TKR COLLEGE OF ENGINEERING AND TECHNOLOGY
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B.TECH – CIVIL ENGINEERING
Course Structure R-20

SEMESTER III

S.No.	Class	Course Code	Name of the Subject	L	T	P	C
1	BS	CBSM9	Numerical Methods	3	0	0	3
2	PC	C13PC1	Building Materials, Construction & Planning	3	0	0	3
3	PC	C13PC2	Surveying & Geomatics	3	0	0	3
4	PC	C13PC3	Strength of Materials - I	3	0	0	3
5	PC	C13PC4	Fluid Mechanics	3	0	0	3
6	ES	CESCA1	Computer Aided Drawing Lab	0	0	2	1
7	PC	C13PC5	Surveying Lab - I	0	0	3	1.5
8	PC	C13PC6	Strength of Materials Lab	0	0	4	2
9	MC	MC003	Cultural Activity	0	0	0	Satisfactory
Total Credits				**15**	**0**	**9**	**19.5**

Mandatory Course: Cultural Activity
The student should participate in culture activity (Music/Dance/Singing/etc.) conducted by the College, student should produce the participation certificate for clearing this course.

SEMESTER IV

S.No.	Class	Course Code	Name of the Subject	L	T	P	C
1	BS	CBSM3	Probability & Statistics	3	0	0	3
2	PC	C14PC1	Engineering Geology	3	0	0	3
3	PC	C14PC2	Strength of Materials - II	3	0	0	3
4	PC	C14PC3	Hydraulics & Hydraulic Machinery	3	0	0	3
5	PC	C14PC4	Structural Analysis - I	3	0	0	3
6	PC	C14PC5	Concrete Technology	3	0	0	3
7	PC	C14PC6	Surveying Lab - II	0	0	3	1.5
8	PC	C14PC7	Engineering Geology Lab	0	0	3	1.5
9	PC	C14PC8	Highway Engineering & Concrete Technology Lab	0	0	3	1.5
10	MC	MC004	Video with Social Messages	0	0	0	Satisfactory
Total Credits				**18**	**0**	**9**	**22.5**

Mandatory Course: Video with Social Messages
Student should make video with social messages. This has to be uploaded in the youtube.com, by maintaining the terms and conditions of youtube.com. Student should produce youtube.com link with screen shot for clearing this mandatory course.

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CIVIL ENGINEERING

B.Tech III Semester **L/T/P/C**
3 /0/ 0/ 3

NUMERICAL METHODS (CBSM9)

Course Objectives:

To learn:

1. It aims to equip the students to deal with advanced level of mathematics and application that would be essential for their disciplines.
2. The topics of those deals with methods to find roots of an equation.
3. The topics of integration that deals using numerical techniques.
4. The topic deals with the solution of PDE using numerical methods.

Course Outcomes:

After learning the contents of this paper the student must be able to

1. Evaluate the root of an equation using numerical methods.
2. Learn the methods and solve the problems of interpolation.
3. Solve the problems using numerical differentiation.
4. Evaluating integral values using numerical techniques.
5. Solve the numerical solution of ODE.
6. Solve the numerical solution of PDE.

UNIT I
Solution of Algebraic and Transcendental Equations

Bisection method- Newton-Raphson method - Iteration method and Regula - falsi method.

UNIT II
Interpolation

Finite differences- interpolation using Newton's forward and backward difference formulae. Central difference interpolation-Gauss'forward and backward formulae. Interpolation with unequal intervals Newton's divided difference and Lagrange's formulae.

UNIT III
Numerical Differentiation & Integration

Numerical Differentiation–Numerical Integration-Trapezoidal rule and Simpson's1/3 and 3/8 rules.

NUMERICAL METHODS (CBSM9)

UNIT IV
Numerical Solutions of Ordinary Differential Equations

Solution by Taylor's series-Picard's Method of successive approximations - Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations.

UNIT V
Numerical Solutions of Partial Differential Equations

Introduction-Finite difference approximations to derivatives-Finite difference methods-Laplace equation-Parabolic equations-Crank-Nicholson method-Solution of heat equation (One dimensional).

Text Books:

1. S.S. Sastry introductory methods of numerical analysis- PHI- 4th Edition 2005.
2. B.S. Grewal- Higher Engineering Mathematics- Khanna Publishers - 36th Edition-2010.

Reference Books:

1. N.P.Bali and Manish Goyal- A text book of engineering Mathematics-Laxmi Publications-Reprint - 2008.
2. Erwinkreyszig- Advanced Engineering Mathematics- 9th Edition- John Wiley & Sons-2006.

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CIVIL ENGINEERING

B.Tech III Semester **L/T/P/C**
3/0/0/3

BUILDING MATERIALS, CONSTRUCTION & PLANNING (C13PC1)

Course Objectives:

To give the students a basic idea about the construction Materials, building components and to introduce various construction materials and equipment.

Course Outcomes:

At the end of the course student will be able to

1. Identify various building materials required for good quality construction & better planning.
2. Have the knowledge of construction methodology, materials and its planning.
3. Know about the functional design of various elements such as arches, lintels, floors, stairs, doors & windows.
4. Have the complete knowledge of form work and plastering.
5. Get the innovative methods of construction by using the latest technology.

UNIT I
Stones, Bricks, Tiles and Sand

Building stones–classifications and quarrying–properties–structural requirements – dressing – Sand and M-Sand.
Bricks – Composition of Brick Earth – Manufacture and Structural requirements, Fly ash, Ceramics. Timber, Aluminium, Glass, Paints and Plastics: Wood – structure–types and properties–seasoning – defects; alternate materials for Timber – GI / fibre – reinforced glass bricks, steel & Aluminium, Plastics.

UNIT II
Cement & Admixtures

Ingredients of cement–manufacture–Chemical composition–Hydration - field & lab tests. Admixtures – mineral & chemical admixtures – uses.

UNIT III
Building Components

Lintels, Arches, walls, vaults–stair cases–types of floors, types ofroofs – flat, curved, trussed; foundations – types; Damp Proof Course; Joinery – doors – windows – materials – types.
Building Services: Plumbing Services: Water Distribution, Sanitary–Lines & Fittings;Ventilations: Functional requirements systems of ventilations. Air-conditioning - Essentials and Types; Acoustics – characteristic – absorption – Acoustic design; Fire protection – Fire Hazards – Classification of fire resistant materials and constructions.

BUILDING MATERIALS, CONSTRUCTION & PLANNING (C13PC1)

UNIT IV
Concrete, Mortars, Masonry and Finishing's Concrete

Plain, reinforced and steel fibre reinforced, light-weight Concrete, High performance Concrete, Polymer Concrete.

Mortars: Lime and Cement Mortars.

Brick masonry – types – bonds; Stone masonry – types; Composite masonry – Brick-Stone Composite; Concrete, Reinforced brick.

Finishers: Plastering, Pointing, Painting, Claddings–Types–Tiles–ACP.

Form work: Types of Form works.

UNIT V
Building Planning

Principles of Building Planning, Classification of buildings and Building by laws.

Text Books:

1. Building Materials and Construction – Arora & Bindra, Dhanpat Roy Publications.
2. Building Construction by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) Ltd., New Delhi.
3. Building Materials by P. C. Varghese, Prentice Hall India Learning Pvt Ltd.
4. Building Construction by PC Varghese Prentice Hall India Learning Pvt Ltd.

Reference Books:

1. Building Materials and Construction by G C Sahu, Joygopal Jena McGraw hill Pvt. Ltd.
2. Building Materials by Duggal, New Age International.
3. Construction Technology – Vol-I & II by R. Chubby, Longman UK.
4. Alternate Building Materials and Technology, Jagadish, Venkatarama Reddy and others, New Age Publications.
5. Engineering Materials by S.C.Rangwala, Charotar Publishing House Pvt. Ltd.
6. Related papers published in International journals.

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CIVIL ENGINEERING

B.Tech III Semester **L/T/P/C**
3/0/0/3

SURVEYING & GEOMATICS (C13PC2)

Course Objectives:

The first step in engineering practice is surveying and the soundness of any civil engineering work is dependent on the reliability and accuracy of surveying. Therefore, it is imperative that a student of engineering should have good knowledge of surveying. To impart the knowledge of surveying and latest technologies in surveying it is necessary to introduce this subject in the curriculum.

Course Outcomes:

At the end of the course student will be able to

1. Calculate angles, distances and levels, Identify data collection methods and prepare field notes.
2. Understanding the working principles of survey instruments, estimate measurement errors and apply corrections.
3. Interpret survey data and Compute Areas and Volumes.
4. Measure horizontal, vertical, and zenith angles with a transit, theodolite and total station instruments.
5. Relate the knowledge on Surveying to the new frontiers of science like Hydrographic surveying, Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.

UNIT I
Introduction and Basic Concepts

Introduction, Objectives, classification and principles of surveying, Scales, Shrinkage of Map, Conventional symbols and Code of Signals, Surveying accessories, phases of surveying. Measurement of Distances and Directions.
Linear distances: Approximate methods, Direct Methods– Chains– Tapes, ranging, Tape corrections, indirect methods– optical methods– E.D.M. method.
Prismatic Compass: Bearings, Included Angles, Local Attraction, Magnetic Declination and dip.

UNIT II
Levelling and Contouring

Levelling: Basics definitions, types of levels and levelling staves, temporary adjustments, methods of levelling, booking and Determination of levels – Height of Instrument Method, Rise and fall method, Effect of Curvature of Earth and Refraction. Contouring: Characteristics and uses of Contours, Direct & Indirect methods of contour surveying, interpolation and sketching of contours. Computation of Areas and Volumes.
Areas: Determination of areas consisting of irregular boundary and regular boundary(coordinates, MDM, DMD methods), Planimeter.
Volumes: Computation of areas for level section and two level sections with and without transverse slopes, determination of volume of earth work in cutting and embankments, volume of borrow pits, capacity of reservoirs.

SURVEYING & GEOMATICS (C13PC2)

UNIT III
Theodolite Surveying

Types of Theodolites, Fundamental Lines, temporary adjustments, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Trigonometrical levelling when base is accessible and inaccessible.
Traversing: Methods of traversing, traverse computations and adjustments, Gale's traverse table, Omitted measurements.

UNIT IV
Tacheometric Surveying

Principles of Tacheometry, stadia and tangential methods of Tacheometry.
Curves: Types of curves and their necessity, elements of simple curve, setting out of simple Curves, Introduction to compound curves.

UNIT V
Modern Surveying Methods

Total Station and Global Positioning System: Basic Principles, Classifications, Applications, Comparison with conventional surveying. Electromagnetic Wave Theory - Electromagnetic Distance Measuring system - Principle of working and EDM instruments, Components of GPS – Space segment, Control segment and User segment, Reference Systems, Satellite Orbits, GPS Observations. Applications of GPS.

Text Books:

1. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) Ltd., New Delhi.
2. Surveying (Vol – 1 & 2), by Duggal S K, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
3. Surveying (Vol –1 & 2), by K.R. Arora, Rajson's Publications.

Reference Books:

1. Plane Surveying by Chandra AM, New Age International Pvt. Ltd., New Delhi.
2. Surveying by Bhavikatti, Vikas Publishing House Ltd.
3. Surveying and Levelling by R. Subramanian, Oxford University Press, New Delhi.
4. Higher Surveying by Chandra AM, New Age International Pvt. Ltd., New Delhi.
5. Global Positioning System - Theory and Practice by Hoffman. B, H. Lichtenegga and J. Collins, Springer-Verlag Publishers.
6. Surveying Vol 1, 2 & 3 by Arora K R, Standard Book House, Delhi.
7. Advanced Surveying, Madhu & Gobi, Pearson India Ltd.

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3/0/0/3

STRENGTH OF MATERIALS - I (C13PC3)

Pre Requisites:

i) Concepts of Engineering Physics and Mathematics.
ii) Elements of Engineering Mechanics.
iii) Analytical and Creative thinking.

Course Objectives:

The subject provides the knowledge on concepts of simple stresses, strains, flexural stresses, shear stresses and deformations in structural members so that the concepts can be applied to the Engineering problems for determining the strength, stiffness and stability of the various members in a structural system.

Course Outcomes:

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

1. Analyze the statically determinate structures.
2. Determine the stresses and strains in the members subjected to axial forces and bending forces.
3. Evaluate shear forces and bending moments.
4. Evaluate the slope and deflection of beams subjected to loads.
5. Determine the principal planes, stresses and strains in structural members.

UNIT I
Simple Stresses and Strains

Concept of stress and strain, St. Venant's principle –Elasticity and plasticity–Types of stresses and strains–Hooke's law – Stress-Strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic Moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Elastic Constants.
Strain Energy: Resilience–Gradual, sudden, impact and shock loadings–simple applications.

UNIT II
Shear Force and Bending Moment

Definition of Beam–Types of beams–Concept ofshear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads, moments and combination of these loads – Point of contra flexure – Relation between SF, BM and Rate of Loading at a section of a beam.

STRENGTH OF MATERIALS - I (C13PC3)

UNIT III
Flexural Stresses

Theory of simple bending–Assumptions–Derivation of bending equation: $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$ - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.
Shear Stresses: Derivation of formula–Shear stress distribution across various beamsections like rectangular, circular, triangular, I, T and Angle sections.

UNIT IV
Deflection of Beams

Bending of a member into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, UDL, Uniformly varying load – Mohr's theorems – Moment area method – application to simple cases including overhanging beams. Conjugate Beam Method: Introduction–Concept of conjugate beam method. Difference between a real beam and a conjugate beam. Deflections of determinate beams with constant and different moments of inertia.

UNIT V
Principal Stresses and Strains

Introduction–Stresses on an inclined section of a bar underaxial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear– Mohr's Circle of stresses – Principal stresses and strains – Analytical and graphical solutions.
Theories of Failure: Introduction–Various theories of failure – Maximum Principal StressTheory, Maximum Principal Strain Theory, Maximum Shear Stress Theory – Maximum Strain Energy Theory and Maximum Shear Strain Energy Theory.

Text Books:

1. Strength of Materials by R. K. Bansal, Lakshmi Publications House Pvt. Ltd.
2. Strength of Materials by R. Subramanian, Oxford University Press.
3. Strength of Materials by S. S. Bhavikatti, S. Chand Publications.
4. Strength of Materials by R. K. Rajput, S. Chand Publications.

Reference Books:

1. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
2. Strength of Materials by R. S. Khurmi, Vikas Publishing House Pvt. Ltd.
3. Strength of Materials by S. S. Rattan, McGraw Hill Education Pvt. Ltd.
4. Strength of Materials and Structures by John Case *et al.*, Butterworth-Heinemann.
5. Strength of Materials by Dr. Sadhu Singh, Khanna Publishers.
6. Strength of Materials by W. A. Nash, MC Graw HillsEducation Pvt. Ltd.
7. Mechanics of Materials by James M. Gere and Barry J Goodno, Cengage Learning India Pvt. Ltd.
8. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd.
9. Strength of Materials by D.S. Bedi, Khanna Publishers.

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3/0/0/3

FLUID MECHANICS (C13PC4)

Pre Requisites: Engineering Mechanics

Course Objectives:

Students who take this class can expect to

1. Develop an appreciation for the properties of Newtonian fluids.
2. Study analytical solutions to variety of simplified problems.
3. Understand the dynamics of fluid flows and the governing non-dimensional parameters.
4. Apply concepts of mass, momentum and energy conservation to flows.
5. Grasp the basic ideas of turbulence.

Course Outcomes:

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

1. Apply conservation laws to derive governing equations of fluid flows.
2. Compute hydrostatic and hydrodynamic forces.
3. Analyze and design simple pipe systems.
4. Apply principles of dimensional analysis to design experiments.
5. Compute drag and lift coefficients.

UNIT I
Introduction

Dimensions and units–Physical properties of fluids specific gravity, viscosity, surface tension, vapour pressure and their influences on fluid motion pressure at a point, Pascal's law, Hydrostatic law – atmospheric, gauge and vacuum pressure– measurement of pressure. Pressure Gauges, Manometers: differential and Micro Manometers. Hydrostatic forces on submerged plane, Horizontal, Vertical, inclined and curved surfaces – Centre of Pressure. Derivations and Problems.

UNIT II
Buoyancy and Floatation

Stability of bodies, meta-centre, liquids in relative equilibrium.
Fluid Kinematics: Description of fluid flow, Stream line, path line and streak lines and stream tube. Classification of flows: Steady, unsteady, uniform, nonuniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity for one, two, three dimensional flows – stream and velocity potential functions, circulation and Vorticity.

FLUID MECHANICS (C13PC4)

UNIT III
Fluid Dynamics and Measurement of Flow

Surface and body forces– Euler's and Bernoulli's equations for flow along a stream line for 3-D flow, (Navier – Stokes equations (Explanationary) Momentum equation and its application – forces on pipe bend. Pitot tube, Venturi meter, and orifice meter – classification of orifices, flow over rectangular, triangular and trapezoidal and stepped notches – Broad Crested weirs.

UNIT IV
Closed Conduit Flow

Reynold's experiment –Characteristics of Laminar & Turbulentflows. Laws of Fluid friction – Darcy's equation, variation of friction factor with Reynold's number, Minor losses – pipes in series – pipes in parallel – Total energy line and hydraulic gradient line, water hammer, Laminar flow, Hagen-Poiseiulle equation.

UNIT V
Boundary Layer Theory

Basic Concepts of Boundary Layer Characteristics of boundary layer along a thin flat plate, laminar and turbulent Boundary layers (no derivations), separation of BL, control of BL, Drag and Lift- Magnus effect.

Text Books:

1. Hydraulic and Fluid Mechanics including Hydraulic Machines by Modi & Seth, Standard Book House, New Delhi.
2. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi publications.

Reference Books:

1. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
2. Mechanics of Fluids by Potter, M.C D.C Wiggers, B.H Ramdan, Cengage.
3. Fluid Mechanics by J F Douglas, J M Gasiorek, J A Swaffield and L B Jack, Pearson Publications.
4. Fluid Mechanics and Fluid Machines by S.K.Som, Gautam Biswas and S.Chakraborty, McGraw Hill Education (India) Pvt. Ltd, New Delhi.
5. Engineering Fluid Mechanics by K L Kumar, S. Chand, Eurasia Publishing House, New Delhi.
6. Fluid Mechanics by F.M. White McGraw Hill Education (India) Pvt. Ltd, New Delhi.

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CIVIL ENGINEERING

B.Tech III Semester **L/T/P/C**
0/0/ 2/ 1

COMPUTER AIDED DRAWING LAB (CESCA1)

Course Objectives:

To make students to understand the detailing of all kinds of structures such as reinforced concrete, plain concrete, steel structures.

Course Outcomes:

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

1. Draw the 2D building drawing.
2. Draw reinforcement detailing of various structural elements.
3. Draw various steel structural members:
   a) Drawing of front view and top view of simple solids like prism, pyramid, cylinder, and conealong with its annotation.
   b) Drawing of plans of buildings using software
      a) Single storey buildings b) Multi storeyed buildings
   c) Drawing the sectional views of prism, pyramid, cylinder, and cone.
   d) Developing sections and elevations for
      a) Single storey buildings b) Multi storeyed buildings
   e) Drawing Orthographic projections of simple objects.
   f) Drawing Isometric view of simple objects by orthographic views.
   g) Detailing of building components like Doors, Windows, Roof Trusses etc. using CAD software.
   h) Different plans of one and Two storeyed buildings
   i) Building with load bearing walls(flat and pitched roof) including details of doors and windows.
   j) RCC framed Structures.
   k) Industrial buildings, North light roof structures – Trussess.

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CIVIL ENGINEERING

B.Tech III Semester **L/T/P/C**
0/0/3/1.5

SURVEYING LAB - I (C13PC5)

Pre Requisites: Surveying Theory

Course Objectives:

To impart the practical knowledge in the field, it is essential to introduce in curriculum. Drawing of Plans and Maps and determining the area are pre requisites before taking up any Civil Engineering works.

Course Outcomes:

At the end of the course, the student will be able to:
Draw plans & maps to determine the areas before taking up any Civil Engineering works.

LIST OF EXPERIMENTS:

1. Surveying of an area by chain survey (closed traverse) & plotting.
2. Chaining across obstacles
3. Determine of distance between two inaccessible points with compass
4. Survey of a given area by prismatic compass (closed traverse) and plotting after adjustment.
5. Radiation method, intersection methods by plane table survey.
6. Two point and three point problems in plane table survey.
7. Levelling – Longitudinal and cross-section and plotting.
8. Trigonometric levelling using theodolite by Base Accessible.
9. Trigonometric levelling using theodolite by Base Inaccessible.
10. Height and distances using principles of tacheometric surveying.
11. Measurement of Horizontal angle & vertical angle.
12. Distance between inaccessible points by theodolite.

Text Books:

1. Elements of Plane Surveying by Arthur R Benton and Philip J Taety, McGraw Hill.
2. Plane Surveying by Chandra A. M, New Age International Pvt. Ltd., New Delhi.
3. Surveying by Bhavikatti, Vikas Publishing House Ltd.
4. Surveying and Levelling by R. Subramanian, Oxford University Press, New Delhi.
5. Global Positioning System Theory and Practice by B.Hoffman, H. Lichtenegga & J. Collins, Springer-Verlag Publications
6. Surveying (Volume 1,2 & 3) by Arora K R,Standard Book House,New Delhi.
7. Advanced Surveying by Madhu & Gobi, Pearson India.

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CIVIL ENGINEERING

B.Tech III Semester **L/T/P/C**
0/ 0/4/ 2

STRENGTH OF MATERIALS LAB (C13PC6)

Course Objectives:

The objective of the course is to make the student understand the procedure for conducting various preliminary tests on materials to observe and measure their behaviour under different types of loading for different types of structures.

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

1. Conduct tension test on Materials like steel etc.
2. Conduct compression tests on spring, wood and concrete.
3. Conduct flexural and torsion tests to determine elastic constants.
4. Determine hardness and impact strength of metals.

List of Experiments:

1. Tension Test
2. Bending Test on (Steel / Wood) Cantilever beam.
3. Bending Test on simple support beam.
4. Torsion Test
5. Hardness Test
6. Spring Test
7. Compression Test on wood or concrete
8. Charpy Impact Test
9. Izod Impact Test
10. Shear Test
11. Verification of Maxwell's Reciprocal theorem on beams.
12. Continuous beam – deflection Test

Equipment Required:

1. UTM for conducting tension test on rods
2. Steel beam for flexure test
3. Wooden beam for flexure test
4. Torsion testing machine
5. Brinnell's / Rock well's hardness testing machine
6. Spring testing machine
7. Compression testing machine
8. Izod Impact machine
9. Shear testing machine
10. Beam setup for Maxwell's theorem verification.
11. Continuous beam setup

Text Book:

1. Material Testing Laboratory Manual by C B. Kukreja, K. Kishore, Ravi Chawala, Standard Publishers Distributors.

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CIVIL ENGINEERING

B.Tech IV Semester **L/T/P/C**
3 /0/0/ 3

PROBABILITY & STATISTICS (CBSM3)

Course Objectives:
To learn:

1. Random variables that describe randomness or an uncertainty in certain realistic situation.
2. The study of discrete and continuous distribution predominantly describes important probability distribution.
3. Sampling distribution of mean, variance, point estimation and interval estimation.
4. The testing of Hypothesis of Large samples.
5. The testing of Hypothesis of small samples.
6. The basic ideas of statistics including correlation and regression.

Course Outcomes:

After learning the contents of this the student must be able to learn the concept of
CO1: Random variables and various discrete and continuous probability distribution and their properties.
CO2: Calculate interval estimations of Mean and Proportion of large samples.
CO3: Make important decisions s for few samples which are taken from a large data.
CO4: Calculate Mean and Proportion and to make important decisions from large samples which are taken from normal populations.
CO5: Test the hypothesis and give the inference to the given data.
CO6: The statistical methods of studying data sample.

UNIT I
Random Variables & Distributions

Random variables –discrete and continuous, mass function, density function of probability distributions, Binomial, Poisson and Normal distributions - related properties.

UNIT II
Sampling Distributions

Sampling distributions of means (σknown and unknown), Estimation theory, point estimations, Interval estimations, maximum error.

UNIT III
Large Samples

Null hypothesis, alternative hypothesis, Type-1, Type-2 errors, critical region, confidence interval for mean, testing of single mean and two means, confidence interval for the proportions ,Test of hypothesis for the single proportions and difference between the proportions.

PROBABILITY & STATISTICS (CBSM3)

UNIT IV
Small Samples

Small samples Test for single mean, difference of two means, test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.

UNITV
Basic Statistics

Correlation and regression, Rank correlation, Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas, power and exponential curves.

Text Books:

1. Probability & Statistics for Engineers by G.S.S. Bhisma Rao, SciTech Publications.
2. Probability & Statistics for Engineers by D.K. Murugesan & P.Guru Swamy, Anuradha Publications.

Reference Books:

1. W.Feller- An introduction to probability theory and its applications- Vol.1- 3rd edition Wiley-1968.
2. 2.Probability & Statistics for Engineers, Millers and John E.Freund, Prentice Hall of India.

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CIVIL ENGINEERING

B.Tech IV Semester **L/T/P/C**
3/ 0/ 0/3

ENGINEERING GEOLOGY (C14PC1)

Course Objectives:

The objectives was course is to give the basics knowledge of Geology that is required for constructing various Civil Engineering Structures, basic Geology, Geological Hazardous and Environmental Geology which gives a complete picture on the Geological aspects that are to be considered for the planning and construction of major Civil Engineering projects.

Course Outcomes:

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

1. Understand weathering process and mass movements.
2. Distinguish geological formations.
3. Identify geological structures and processes for rock mass quality.
4. Identify subsurface information and groundwater potential sites through geophysical investigations.
5. Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels.

UNIT I
Introduction

Importance of Geology from Civil Engineering point of view. Brief study of case histories of failure of some civil engineering constructions due to geological draw backs. Importance of Physical geology, petrology and structural geology. Weathering of Rocks: Its effect over the properties of rocks importance of weathering with reference to dams, reservoirs and tunnels weathering of common rock like “Granite”.

UNIT II
Mineralogy

Definition of mineral, Importance of study of minerals, different methods of study of minerals. Advantages of study of minerals by physical properties. Role of study of physical properties of minerals in the identification of minerals. Study of physical properties of following common rock forming minerals: Feldsper, Quartz, Flint, Jasper, Olivine, Augite, Hornblende, Muscovite, Biotite, Asbestos, Chlorite, Kyanite, Garnet, Talc, Calcite. Study of other common economics minerals such as Pyrite, Hematite, Magnetite, Chlorite, Galena, Pyrolusite, Graphite, Magnesite and Bauxite.

UNIT III
Petrology

Definition of rock: Geological classification of rocks into igneous, Sedimentary and metamorphic rocks. Dykes and sills, common structures and textures of igneous. Sedimentary and Metamorphic rocks. Their distinguishing features, Megascopic and microscopic and microscopic study of Granite, Dolerite, Basalt, Pegmatite, Laterite, Conglomerate, Sand Stone, Shale, Limestone, Gneiss, Schist, Quartzite, Marble and Slate.

ENGINEERING GEOLOGY (C14PC1)

UNIT IV
Structural Geology

Out Crop, Strike and dip study of common geological structures associating with the rocks such as folds, faults unconformities, and joints – their important types and case studies. Their importance In-situ and drift soils, common types of soils, their origin and occurrence in India, Stabilization of soils, Ground water, Water table, common types of ground water, springs, cone of depression, geological controls of ground water movement, ground water exploration.

Geological Hazards:

Earth Quakes: Causes and effects, shield areas and seismic belts. Seismic waves, Richter scale, precautions to be taken for building construction in seismic areas. Landslides,their causes and effect; measures to be taken to prevent their occurrence. Importance of study of ground water, earth quakes and landslides. Importance of Geophysical Studies: Principles of geophysical study by Electrical resistivity methods.

UNIT V
Geology of Dams, Reservoirs, and Tunnels

Types of dams and bearing of Geology of site in their selection, Geological Considerations in the selection of a dam site. Analysis of dam failures of the past. Factors contributing to the success of a reservoir. Geological factors influencing water lightness and life of reservoirs – Purposes of tunnelling, Effects of Tunnelling on the ground Role of Geological Considerations in tunnelling over break and lining in tunnels.

Text Books:

1. Engineering Geology by N. ChennaKesavulu, Trinity Press.
2. Engineering Methods by D. Venkat Reddy, Vikas Publishers.
3. Engineering Geology by S K Duggal, H K Pandey, McGraw Hill Education Pvt. Ltd.
4. Principles of Engineering Geology by K.V.G.K. Gokhale, B.S Publications.

Reference Books:

1. F.G. Bell, Fundamental of Engineering B.S. Publications.
2. Krynine & Judd, Principles of Engineering Geology & Geotechnics, CBS Publishers & Distribution.
3. Engineering Geology by Subinoy Gangopadhyay, Oxford the University Press.
4. Engineering Geology for Civil Engineers by P.C. Varghese, PHI.

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STRENGTH OF MATERIALS - II (C14PC2)

Pre Requisites:

i) Strength of Materials – I
ii) Concepts of Engineering Physics and Mathematics.
iii) Elements of Engineering Mechanics.
iv) Analytical and Creative thinking.

Course Objectives:

Study of the subject provides the understanding on concepts of Torsion in circular shafts & springs, columns, combined direct & bending stresses, basic analysis of cylinders and unsymmetrical bending so that the concepts can be applied to the Engineering problems for determining the strength, stiffness and stability of the various members in a structural system.

Course Outcomes:

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

1. Determine stresses in the members subjected to Torsion.
2. Analyze columns and struts.
3. Understand the concept of direct and bending stresses.
4. Analyze and design shafts, springs, thin and thick cylinders.
5. Understand the concept of unsymmetrical bending.

UNIT I
Torsion of Circular Shafts

Theory of pure torsion – Assumptions made in the theory of pure torsion–Derivation of Torsion equation: $\frac{T}{J} = \frac{q}{r} = \frac{N\theta}{L}$– Torsional moment of resistance – Polar section modulus – Torsional Rigidity & Torsional Stiffness – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure. **Springs:** Introduction–Types of springs–deflection of close and open coiled helical springsunder axial pull and axial couple – Springs in series and parallel – Carriage or leaf springs.

UNIT II
Columns and Struts

Introduction–Types of columns–Short, medium and long columns–Axially loaded compression members – Crushing load – Euler's theorem for long columns –assumptions – derivation of Euler's critical load formulae for various end conditions – Equivalent length of a column – slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine-Gordon formula – Long columns subjected to eccentric loading – Secant formula – Empirical formulae – Straight line formula – Prof. Perry's formula.
Beam Columns: Laterally loaded struts–subjected to uniformly distributed andconcentrated loads – Maximum B.M. and stress due to transverse and lateral loading.

STRENGTH OF MATERIALS - II (C14PC2)

UNIT III
Direct and Bending Stresses

Stresses under the combined action of direct loading and bending moment, Kernel of a section – determination of stresses in the case of Dams, Retaining walls and Chimneys – conditions for stability – stresses due to direct loading and bending moment about both axis. **Beams Curved In Plan**: Introduction– Circular beams loaded uniformly and supported on symmetrically placed columns – Semi-circular beam simply supported on three equally spaced supports.

UNIT IV
Thin Cylinders

Thin seamless cylindrical shells–Derivation of formula for longitudinaland circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter and volume of thin cylinders – Thin spherical shells.
Thick Cylinders: Introduction –Lame's theory for thick cylinders –Derivation of Lame's formulae – distribution of hoop and radial stresses across thickness – design of thick cylinders – compound cylinders – Shrink fit allowance – Thick spherical shells.

UNIT V
Unsymmetrical Bending

Introduction–Centroidal principal axes of section–Graphicalmethod for locating principal axes – Moments of inertia referred to any set of rectangular axes – Stresses in beams subjected to unsymmetrical bending – Principal axes – Resolution of bending moment into two rectangular axes through the centroid – Location of neutral axis – Deflection of beams under unsymmetrical bending.
Shear Centre: Introduction – Shear centre for symmetrical and unsymmetrical (Channel, I, Tand L) sections.

Text Books:

1. Mechanics of Materials by Dr. B C Punmia, A. K. Jain, Dr. Arun Kumar Jain, Laxmi Publication (P) Ltd.
2. Strength of Materials by B.S. Basavarajaiah& B.S. Mahadevappa, Universities Press.
3. Theory of Structures (SMTS-II) by B.C. Punmia, Ashok K. Jain, Dr. Arun K. Jain, Laxmi Publications.
4. Strength of Materials by R.K Rajput, S. Chand & Company Ltd.

Reference Books:

1. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd.
2. Introduction to Strength of Materials by U. C. Jindal, Galgotia Publications.
3. Mechanics of Materials by R. C. Hibbeler, Pearson Education.
4. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.
5. Strength of Materials by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd.
6. Advanced Mechanics of Solids and Structures by N. Krishna Raju, D.R. GuruRaja, Narosa Publishing House.

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CIVIL ENGINEERING

B.Tech IV Semester **L/T/P/C**
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HYDRAULICS AND HYDRAULIC MACHINERY (C14PC3)

Pre Requisites: Fluid Mechanics

Course Objectives:

To understand basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation & mixing.

Course Outcomes:

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

1. Understand the concepts o channel flows.
2. Compute flow profiles in channel transitions and analyze hydraulic transients.
3. Under the concepts of Hydrodynamic force of jets.
4. Design the working proportions of hydraulic machines.

UNIT I
Open Channel Flow

Types of flows – Type of channels–Velocity distribution–Energyand momentum correction factors – Chezy's, Manning's and Bazin formulae for uniform flow – Most Economical sections.
Critical flow: Specific energy–critical depth – computation of critical depth – critical sub-critical and super critical flows. Non uniform flow– Dynamic equation for G.V.F, Mild, Critical, Steep, horizontal and adverse slopes-surface profiles–direct step method – for surface profiles –Rapidly varied flow, hydraulic jump, energy dissipation.

UNIT II
Hydraulic Similitude

Dimensional analysis-Rayleigh's method and Buckingham's pi theorem –study of Hydraulic models – Geometric, kinematic and dynamic similarities-dimensionless numbers – model and prototype relations. Distorted and non-distorted models. Scale Effect.

UNIT III
Hydrodynamic Force of Jets

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.

HYDRAULICS AND HYDRAULIC MACHINERY (C14PC3)

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. Governing of turbines – surge tanks –unit and specific turbines–unit speed, unit quantity, unit power, specific speed– performance characteristic curve.

UNIT V
Centrifugal Pump

Installation details-classification-types work done- Manometric head-minimum starting speed-losses and efficiencies-specific speed multistage pumps-pumps in parallel- performance of pumps-characteristic curves- NPSH-cavitation.

Reciprocating pumps: Basics, types, air vessels, slip.

Definition of terms – load factor, utilization factor, capacity factor.

Text Books:

1. Hydraulic and Fluid Mechanics including Hydraulic Machines by Modi & Seth, Standard Book House, New Delhi.
2. Fluid Mechanics and Hydraulic Machines by R.K Bansal, Laxmi Publications.
3. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.

Reference Books:

1. Flow in Open channel flow by Ranga Raju, McGraw Hill Education (India) Pvt. Ltd.
2. Flow through Open Channels by Rajesh Srivastava, Oxford University Press.
3. Open Channel flow by K. Subramanya, Tata McGraw Hill Education (India) Pvt. Ltd.
4. Fluid Mechanics & Machinery by CSP Ojha, P.N. Chandramouli and R. Berndtsson Oxford University Press.

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STRUCTURAL ANALYSIS - I (C14PC4)

Pre Requisites: Strength of Materials–I

Course Objectives:

To make the students to understand the principles of analysis of structures subjected to static and moving loads by various methods.

Course Outcomes:

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

1. Analyze Perfect, Imperfect And Redundant Frames.
2. Formulate Equilibrium and compatibility equations for structural members.
3. Analyze one dimensional and two dimensional problems using classical methods.
4. Analyze indeterminate structures.
5. Analyze structures for gravity loads, moving loads and lateral loads.

UNIT I
Introduction to Structures and Indeterminacy

Equilibrium and compatibility equations -types of supports and reactions, types of joints and equilibrium equations, Static and kinematic indeterminacies of beams and frames. Effect of force releases like moment hinge, shear releases, link on static indeterminacy, Relative Merits of indeterminate structures over determinate structures.
Propped Cantilever and Fixed Beams: Types of props : Elastic and Rigid props, Determination of – Analysis of Propped cantilever and fixed beams, including the beams with different moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads – Shear force and Bending moment diagrams for Propped Cantilever and Fixed Beams–Deflection of Propped cantilever and fixed beams; effect of sinking of support, effect of rotation of a support.

UNIT II
Frames

Classification– plane and space frames, pin jointed and rigid jointed frames. Analysis of Perfect Frames: Types of frames– Perfect, Imperfect and Redundant pin jointed frames, assumptions, transfer of load to joints from wind and other forces – Analysis of determinate pin jointed frames using method of joints and method of sections for vertical loads, horizontal loads and inclined loads, Tension coefficient method for pin jointed plane frames.

STRUCTURAL ANALYSIS - I (C14PC4)

UNIT III
Energy Theorems

Introduction–Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces – Castigliano's first theorem–UnitLoad Method. Deflections of simple beams and pin-jointed plane trusses.

Three Hinged Arches: Introduction–Types of Arches–Comparison between three hinged and two hinged Arches. Linear Arch. Eddy's theorem. Analysis of three hingedarches. Normal Thrust and radial shear in an arch. Geometrical properties of parabolic and circular arch. Three hinged circular arch at different levels. Absolute maximum bending moment diagram for a three hinged arch.

UNIT IV
Slope Deflection Method

Derivation of slope-deflection equation, application to continuousbeams with and without settlement of supports. Shear force and bending moment diagrams and Elastic curve.

Moment Distribution Method: Application to continuous beams with and without settlement of supports. Shear force and bending moment diagrams and Elastic curve.

UNIT V
Moving Loads and Influence Lines

Introduction –applications to bridges (only description), 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 – Point loads, UDL longer than the span, UDL shorter than the span– maximum SF and BM at a given section and absolute maximum and B.M due to single concentrated load UDL longer than the span, UDL shorter than the span, two point loads with fixed distance between them and several point loads- Equivalent uniformly distributed load–Focal length. Influence lines for forces in members of deck and through type trusses like Pratt and Warren trusses. Equivalent uniformly distributed load. Focal length. Muller Breslau's principle for determinate and indeterminate beams (qualitative).

Text Books:

1. Basic Structural Analysis by K.U. Muthu et.al, I.K International.
2. Structural Analysis Vol–I & II by V. N. Vazirani and M. M. Ratwani, Khanna Publishers.
3. Structural Analysis Vol–I & II by G. S. Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Ltd.
4. Mechanics of Structures Vol–I and II by H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.

Reference Books:

1. Structural Analysis by R. C. Hibbeler, Pearson Education.
2. Structural Analysis by Devdas Menon, Narosa Publishing House.
3. Basic Structural Analysis by C. S. Reddy., Tata McGraw Hill Education Pvt. Ltd.
4. Fundamentals of Structural Analysis by M. L. Gambhir, PHI Learning Pvt. Ltd.
5. Structural Analysis -I by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd.
6. Theory of Structures by S.Ramamrutham, R.Narayan, Dhanpat Rai Publishing Company.

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CONCRETE TECHNOLOGY (C14PC5)

Course Objectives:

1. Any Civil Engineering student shall have the basic knowledge about the preparation of Concrete and the Technology involved in it as Concrete happens to be the widely used building material.
2. The subject is designed to give the basic knowledge as well as latest developments in concrete technology.

Course Outcomes:

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

1. Identify Quality Control tests on concrete making materials.
2. Understand the behavior of fresh and hardened concrete.
3. Design concrete mixes as per IS and ACI codes.
4. Understand the durability requirements of concrete.
5. Understand the need for special concretes.

UNIT I
Cement

Portland cement – chemical composition – Hydration, Setting of cement – Structure of hydrate cement – Test on physical properties – Different grades of cement. Admixtures: Types of admixtures – mineral and chemical admixtures.

UNIT II
Aggregates

Classification of aggregate – Particle shape & texture – strength & other mechanical properties of aggregate – Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate – Bulking of sand – Deleterious substance in aggregate –Soundness of aggregate – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Gap graded aggregate – Maximum aggregate size.

UNITIII
Fresh Concrete

Workability – Factors affecting workability – Measurement of workability by different tests – Setting times of concrete – Effect of time and temperature on workability – Segregation & bleeding – Mixing and vibration of concrete – Steps in manufacture of concrete – Quality of mixing water.

CONCRETE TECHNOLOGY (C14PC5)

UNIT IV
Hardened Concrete

Water/Cement ratio – Abram's Law – Gel-space ratio – Nature of strength of concrete – Maturity concept – Strength in tension & compression – Factors affecting strength – Relation between compressive & tensile strength – Curing. Testing Of Hardened Concrete: Compression tests – Tension tests – Flexure tests – Splitting tests – Pull-out test, Non-Destructive testing methods – Codal provisions for NDT. Elasticity, Creep & Shrinkage – Modulus of Elasticity – Dynamic modulus of elasticity – Poisson's ratio – Creep of concrete – Factors influencing creep – Relation between creep & time – Nature of creep – Effects of creep – Shrinkage – types of shrinkage.

UNIT V
Mix Design

Factors in the choice of mix proportions – Durability of concrete – Quality Control of concrete – Statistical methods – Acceptance criteria – Proportioning of concrete mixes by BIS method and ACI mix design. Special Concretes: Introduction to light weight concrete – Cellular concrete – No-fines concrete – High density concrete – Fibre reinforced concrete – Polymer concrete – High performance concrete – Self compacting concrete.

Text Books:

1. Concrete Technology by M. S. Shetty, S. Chand & Co.
2. Concrete Technology by M.L. Gambhir, Tata McGraw Hill Publishers.
3. Concrete Technology by AR. Shanta Kumar, Oxford University Press.

Reference Books:

1. Concrete: Micro Structure, Properties and Materials, P.K. Mehta and J.M. Monteiro, McGraw Hill Publishers.
2. Concrete Technology by Job Thomas, Cengage learning India Pvt. Ltd.
3. Properties of Concrete by A. M. Neville, Pearson.
4. IS:10262-2009 –Concrete Mix Proportioning Guide Lines.
5. IS:456-2000– Plain and Reinforced Concrete Code of Practice.

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SURVEYING LAB - II (C14PC6)

Pre Requisite: Surveying Theory

Course Objective:

To impart the practical knowledge in the field to set out any Civil Engineering work.

Course Outcomes:

Perform surveying on any civil engineering works:

1. Determine of area using total station
2. Traversing using total station
3. Contouring using total station
4. Determination of remote height using total station
5. Stake out using total station
6. Determination of Distance, gradient using total station
7. Differential height between two inaccessible points using total station
8. Curve setting using total station
9. Resection using total station
10. Setting out works for buildings
11. Setting out works for pipe lines
12. Finding position of stations using G.P.S

Reference Book:

1. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) Ltd., New Delhi.

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ENGINEERING GEOLOGY LAB (C14PC7)

Pre Requisites: Engineering Geology.

Course Objectives:

The object of this lab is that to provide practical knowledge aboutphysical properties of minerals, rocks, drawing of geological maps, showing faults, uniformities etc.

Course Outcomes:

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

1. Identify the various rocks, minerals depending on geological classifications
2. Study of physical properties and identification of minerals referred under theory.
3. Megascopic study of rocks.
4. Microscopic study of rocks.
5. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
6. Geological Investigation by using electrical resistivity meter.

List of Experiments:

1. Identification of Minerals.
2. Identification of Igneous rocks.
3. Identification of Sedimentary rocks.
4. Identification of Metamorphic rocks.
5. Interpretation of Geological maps along with geological section.
6. Simple strike and Dip problems.
7. Microscopic Identification of rocks.
8. Measurement of Ground water exploration by Electrical Resistivity meter.
9. Measurement of Bed rock investigation.
10. Measurement of Mineral exploration.
11. Measurement of Study of Geological structural features.
12. Measurement of Sand in gravel deposit locations.

Reference Book:

1. Engineering Geology Lab Record / Manual by Dr. N. Chenna Kesavulu, Trinity Press.

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HIGHWAY ENGINEERING AND CONCRETE TECHNOLOGY LAB (C14PC8)

Course Objectives:
The objectives of the course are

1. To gain the practical knowledge on properties of Aggregate, Cement.
2. To know the properties of bitumen.

Course Outcomes:
The students will be able to
1. Assess the quality of various pavement materials and their suitability in highway construction,
2. Understand properties of Concrete material,
3. Behavior of Concrete & Properties of fresh & hardened Concrete.

I. Tests on Cement
1. Normal Consistency and fineness of Cement.
2. Initial setting time and final setting time of Cement.
3. Specific Gravity of Cement
4. Soundness of Cement.
5. Compressive Strength of Cement.

II. Tests on Aggregate
1. Aggregate Crushing Value
2. Bulking of Sand
3. Aggregate Impact value
4. Attrition test
5. Abrasion test
6. Shape test

III. Bituminous Material Test
1. Penetration test
2. Ductility test
3. Softening point test
4. Flash and fire point test

Text Books:
1. Concrete Manual by M.L. Gambhir, Dhanpat Rai & Sons.

Reference Books:
1. Concrete Technology by M.S. Shetty, S. Chand & Co.
2. MS-2 Manual (2015) 7th Edition, Asphalt Institute.
3. Highway Engineering by S. K. Khanna, C. E. G. Justo, Veera Ragavan, Khanna Publishers.
4. Highway Materials and Pavement testing by SK.Khanna, SEGJusto and Veera Ragavan, Nem Chand Bros.
5. IS: 2386 Part 1, 2, 6– Methods of test for Aggregate for Concrete.
6. IS: 10262-2009 –Concrete Mix Proportioning Guide Lines.
7. IS: 4031–Physical Test on Cements.