2-D Frame Analysis and Design
3. 3-D Frame Analysis and Design
4. Design and analysis of multi-storied building
5. Analysis of plane/space truss
6. Design of a different types of Retaining Walls
7. Foundation Design
8. Wind Analysis of tall towers / buildings.

Part-B
Any four experiments using AutoCAD (2 from DRCS, 2 from DSS)

DRCS
1. Reinforcement particulars of T-beams and L-beams.
2. Reinforcement detailing of continuous beams.
3. Reinforcement particulars of columns.
4. Detailing of One way, Two way and continuous slabs.

DSS
5. Detailing of Compound beams including curtailment of flange plates.
6. Detailing of Column including lacing and battens.
7. Detailing of steel roof trusses including particulars at joints.
8. Detailing of beams including curtailment of flange plates.

TEXT BOOKS
1. N. Subramanian, Design of Steel Structures, Oxford University Press, 2016.

REFERENCES
Pre-requisites: Nil

Course Educational Objectives: The course focuses on study of available traditional and eco-friendly materials, Eco friendly and cost effective technologies, Eco-friendly building materials, rural housing approaches in disaster prone areas.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Select appropriate traditional materials for construction.
CO2: Select appropriate eco-friendly materials for construction.
CO3: Analyze the eco friendly technologies for low cost construction.
CO4: Describe prefabrication techniques and assess the wind effects on low rise buildings.
CO5: Categorize the approaches followed in disaster prone areas.

UNIT-I: TRADITIONAL BUILDING MATERIALS
Traditional Building Materials: Introduction-housing scenario in India, Traditional building materials-stabilized soil bricks, improved mud and thatch, burnt and un burned bricks, laterite-lime bricks, sand-lime blocks, stone block masonry units, bamboo, hollow cement blocks, light weight concrete blocks, wood-cement products, fly ash bricks, cementitious binder from rice husk, lime based binders.

UNIT-II: ECO-FRIENDLY BUILDING MATERIALS

UNIT-III: IMPROVED BUILDING TECHNOLOGIES
Foundations: Introduction, types of soli, types of foundations, permissible settlements, soil investigations.
Walls: Introduction, stabilized earth wall construction, building blocks (lato blocks) from lateritic soil, brick masonry walls, cellular concrete blocks, hallow concrete blocks, shell type houses made of hallow clay blocks, pre cast concrete panels.
Roofs: Introduction, catenary hollow clay blocks/brick shell roofs, pre cast reinforced concrete-channel units-cored units, roofing system with cellular unit, cellular light weight concrete roofing system.

UNIT-IV: PRE-FABRICATION AND WIND EFFECTS
Prefabrication: Introduction, advantages of pre-fabrication, areas where prefabrication techniques can be introduced, joints in pre cast concrete structures.
Wind effects on low rise buildings: Introduction, wind structure interaction concepts, codal provision, housing in cyclone prone areas, cyclone resisting core units.

UNIT-V: RURAL HOUSING AND HOUSING IN DISASTER PRONE AREAS
Rural housing: Introduction, traditional practice of rural house construction, appropriate rural housing technology, mud housing technology, mud roofs, characteristics of mud, fire retardant treatment for trench roof.
Housing in disaster prone areas: Introduction, traditional houses in disaster prone areas, types of damages failures of non engineered buildings, repair and rehabilitation of earthquake damaged non engineered buildings, recommendations for feature construction.

TEXT BOOKS:

REFERENCES:
Prerequisite: NIL

**Course Educational Objective (CEO):** This course will make students proficient in Quantitative techniques, language & communication skills to qualify in placement tests, demonstrate industry-readiness skills by applying concepts and tools that will serve as building blocks for analytical thinking and professional development.

**Course Outcomes (COs):** After the completion of this course, student will be able to:
- **CO1:** To identify, analyze and apply quantitative techniques related to qualify in Placement tests.
- **CO2:** To effectively utilize verbal ability & communication skills to qualify in Placement tests.
- **CO3:** To effectively communicate in professional as well as social contexts.
- **CO4:** To apply key soft skills effectively in Job Interviews as well in other professional contexts.
- **CO5:** Inculcate lifelong learning through personal effectiveness as well as leadership.

**UNIT – I:**
**Verbal Ability:** Tenses & Conditional Clauses  
**Quantitative Aptitude:** Alligation or Mixture, Simple Interest and Compound Interest

**UNIT – II:**  
**Verbal Ability:** Sentence Completions  
**Quantitative Aptitude:** Time and work, Pipes and Cistern, Permutations and Combinations, Probability

**UNIT – III:**  
**Verbal Ability:** Spot the Errors  
**Quantitative Aptitude:** Time and Distance, Problems on trains, Boats and Streams, Races and Games of Skill

**UNIT – IV:**  
**Verbal Ability:** Jumbled Sentences, Cloze Tests  
**Quantitative Aptitude:** Area, Volume and Surface Areas, Progressions

**UNIT – V:**  
**Verbal Ability:** Advanced Reading Comprehension  
**Quantitative Aptitude:** Clocks and Calendars, Cubes and Dice

**TEXT BOOKS:**
REFERENCES:
2. Baron’s Guide on GRE
5. Quantitative Aptitude by Arun Sharma

Course Educational Objective: This course aims to deal with the basic principles of estimating the quantities in building, roads and canals. The course also provides details about the procedures and practices for writing specifications, preparation of analysis of rates and procedural aspects of valuating the property.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Estimate the quantities for various types of structures.
CO2: Calculate the quantities of different items in buildings and roads.
CO3: Compute the quantity estimate for canals.
CO4: Prepare and write specifications and rate analysis.
CO5: Perform valuation of the property as per the prevailing regulations.

UNIT-I: ESTIMATE OF BUILDINGS
Methods of estimating; Main items of work; Deduction for openings; Degree of accuracy; Units of measurement.

METHODS OF BUILDING ESTIMATES
Individual wall method; Centre line method; Arch masonry calculation; Estimate of steps.

ESTIMATE OF RESIDENTIAL BUILDING
Estimate of a building from line plan.

UNIT-II: ESTIMATE OF RCC WORKS AND ROADS
Standard hooks and cranks; Estimate of RCC slab; RCC beam; RCC T-beam slab and RCC column with foundation.

ROAD ESTIMATING: Estimate of earthwork; Estimate of pitching of slopes; Estimate of earthwork of road from longitudinal sections; Estimate of earthwork in hill roads.

UNIT-III: CANAL ESTIMATE
Earthwork in canals—different cases; Estimate of earthwork in irrigation channels.

SPECIFICATIONS: Purpose and method of writing specifications; General specifications. Detailed Specifications for Brick work; R.C.C; Plastering; Mosaic Flooring; R.R.Stone Masonary.

UNIT-IV: ANALYSIS OF RATES
Task or out – turn work; Labour and materials required for different works; Rates of materials and labour; Preparing analysis of rates for the following items of work: i) Concrete ii) RCC Works iii) Brick work in foundation and super structure iv) Plastering v) CC flooring vi) White washing. Standard Schedule of Rates.

PWD ACCOUNTS AND PROCEDURE OF WORKS
Organization of Engineering department; Work charged establishment; Contract; Tender; Tender notice; Tender Schedule; Earnest money; Security money; Measurement book; Administrative approval; Technical sanction; Plinth area; Floor Area; Carpet area; Approximate Estimate; Plinth area estimate; Revised Estimate; Supplementary estimate.
UNIT-V: VALUATION
Cost; Price & value; Methods of valuation; Out goings; Depreciation; Methods for estimating cost depreciation; Valuation of building.

Miscellaneous Topics: Gross income; Net income; Scrap value; Salvage value; Obsolescence; Annuity; Capitalized value; Years purchase; Life of structures; Sinking fund; Standard rent; Process of fixing standard rent; Mortgage.

TEXT BOOKS

REFERENCES
Pre-requisites: Nil

Course Educational Objective:
The course is designed to understand the techniques of Remote Sensing and GIS Technology for civil engineering applications.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Interpret the concepts of Photogrammetry and its applications such as determination of heights of objects on terrain.
CO2: Illustrate the Electromagnetic spectrum and utilize the energy interactions of EMR with atmosphere and earth surface features for GIS data generation.
CO3: Analyze the methods of map projections and understand coordinate systems on GIS Software packages to produce high resolution thematic maps.
CO4: Apply the concepts of vector and raster data model for representation of topological earth features and its importance.
CO5: Apply the RS & GIS techniques for solving civil engineering applications

UNIT-I: INTRODUCTION TO PHOTOGRAMMETRY
Principle and types of aerial photograph, Geometry of vertical aerial photograph, scale and height measurement on single vertical aerial photograph, height measurement based on relief displacement, fundamentals of stereoscopy, fiducial points, parallax measurements using fiducial points.

UNIT-II: REMOTE SENSING
Basic concept of remote sensing, data and information, remote sensing data collection, remote sensing advantages and limitations, remote sensing process; electromagnetic spectrum, energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian satellites and sensors characteristics, resolution, map and image and false color composite, Introduction to digital data, elements of visual interpretation techniques.

UNIT-III: GEOGRAPHIC INFORMATION SYSTEM
Introduction to GIS, Components of a GIS, Geospatial data: Spatial data, attribute data, joining spatial and attribute data; GIS operations: Spatial data input, attribute data management, data display, data exploration, data analysis.
COORDINATE SYSTEMS: Geographic coordinate system: Approximation of the earth, datum; map projections: types of map projections, map projection parameters, commonly used map projections, projected coordinate systems.

UNIT-IV: VECTOR AND RASTER DATA MODEL
VECTOR DATA MODEL: Representation of simple features, topology and its importance; coverage and its data structure, shape file; geometric representation of spatial feature and data structure, topology rules.
RASTER DATA MODEL: Elements of the raster data model, types of raster data, raster data structure, data conversion, integration of raster and vector data. Data Input: Metadata, conversion of existing data, Creating new data; Remote sensing data, fields data, text data, digitizing, scanning, on screen digitizing, importance of source map, data editing.
UNIT-V: CIVIL ENGINEERING APPLICATIONS
Surface water mapping and inventory, rainfall runoff relations, watershed management for sustainable development, reservoir sedimentation, ground water targeting, and identification for groundwater recharge, Waste Management Facilities, Water Quality Modeling and Mapping.

TEXT BOOK

REFERENCES
6. Remote sensing and Geographical Information Technology, NPTEL video lectures and web notes

Course Educational Objectives: This course deals with design of shallow and deep foundations, different types of slabs along with stair case and retaining walls.

COURSE OUTCOMES: At the end of the course, the student will be able to-
CO1: Design the footings
CO2: Design the piles.
CO3: Design different slabs.
CO4: Design the stair cases
CO5: Design cantilever type retaining walls

UNIT- I: DESIGN OF SHALLOW FOUNDATIONS
Design of shallow foundation – square – rectangular isolated footing of uniform thickness and sloped footing – combined footing.

UNIT-II DESIGN OF PILE FOUNDATIONS

UNIT-III DESIGN OF SLABS
Yield line theory – Design of circular, flat and grid slabs with different boundary conditions subjected to UDL.

UNIT-IV DESIGN OF STAIRS
Design of stairs spanning horizontally – Design of dog legged stair.

UNIT-V DESIGN OF CANTILEVER RETAINING WALLS
Types of retaining walls, Forces on retaining walls; Stability requirements; Design and detailing of cantilever type retaining wall.

TEXT BOOKS

REFERENCES
4. Advanced Structural Design and Design of Concrete Structures, NPTEL web notes.

IS CODES:
IS 456-2000: Plain and reinforced concrete
IS 2911: Pile Foundation- Underreamed piles
Pre-requisites: DRCS-I.

Course Educational Objective: The course deals with the analysis and design of prestressed concrete structural elements. The primary topics include the concept and principles of prestressing, methods of prestressing concrete, stress limits, losses of prestress, selection of section, serviceability and strength requirements. Students will also be familiar with the analysis and design procedure of simply supported prestressed concrete non-composite and composite beams.

Course Outcomes: At the end of this course the student will be able to
CO1: Identify the different methods of pre-stressing.
CO2: Compute the effective pre-stress including the short and long term losses.
CO3: Analyze the different losses of pre-stressing
CO4: Design prestressed concrete beams under flexure.
CO5: Design prestressed concrete beams under shear and torsion and interpret the relevant IS code provisions for prestressed concrete.

UNIT-I: BASIC CONCEPTS OF PRESTRESSING
Advantages and Applications of Prestressed Concretes, High Strength Concrete- Permissible Stresses, Shrinkage, Creep, Deformation Characteristics, High strength Steel- Types, Strength-Permissible Stresses- Relaxation of Stress, Stress Corrosion- Durability, Fire Resistance, Cover Requirements.

UNIT-II: PRE-STRESSING SYSTEMS:
Introduction, Tensioning devices, Pre-tensioning Systems, Post tensioning Systems, Basic Assumptions in Analysis of prestress and design, Analysis of prestress, Resultant Stresses at a section- pressure line- Concepts of load balancing- Stresses in Tendons, Cracking moment.

UNIT-III: LOSSES OF PRE-STRESSING
Loss of Pre-stress in pre-tensioned and post tensioned members due to various causes - Elastic shortening of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage, differential shrinkage- bending of members and frictional losses-Total losses allowed for design.

UNIT-IV: DESIGN FOR FLEXURAL RESISTANCE
Types of flexural failure – Code procedures-Design of sections for flexure- Control of deflections-Factors influencing-Prediction of short term and long term deflections.

UNIT-V: DESIGN FOR SHEAR AND TORSION
Shear and Principal Stresses- Design of Shear reinforcements- Codal Provisions- Design for Torsion, Design for Combined bending, shear and torsion.
TRANSFER OF PRESTRESS IN PRE TENSIONED MEMBERS:- Transmission length- Bond stresses- end zone reinforcement- Codal provisions- Anchorage zone Stresses in Post tensioned members- Stress distribution in end block- Anchorage Zone reinforcement.

TEXT BOOKS
REFERENCES
5. Prestressed Concrete Structures, NPTEL video lectures.

IS Codes
1. IS 1343: 2012 Code of Practice for Pre Stressed Concrete
2. IS 3370(Part 3): 2013 Code of Practice for Concrete Structures for the Storage of Liquids-Part 3 Pre stressed Concrete
3. IS 3370(Part 4): 2013 Code of Practice for Concrete Structures for the Storage -Part 4

NOTE : These codes are permitted in the End Examinations
Pre-requisites: Highway Engineering

Course Educational Objective: The course aims to teach the design principles, factors and various methods of designing the pavements using IRC recommended codes. The course helps the students to evaluate the pavement performance and stabilise the pavement by adopting various techniques.

Course Outcomes: At the end of the course, the students will be able to:
- CO1: Analyse the factors affecting the various types of pavements under application of loads.
- CO2: Design of flexible pavement by theoretical and empirical methods.
- CO3: Design of rigid pavement by IRC method and Westergaard approach.
- CO4: Evaluate the pavement performance and maintenance as per IRC recommendations.
- CO5: Applications of Geo-synthetics in stabilisation of highway pavements.

UNIT-I: FACTORS AFFECTING PAVEMENT DESIGN
Variables considered in Pavement Design, Types of pavements, Functions of individual layers, Classification of axle types of rigid chassis and articulated commercial vehicles, legal axle and gross weights on single and multiple units, tire pressure, contact pressure, EAL and ESWL concepts, traffic analysis, ADT, AADT, truck factor, growth factor, lane, directional distributions & vehicle damage factors.

UNIT-II: DESIGN OF FLEXIBLE PAVEMENTS

UNIT-III: DESIGN OF RIGID PAVEMENTS
Cement concrete pavements - Modified Westergaard approach - Design procedure as per latest IRC guidelines - Concrete roads and their scope in India.

UNIT-IV: MAINTENANCE AND EVALUATION OF PAVEMENTS

UNIT-V: STABILISATION OF PAVEMENTS

TEXT BOOKS
REFERENCES
5. Pavement Design, NPTEL video lectures and web notes.

IS CODES
1. IRC Standards
2. Bureau of Indian Standards (BIS) Publications on Highway Materials
3. MORTH Guidelines for Highway Engineering.

B.Tech. (VII Sem.)

17CE33 - GROUND WATER ENGINEERING AND MANAGEMENT


Course Educational Objective: The course is designed to understand the principles involved in design and construction of wells and create awareness on improving the groundwater potential using various recharge techniques. Learn groundwater management using advanced tools.

Course Outcomes: At the end of the course, the student will be able to:
- CO1: Apply the Principals involved in design of wells.
- CO2: Identify the well construction practices.
- CO3: Apply suitable techniques for groundwater recharge.
- CO4: Interpret geophysical exploration data for systematic exploration of groundwater.
- CO5: Develop and apply the groundwater models for prediction of relevant parameters.

UNIT I: INTRODUCTION
Ground water utilization and historical background, ground water in hydrologic cycle, ground water budget, ground water level fluctuations and environmental influence, Origin and age of ground water, rock properties affecting groundwater, groundwater column, zones of aeration & saturation, aquifers and their characteristics / classification, groundwater basins and springs, Ground water flow rates and flow directions.

UNIT II: WELL CONSTRUCTION AND DEVELOPMENT
Water wells, drilling methods-rotary drilling, percussion drilling, well construction-installation of well screens-pull-back method, open- hole, bail- down and wash-down methods, well development-mechanical surging using compressed air, high velocity jetting of water, over pumping and back washing, well completion, well disinfection, well maintenance.

UNIT III: ARTIFICIAL RECHARGE AND QUALITY ANALYSIS OF GROUND WATER
Concept and methods of artificial ground water recharge, recharge mounds and induced recharge, wastewater recharge for reuse, water spreading. Sources and causes of pollution, potential evaluation of pollution, analysis of ground water quality, water quality for irrigation engineering, Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh and saline water interface, saline water intrusion control.

UNIT IV: INVESTIGATION TECHNIQUES 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 V: MODELING AND MANAGEMENT OF GROUND WATER
Ground water modeling through porous media, general flow equations through porous media, analog, electric analog, digital computer models, 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 aquifers, stream-aquifer interaction.
TEXT BOOKS

REFERENCES
4. Ground Water Hydrology, NPTEL video lectures and web notes.
Pre-requisites: Reinforced Concrete Design

Course Educational Objective: The course aims to teach the fundamentals of response of dynamic load on structures, vibrations due to dynamic loads. The course further deals with design principles of earth quake resistant design and various design forces to be considered.

Course Outcomes:
CO1: Illustrate the basics of dynamic loads and seismology
CO2: Interpret the different earthquake vibrations of structures
CO3: Deduce the principles of earth quake resistant design
CO4: Choose appropriate forces for design of buildings
CO5: Design the structures based on ductility considerations

UNIT – I: DYNAMIC LOADS AND SEISMOLOGY
Introduction to Dynamic Loads - Static Load v/s Dynamic Load, Types of Dynamic forces.
Engineering seismology- Earthquake phenomenon cause of earthquakes, Faults-Plate Tectonics- Seismic waves-Terms associated with earthquakes-Magnitude/Intensity of an earthquake, scales, Energy Released, Earthquake measuring instruments Seismoscope, Seismograph, accelerograph, Characteristics of strong ground motions, Seismic zones of India as per IS 1893-2002.

UNIT – II: FUNDAMENTALS OF EARTHQUAKE VIBRATIONS OF STRUCTURES

UNIT – III: INTRODUCTION TO EARTHQUAKE RESISTANT DESIGN

UNIT – IV: DESIGN FORCES FOR BUILDINGS
Equivalent static method, Determination of lateral forces as per IS 1893 (Part 1), Modal analysis using response spectrum.

UNIT – V: DUCTILITY CONSIDERATIONS IN EARTHQUAKE RESISTANT DESIGN OF RC BUILDINGS
Introduction, Impact of Ductility, Requirements for Ductility, Assessment of Ductility, Factors affecting ductility, Ductile detailing considerations as per IS 13920-1993.
TEXTBOOKS

REFERENCES
**Prerequisites:** Environmental Studies

**Course Objectives:** This course deals with importance of meteorology on air pollution and dispersion of air pollutants, air pollution control techniques, impacts of noise pollution on society and study the principles for reduction of noise pollution, solid waste management in the society, impacts of hazardous waste flow in society and application of environmental management principles to develop solutions to major environmental problems.

**COURSE OUTCOMES**

CO1: Evaluate the impacts of air pollution due to meteorology and estimate the ground level concentrations of pollutants at any location using available air quality models  
CO2: Design the air pollution control equipment  
CO3: Apply appropriate measures to estimate and reduce noise pollution  
CO4: Apply appropriate techniques for management of solid waste in the society  
CO5: Analyze the impacts of hazardous waste flow in society and apply the principles of environmental management to develop solutions to major environmental problems

**UNIT-I: AIR POLLUTION – METEOROLOGY & DISPERSION**
Air pollution: Concept – Primary and secondary pollutants, Properties, Units of measurement-Simple problems  

**UNIT-II: AIR POLLUTION CONTROL TECHNIQUES**

**UNIT-III: NOISE POLLUTION**
Noise Pollution – Sound and Noise, Sources of Noise, Basic definitions – Power, Intensity, Decibels, Equivalent Noise levels, Sound Intensity Level, Sound Pressure level, Weighting Networks, Octave band, Impacts of Noise, Noise rating systems, Noise level Standards-Simple calculations for - estimating equivalent noise levels, Addition of sound levels, Averaging Sound pressure levels, Simple control methods.

**UNIT-IV: SOLID WASTE MANAGEMENT**
Solid Waste Management – Regulations in India, Sources, Composition and Properties of solid waste, Collection and Handling, Door to door collection services, Principles of separation and processing, Concept of recycling and recovery of solid wastes, Solid Waste Disposal methods – Composting, Incineration, Land filling, Gas generation and Leachate Control - Simple calculations for estimation of moisture content, density, Energy content, methane generation, landfill area.
UNIT V: HAZARDOUS WASTE & ENVIRONMENTAL MANAGEMENT
Regulations in India of - Hazardous Waste, Biomedical Waste, Plastic Waste, E-Waste-Classification, Control and Disposal methods - Indian Scenario
Treatment Storage and Disposal Facility (TSDF) concept-Concept of Common Effluent Treatment Plants
Environmental Impact Assessment & Environmental Audit – Necessity, Objectives, Advantages and Limitations, Case studies.

TEXT BOOKS

REFERENCES
4. Solid & Hazardous Waste Management, NPTEL Video Lectures
5. Environmental Air Pollution, NPTEL Video lectures and web notes
Pre-requisites: Highway Engineering

Course Educational Objective: The course aims to teach the importance of planning, selection of alignment and providing good road network in the rural road development process. The coverage of this course enables the students to design a pavement and various materials. The concept of using waste materials in pavement design and approaches how can construct a quality pavement and maintenance after construction.

COURSE OUTCOMES
- CO1: Describe the major concepts of planning and alignment of rural roads.
- CO2: Identify appropriate materials required for design a pavement.
- CO3: Design flexible and rigid pavements.
- CO4: Categorize the ways of usage of waste material for pavement construction.
- CO5: Illustrate the quality control aspects involved in the construction and maintenance of pavements.

UNIT-I: PLANNING AND ALIGNMENT
Planning of Rural Roads, Concept of Network planning, rural roads planning, road alignment and surveys, governing factors on route selection, factors considered for alignment.

UNIT-II: MATERIALS
Introduction, Soil ,material surveys, embankment and subgrade materials, stabilized Soils, Road aggregates, aggregate for base courses, new materials as stabilizers, materials for desert areas, materials for bituminous constructions and surfacing; materials for rigid pavements, special pavement, climatic suitability of concrete materials.

UNIT-III: PAVEMENT DESIGN:
Introduction: design procedure, pavement components and general criteria for road drainage, system of drainage, surface and subsurface systems.

UNIT-IV: WASTE MATERIAL FOR PAVEMENT CONSTRUCTION
Introduction, fly ash for road construction, design & construction, design & construction of fly ash embankment lime fly ash and stabilized soil, lime fly ash pavements, control of compaction, concrete stabilized fly ash with admixtures.

UNIT-V: QUALITY CONTROL IN CONSTRUCTION AND MAINTENANCE
Introduction, Pre-requirements, organizational setup, specification and code of practice, Laboratory equipment, Earth and granular layers, bituminous courses, semi- rigid and rigid pavements, special requirements, recovered of quality control data. Distresses/Defects in Pavements, Definitions of Maintenance Activities, Inventory of Road and Inspection, Types of Maintenance, Classification of Maintenance Activities, Maintenance, Norms of Maintenance Cost.

TEXT BOOKS:

REFERENCES:
1. IRC related code books.
Pre-requisites: Geo Technical Engineering-I and Geo Technical Engineering-II

Course Educational Objective: The course aims to teach the ground improvement techniques suitable for different soils. The course coverage includes the principles of drainage and dewatering of soils under various conditions and the principles for the in-situ treatment of soils.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify the ground improvement techniques suitable for different soils.
CO2: Assess the process of drainage and dewatering of soils under various conditions.
CO3: Evaluate the suitable procedure for the in-situ treatment of soils.
CO4: Select the suitable grouting techniques for the soils in different conditions.
CO5: Recognize the appropriate application of geosynthetics in soils.

UNIT –I: INTRODUCTION
Role of ground improvement in foundation engineering – Ground improvement methods – Geotechnical problems in lateritic, alluvial and black cotton soils – selection of Ground improvement techniques based on soil conditions-use of piezometers-inclinometers in field-Ground anchors

UNIT –II: DRAINAGE AND DEWATERING
Well point system – Vacuum dewatering system – Electro-osmotic method – Seepage analysis for two dimensional flow – fully penetrating slots in homogeneous deposits (simple cases only).

UNIT –III: INSITU TREATMENT OF SOILS

UNIT- IV: GROUTING TECHNIQUE AND STABILISATION
Stabilisation: Methods of stabilization-mechanical-cement- lime-bituminous-chemical stabilization with calcium chloride, sodium silicate and gypsum.

UNIT-V: GEOSYNTHETICS APPLICATIONS
Types of Geosynthetic materials- Geotextile – Types – Geotextiles in Filtration, Drainage, Separation and Reinforcement – Geomembranes – Containments and barriers – Application to Landfills, Highways etc.

TEXT BOOKS
REFERENCES
5. Ground Improvement Techniques, NPTEL video lectures.
Pre-requisites: Nil

Course Educational Objective: The course focuses on developing the detailed knowledge about the safety measures to be taken at construction field and industrial areas. It also aims to provide fundamentals of ergonomics for a better workplace and impacts and mitigation of fire accidents.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Illustrate various concepts of safety measures undertaken in a manufacturing organization.
CO2: Analyze and implement various safety measures in project construction.
CO3: Demonstrate safety and control measures for industries.
CO4: Apply the concepts of Ergonomics for improvement in workplace
CO5: Analyze different controlling measures and apply during fire accidents.

UNIT-I: SAFETY BASICS
Concepts: Safety background, principles of safety management, development and growth of safety movement, safety principles, policy, safety inspection, planning, safety measures in manufacturing industry, Employees participation in safety, safety and productivity, regulatory agencies and statutory bodies dealing with safety in India and abroad, safe rigging practice and standard crane signals.

UNIT II: CONSTRUCTION SAFETY
Safety appliances- in transport, road safety, ladder- types, safety practices and checklist; scaffoldings approaches, excavations, road work, machinery, hoists, Electricity- checklist for temporary electrical connections, shuttering and shoring, , hazards of construction site, Personal Protective Equipment (PPE), safety with lifting machines, safety procedures for working at height, checklist for working at height, construction safety management checklist

UNIT III: INDUSTRIAL SAFETY
Types of accidents in Industry, effects of accidents on human body, accident prevention Environmental factors in industry
Industrial hazards- classification of hazards, hazard management program, Machine Guarding
Industrial Fatigue- types of fatigue, effects of fatigue, circadian rhythms, factors affecting fatigue, managing and mitigation of fatigue

UNIT IV: ERGONOMICS
Origin and development of ergonomics, Boundaries for ergonomics, ergonomics considerations, principles, objectives, role of an ergonomist, identification of ergonomics problems, ergonomics and workplace- workplace contributing factors, ergonomic improvement, identify poor posture and risks, ergonomics education and training.

UNIT V: FIRE SAFETY
Stages of fire, fire triangle, fire tetrahedron, smouldering, ignition process, fire properties of materials used in construction, testing for resistance to fire, passive fire protection, fire escapes routes and refuge, detectors types based on effects, Selection of detectors, alarm systems, fire alarm systems and control panels, principles of operations, types of fire extinguishers, water based fixed fire protection systems.
TEXT BOOKS:

REFERENCES:
Pre-requisites: Remote Sensing and GIS applications, Core Civil Engineering Subjects

Course Educational Objective: The course is designed to introduce GIS software and apply GIS software to simple problems in civil engineering problems. It also involves in developing coding in C language for civil engineering problems and analyzing results.

Course Outcomes:
At the end of the course the student will be able to
CO1: Digitize and create thematic map and extract important features using GIS software.
CO2: Analyze and Interpret the maps created using GIS for specific applications.
CO3: Develop coding for civil engineering problems and analyze the results.

List of experiments

Note: A minimum of twelve (10 No) shall be done and recorded.
Any 3 from Part A and 7 from Part B.

PART-A: EXCERCISES IN GIS
1. Digitization of Map/Topo sheet
2. Creation of thematic maps.
3. Estimation of features and interpretation
4. Developing Digital Elevation model
5. Simple applications of GIS in Civil Engineering.

GIS SOFTWARES:
1. Arc GIS 9.0
2. ERDAS 8.7
3. Map info 6.5
Any one or Equivalent.

PART-B: EXCERCISES IN COMPUTER APPLICATIONS
1. Design of sedimentation tank.
2. Determination vertical stress distribution in soil.
3. Design of Triangular-, Rectangular- and trapezoidal notch.
4. Design of Open Channel.
5. Determination of engineering properties of soils.
7. Design of doubly reinforced beam.
8. Design of T beam.
9. Design of Tension/Compression Members.
10. Design of pavement.

TEXT BOOK/REFERENCES
1. Laboratory manual developed by Civil Engineering Department.
**Prerequisite:** Estimation and Quantity Surveying

**Course Educational Objective:** The course deals with usage of software tools for calculating the quantities and estimating the cost of different structures. It also deals with managing the project by using software tools.

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

CO1: Estimate the quantities for different items of civil engineering using software tools.

CO2: Prepare the estimate of different items of RCC elements.

CO3: Control the project for execution of civil engineering projects through systematic planning.

**Note:** A minimum of twelve (12No) shall be done and recorded.

**CYCLE-1: Quantity Surveying** (At least SIX of the following using software such as MS Excel/Qty/Road Estimate/Super Rate analysis etc.)

1. Quantity estimation of a single storey residential building (different items).
3. Quantity estimation of a B.T.Road (different items).
5. Quantity estimation of a Canal (different items).
7. Find out the labour requirement and preparing the Rate Analysis for different items of work.
   a) C.C b) R.C.C c) Brick work d) Flooring

**CYCLE-2:** (At least THREE of the following by using software such as MS Excel)

1. Quantity estimation of RCC roof slab and preparing schedule of bars
2. Quantity estimation of RCC beam and preparing schedule of bars
3. Quantity estimation of RCC Column with foundation footing and preparing schedule of bars
4. Quantity estimation of RCC retaining wall and preparing schedule of bars.

**CYCLE-3: Project Management** (Any THREE of the following using software such as MS Project /Primavera etc.)

1. Preparing the Project management report for a single storey residential building/Road/Canal by using the Bar Chart/Mile stone chart.
2. Preparing the Project management report for a single storey residential building by using the network technique (PERT/CPM).
3. Preparing the Project management report for a B.T.Road by using the network technique (PERT/CPM).
4. Preparing the Project management report for a Canal by using the network technique (PERT/CPM).

**TEXT BOOK:**
Laboratory Manual developed by Civil Engineering Department.
Pre-requisites: Environmental Studies

Course Educational Objective: This course teaches the basic terminology of Environmental sanitation, different methods for control of Communicable and non-communicable diseases, the control techniques for rodent and vectors, sanitation measures that are required in few Institutions, sanitation management aspects due to rural and refuse wastes.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Recognize the basic terminology of Environmental sanitation
CO2: Interpret the control approaches of Communicable and non-communicable diseases
CO3: Identify and assess the control approaches for rodent and vectors
CO4: Classify the appropriate sanitation measures for several institutions.
CO5: Categorize the sanitation aspects for rural and refuse management

UNIT-I: ENVIRONMENTAL SANITATION BASICS
Introduction, History and evolution of sanitation practices, Role of Sanitary Engineer, Sanitation management aspects for liquid and solid wastes, Basic Definitions, Transmission of infectious agents, Types of diseases – Communicable, Non-communicable, Water borne diseases, Different modes of communicating diseases, Mortality rates.

UNIT-II: CONTROL OF COMMUNICABLE AND NON-COMMUNICABLE DISEASES
Communicable Diseases: Impacts, Control of Source (Agent Factors), Control of Mode of Transmission or Contributing Factor (Environmental Factors), Control of Susceptibles (Host Factors), Epidemic Control,
Non-Communicable Diseases:
Respiratory Diseases: Types, Impacts, Control approaches,
Water- and Food borne Diseases: Types, Impacts, Characteristics and Control of Water- and Food borne Diseases

UNIT-III: INSECT VECTOR AND RODENT CONTROL
Mosquitoes as carriers of diseases – Mosquito control – Drainage, subsurface drainage – Man made mosquito breeding centres –outdoor control of mosquitoes – Housefly as disease carrier Fly control – Rodent control, Control Diseases transmitted from Animals.

UNIT-IV: INSTITUTIONAL SANITATION
Sanitation measures in Hotels/restaurants, Public bathing ghats, Schools, Hospitals, Swimming pools, Prisons.

UNIT-V: RURAL AND REFUSE SANITATION
Rural sanitation: Aqua privy, Septic tank, Soak pit and sulabh mode of sanitation, Appropriate low cost rural sanitation techniques, Biogas generation from toilet.
Refuse Sanitation: Municipal garbage – sources, generation, collection, recovery and disposal options, Sanitation problems with regard to: Dumping and sanitary landfilling, mass firing of waste and incineration, Mosquito breeding, Leachate, Management issues.
Ecological Sanitation: Principle, Eco-sanitation as a sustainable approach
Occupational health hazards: Concept, Types, Safety aspects of sanitation workers
TEXT BOOKS

REFERENCES
B.Tech. (VIII Sem.) 17CE39 - TRAFFIC ENGINEERING AND TRANSPORT PLANNING

L T P Cr.
3 - - 3

Pre-requisites: Highway Engineering

Course Educational Objective: The course aims to teach the fundamental parameters of traffic flow. The coverage of this course aims to give knowledge about various traffic control devices, road safety, and importance of highway capacity and transport system planning. It deals with effect of traffic on environment and presents a basic idea about tunneling.

COURSE OUTCOMES At the end of the course, the student will be able to:
CO1: Identify different parameters of traffic flow.
CO2: Interpret the different technical aspects of traffic control and design signals.
CO3: Describe the various techniques adopted in highway safety and capacity.
CO4: Categorize the transport system planning.
CO5: Review the impact of traffic on environment and exposed to fundamentals of tunnelling.

UNIT-I: FUNDAMENTAL PARAMETERS OF TRAFFIC FLOW
Traffic stream characteristics: Introduction to traffic engineering: Road user characteristics, human and vehicle characteristics
Fundamental parameters of traffic flow: Speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation, relation between speeds, flow, density, fundamental diagrams;

UNIT-II: TRAFFIC CONTROLS
Traffic signs- Importance of traffic signs, types of traffic signs
Road markings and regulation - functions, types of road markings, basic principles of regulation, regulation of speed, vehicles and parking
Traffic signals- advantages and disadvantages of traffic signals, Number and location of signals faces, warrants for signals, Signal Design by Webster Method – Signal Phasing and Timing Diagrams, delays at signalised intersection.

UNIT-III: HIGHWAY SAFETY AND CAPACITY
Collection of accident data, statistical methods for analysis of accident data, Causes –Engineering Measures to reduce Accidents- Enforcement Measures –Educational Measures- Road Safety Audit-Principles of Road Safety Audit-Importance of Highway capacity and level of service of rural highways and urban roads -Types of intersections and channelization

UNIT -IV: TRANSPORT SYSTEM PLANNING
Introduction to Transport Systems Planning, Definition and examples of System, Objectives of transport planning, components of Transport systems planning, Classification of Transit Systems

UNIT-V: ENVIRONMENT AND TUNNELLING
Highway and The Environment- Detrimental effect of traffic on environment – Air Pollution – Pollutants due to Traffic – Measures to reduce Air Pollution due to Traffic- Noise Pollution – Measures to reduce Noise Pollution.
Tunnelling-Necessity of tunnels, advantages and disadvantages of tunnelling, tunnelling shapes and sizes, tunnelling methods tunnel lining, drainage and ventilation.
TEXT BOOKS:

REFERENCES:
3. R.S. Hamilton (Editor), R.M. Harrison (Editor) 'Highway Pollution' (Studies in Environmental Science 44), Elsevier science publishing company inc.
Prerequisites: Environmental studies, Water and Wastewater Engineering

Course Objectives: This course deals with the designing of water distribution systems, hydraulic design of sewers and sewer appurtenances, sewage disposal and self purification streams, advanced water and wastewater treatment techniques.

COURSE OUTCOMES: At the end of the course, the student will be able to:
CO1: Design the water distribution systems.
CO2: Design sewerage systems and differentiate the several sewer appurtenances and plumbing system used in sewerage system.
CO3: Evaluate and analyze the natural purification and disposal options of sewage.
CO4: Apply the basic principles of advanced water treatment techniques for real life problems.
CO5: Apply the basic principles of advanced waste water treatment techniques for real life problems.

UNIT-I: WATER DISTRIBUTION SYSTEM
Distribution of water: Objectives - Methods of distribution, Layouts of distribution networks, Distribution reservoirs, Storage capacity of reservoir, Design and calculation of hydraulic parameters of pipe flow, Nomogram, Analysis of pipe networks –Pipes in series, Pipes in parallel, Equivalent Pipe method, Hardy Cross method (one loop simple flows) - Appurtenances in distribution system – Pipe laying and testing

UNIT-II: SEWER DESIGN & SEWER APPERTUNANCES
Sewer appurtenances: Types, Precautions while entering sewers, Ventilation of sewers, Plumbing system, Traps and Pipes, Types of traps, Systems of plumbing -Single stack system - One pipe system -Two pipe system - Sanitary fittings, Sewer materials.

UNIT-III: DISPOSAL OF SEWAGE AND SELF PURIFICATION OF STREAMS
Self purification of natural streams: Zones of pollution in a river, Oxygen deficit, Deoxygenation and reoxygenation, Oxygen Deficit curve, Streeter - Phelps equation, Problems

UNIT-IV: ADVANCED WATER TREATMENT
Desalination: Reverse osmosis process, Electro dialysis, Solar Evaporation

UNIT-V: ADVANCED WASTEWATER TREATMENT
Advanced wastewater treatment: Modifications in ASP - Ponds and lagoons- Oxidation ponds, aerated lagoon, stabilization ponds, oxidation ditches, Rotating biological contactors, UASB, Nitrification-Denitrification, Ammonia stripping, Phosphorous removal, Activated carbon applications..

TEXT BOOKS

REFERENCES
6. Manual on sewerage and sewage treatment, CPHEEO, Ministry of urban affairs and employment, Govt. of India, New Delhi, 2001
7. Water and Wastewater Engineering, NPTEL video lectures and web notes
Pre-requisites: Building materials

Course Educational Objectives: The course provides need of prefabrication and the design principles for abnormal loading conditions. This course also provides the knowledge on joints in structural members and behavior of various structural members.

COURSE OUTCOMES: At the end of the course, the student will be able to:
CO1: Comprehend the need of pre fabrication
CO2: Distinguish the structural connections and behavior of components
CO3: Identify the appropriate design principles
CO4: Characterize the joints in structural members
CO5: Design the members for abnormal loads

UNIT-I: INTRODUCTION
Need for prefabrication, Principles, Materials, Modular coordination, Standardization, Systems, Production, Transportation, Erection.

UNIT-II: PREFabricated COMPONENTS
Behaviour of structural components, Large panel constructions, Construction of roof and floor slabs, Wall panels, Columns, Shear walls

UNIT-III: DESIGN PRINCIPLES
Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.

UNIT-IV: JOINT IN STRUCTURAL MEMBERS
Joints for different structural connections – Dimensions and detailing – Design of expansion Joints

UNIT-V: DESIGN FOR ABNORMAL LOADS
Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

TEXT BOOKS
1. CBRI, “Building Materials and Components”, India, 1990
2. Lecture notes developed by department faculty members.

REFERENCES
Pre-requisites: Structural Analysis I &II, Reinforced Concrete Design

Course Educational Objective: The objective is to equip the students with a thorough understanding of the behavior and design of bridges. Various applied loads, such as truck load, impact, horizontal braking/centrifugal forces, wind and seismic loads are discussed thoroughly. Background to design equations for different types of bridges and relevant modern research will also be discussed to provide the students with solid understanding of the topics covered.

Course Outcomes: At the end of the course, the student will be able to:
CO1 : Identify the various components of Bridges and their site selection
CO2: Design RC slab culverts
CO3: Design T Beam bridges
CO4: Design the pier and abutments
CO5: Design the foundations for bridges

UNIT-I: INVESTIGATION FOR BRIDGES
Components of a Bridge; Classification; Standard Specifications; Need for Investigation; Selection of Bridge Site; Preliminary Data to be Collected; Preliminary Drawings; Determination of Design Discharge; Economical Span; Location of Piers and Abutments; Vertical clearance above HFL; Scour depth; Traffic Projection; Choice of Bridge type; Importance of Proper Investigation.

UNIT-II: CONCRETE BRIDGES AND CULVERTS

UNIT-III: T – BEAM BRIDGE
Pigeaud’s method for computation of slab moments; Courbon’s method for computation of moments in girders; Design of simply supported T – beam bridge.

UNIT-IV: SUB STRUCTURE FOR BRIDGES
Pier and abutment caps; Materials for piers and abutments; Design of pier; Design of abutment; Backfill behind abutment; Approach slab.

UNIT-V: INSPECTION AND MAINTENANCE OF BRIDGES:
Procedure and methods for inspection, Testing of bridges, Maintenance of Sub structures and super structures, Maintenance of bearings, Maintenance schedules

TEXT BOOKS

REFERENCES
3. Bridge Engineering, NPTEL video lectures and web notes.

Course Educational Objectives: This course provides the knowledge on the principles involved in the design of the counter fort retaining wall, bunkers, silos and chimneys. The course also gives the complete information regarding the design of gantry girder and steel water tanks.

COURSE OUTCOMES: At the end of the course, the student will be able to:
CO1: Design the counter-fort retaining wall.
CO2: Design the bunkers, silos and Chimneys.
CO3: Design the overhead RCC water tanks.
CO4: Design the gantry girder.
CO5: Design the steel water tanks.

UNIT–I: RETAINING WALLS
Types of retaining walls, Forces on retaining walls; Stability requirements; Design and detailing of counter fort retaining wall.

UNIT–II: BUNKERS, SILOS AND CHIMNEYS
Introduction, concepts of loading and design.

UNIT–III: RCC TANKS
Introduction – RCC water tanks –surface and underground, Design and detailing of overhead circular and Intze RCC tanks including staging.

UNIT–IV: GANTRY GIRDERS
Introduction, various loads, specifications, design of gantry girder.

UNIT–V: STEEL WATER TANKS
Design of steel water tanks.

TEXT BOOKS

REFERENCES

IS CODES:
IS 456-2000 plain and reinforced concrete
IS 800-2007, IS 3370, IS 4995-1974 and Any other relevant IS Codes
IS 456, IS 3370, IS 800 and SP-16 Interaction charts are permitted in the Exam
Pre-requisites: Engineering Mechanics, Structural Analysis, Matrix Methods of Analysis.

Course Educational Objective: The aim of this course is to introduce basic principles of numerical methods and it is further extended to cover the application of finite element method by the inclusion of 1-D bar elements, truss elements, beam elements, and 2-D elements like CST, ring elements. The objective of the course is determination of structural deformations, strains, element stress and heat transfer problems.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Idealize given structure with mathematical modelling and boundary conditions.
CO2: Apply the one-dimensional approach of Finite element modelling
CO3: Analyze the trusses using Finite element approach
CO4: Apply the two-dimensional approach of Finite element modelling
CO5: Solve multi-nodal problems

UNIT – I: FUNDAMENTAL CONCEPTS
Introduction - Stresses and equilibrium - Boundary conditions - Strain displacement relations - Stress strain relations - Potential energy and equilibrium – Weighted Integral and Weak Formulations – Variation Approach – Rayleigh Ritz Method

UNIT – II: ONE - DIMENSIONAL PROBLEMS

UNIT – III: TRUSSES
Introduction – Plane trusses – Local and Global coordinate systems – Element Stiffness Matrix – Stress Calculations – Introduction to three dimensional trusses

UNIT – IV: TWO DIMENSIONAL PROBLEMS

UNIT – V: TWO DIMENSIONAL ISOPARAMETRIC ELEMENTS AND NUMERICAL INTEGRATION

TEXT BOOKS
REFERENCES

6. Finite Element Analysis, NPTEL video lectures.
Pre-requisites: Hydrology, Irrigation and Water Resources Engineering

Course Educational Objective: The course is designed to understand the concept of watershed management, watershed characteristics and concepts of watershed modelling.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Determine watershed parameters and analyse watershed characteristics to take appropriate management action.
CO2: Quantify soil erosion and design control measures
CO3: Suggest suitable harvesting techniques for better watershed management
CO4: Apply land grading techniques for proper land management
CO5: Apply appropriate models for watershed management.

UNIT-I: WATER SHED CHARACTERISTICS
Introduction: Concept of watershed development, objectives of watershed development, need for watershed development, Integrated and multidisciplinary approach for watershed management.
Characteristics of Watersheds: Size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

UNIT-II: PRINCIPLES OF EROSION
Types and causes of erosion, factors affecting erosion, estimation of soil loss due to erosion-Universal soil loss equation. Measures to Control Erosion: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, check dams, rock-fill dams, brushwood dam, Gabion.

UNIT-III: WATER HARVESTING
Techniques of rain water harvesting- rain water harvesting from roof top, surface flow harvesting, subsurface flow harvesting, stop dams, farm ponds and dugout ponds, percolation tanks.

UNIT-IV: LAND MANAGEMENT
Land use and Land capability classification, management of forest, agricultural, grassland and wild land, land grading operation, Reclamation of saline and alkaline soils.

UNIT-V: WATERSHED MODELLING
Data of watershed for modelling, application and comparison of watershed models, model calibration and validation, advances of watershed models.

TEXT BOOKS:

REFERENCES:
3. Watershed Management, NPTEL video lectures and web notes.
Pre-requisites: Building materials

Course Educational Objective: This course aims to learn bye-laws, NBC regulations and basic principles of planning using the concepts of Vastu-Shastra. It also covers the materials required for construction and concept of efficient intelligent buildings and low cost housing aspects.

Course Outcomes: At the end of the course, the student will be able to:
CO1: Identify the building bye laws and NBC regulations.
CO2: Analyze the basic principles of architectural planning in construction practice using basic rules of Vastu Shastra.
CO3: Select suitable materials required for construction of buildings
CO4: Compare the modern concepts of green buildings, smart buildings, pre-fabricated construction.
CO5: Justify the importance of low cost and energy efficient housing.

UNIT-I: BUILDING BYE LAWS AND NBC REGULATIONS
Introduction: Types of buildings, criteria for location and site selection, site plan and its detail, Components of building.
Building Bye Laws and NBC Regulations: Objective of bye-laws, Regulation regarding; means of access, lines of building frontages, covered area, floor area ratio, open spaces around buildings, height & sizes of rooms, plinth regulation and sanitation provisions

UNIT-II: PRINCIPLES OF PLANNING&CONCEPT OF VAASTUSHAASTRA
Different factors affecting planning viz-aspect, prospect, furniture requirement, roominess, grouping, circulation, elegance, privacy, Principles of Anthropometry- Planning for residential buildings and non residential buildings.
Vaastu: Concept- Fundamentals-Basic rules of Vaastusastra-Relevance of Vaastu today

UNIT-III: BUILDING MATERIALS&MAINTENANCE ASPECTS
Characteristic properties and selection of different building materials such as bricks, stones, tiles, wood, cement, concrete, steel, asbestos sheets, types of masonry –Role in building technology, Alternate materials for building construction- Deterioration of buildings-Preventive maintenance in buildings-planning, Handling of cracks, dampness, corrosion

UNIT-IV: NEW APPROACHES IN BUILDING TECHNOLOGY

UNIT-V: LOW COST HOUSING
Low cost housing-Concept-Rural housing-Housing in disaster prone areas-Low cost infra structural options-Social housing-Prefabricated housing-Energy efficient construction – case studies.
TEXT BOOKS:

REFERENCES / SITES: