Course Title: Analysis of Determinate Structures

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CV42	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

1. Apply knowledge of mathematics and engineering in calculating slope and deflections
2. Identify, formulate and solve engineering problems
3. Analyse structural systems and interpret data
4. Engage in lifelong learning with the advances in Structural Engineering

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Introduction and Analysis of Plane Trusses Structural forms, Conditions of equilibrium, Compatibility conditions, Degree of freedom, Linear and non linear analysis, Static and kinematic indeterminacies of structural systems, Types of trusses, Assumptions in analysis, Analysis of determinate trusses by method of joints and method of sections.	**10 Hours**	**L2,L4,L5**
Module -2		
Deflection of Beams Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment-curvature equation. Double integration method and Macaulay's method: Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple. Moment area method: Derivation, Mohr's theorems, Sign conventions, Application of moment area method for determinate prismatic beams, Beams of varying section, Use of moment diagram by parts. Conjugate beam method: Real beam and conjugate beam, conjugate beam theorems, Application of conjugate beam method of determinate beams of variable cross sections.	**10 Hours**	**L2,L4,L5**
Module -3		
Energy Principles and Energy Theorems Principle of virtual displacements, Principle of virtual forces, Strain energy and complimentary energy, Strain energy due to axial force, bending, shear and torsion, Deflection of determinate beams and trusses using total strain energy, Deflection at the point of application of single load, Castigliano's theorems and its application to estimate the deflections of trusses, bent frames, Special applications-Dummy unit load method.	**10 Hours**	**L2,L4,L5**

Module -4		
Arches and Cable Structures Three hinged parabolic arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. Analysis of cables under point loads and UDL. Length of cables for supports at same and at different levels- Stiffening trusses for suspension cables.	**10 Hours**	**L2, L4, L5**
Module -5		
Influence Lines and Moving Loads Concepts of influence lines-ILD for reactions, SF and BM for determinate beams-ILD for axial forces in determinate trusses-Reactions, BM and SF in determinate beams using rolling loads concepts.	**10 Hours**	**L2, L4, L6**

Course outcomes: After studying this course, students will be able to:

1. Evaluate the forces in determinate trusses by method of joints and sections.
2. Evaluate the deflection of cantilever, simply supported and overhanging beams by different methods
3. Understand the energy principles and energy theorems and its applications to determine the deflections of trusses and bent frames.
4. Determine the stress resultants in arches and cables.
5. Understand the concept of influence lines and construct the ILD diagram for the moving loads.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*
- *Interpretation of Data.*

Question paper pattern:

- The question paper will have ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Reddy C S, Basic Structural Analysis, Tata McGraw Hill, New Delhi.
2. Muthu K U. etal, Basic Structural Analysis, 2nd edition, IK International Pvt. Ltd., New Delhi,2015.
3. Bhavikatti, Structual Analysis, Vikas Publishing House Pvt. Ltd, New Delhi, 2002.

Reference Books:

1. Hibbeler R C, Structural Analysis, Prentice Hall, 9th edition, 2014
2. Devadoss Menon, Structural Analysis, Narosa Publishing House, New Delhi, 2008.
3. Prakash Rao D S, Structural Analysis, University Press Pvt. Ltd, 2007.

Course Title: Applied Hydraulics

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CV43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course Objectives: The objectives of this course is to make students to learn:

1. Principles of dimensional analysis to design hydraulic models and Design of various models.
2. Design the open channels of various cross sections including design of economical sections.
3. Energy concepts of fluid in open channel, Energy dissipation, Water surface profiles at different conditions.
4. The working principles of the hydraulic machines for the given data and analyzing the performance of Turbines for various design data.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1: Dimensional and Model analysis	**10**	
Dimensional analysis Dimensional analysis and similitude: Dimensional homogeneity, Non Dimensional parameter, Rayleigh methods and Buckingham π theorem, dimensional analysis, choice of variables, examples on various applications.	**03**	**L1, L2, L3**
Model analysis: Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification, Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynold's, and Froude's Model.	**04**	**L1, L2, L3**
Buoyancy and Flotation Buoyancy, Force and Centre of Buoyancy, Metacentre and Metacentric height, Stability of submerged and floating bodies, Determination of Metacentric height, Experimental and theoretical method, Numerical problems	**03**	**L1, L2, L3,L4**
Module 2: Open Channel Flow Hydraulics	**10**	
Uniform Flow Introduction, Classification of flow through channels, Chezy's and Manning's equation for flow through open channel, Most economical channel sections, Uniform flow through Open channels, Numerical Problems.	**06**	**L3,L4**
Specific Energy and Specific energy curve, Critical flow and corresponding critical parameters, Metering flumes, Numerical Problems	**04**	**L2, L3**
Module 3: Non-Uniform Flow	**10**	
Hydraulic Jump, Expressions for conjugate depths and Energy loss, Numerical Problems	**03**	**L2,L3,L4**
Gradually varied flow, Equation, Back water curve and afflux, Description of water curves or profiles, Mild, steep, critical,	**04** **03**	**L2,L3**

horizontal and adverse slope profiles, Numerical problems, Control sections		
Module 4: Hydraulic Machines	**10**	
Introduction, Impulse-Momentum equation. Direct impact of a jet on a stationary and moving curved vanes, Introduction to concept of velocity triangles, impact of jet on a series of curved vanes- Problems	**05**	**L2,L3**
Turbines – Impulse Turbines		
Introduction to turbines, General lay out of a hydro-electric plant, Heads and Efficiencies, classification of turbines. Pelton wheel-components, working principle and velocity triangles. Maximum power, efficiency, working proportions – Numerical problems	**05**	**L1, L2, L3,L4**
Module 5: Reaction Turbines and Pumps	**10**	
Radial flow reaction turbines: (i) Francis turbine- Descriptions, working proportions and design, Numerical problems. (ii) Kaplan turbine- Descriptions, working proportions and design, Numerical problems. Draft tube theory and unit quantities. (No problems) Centrifugal pumps: Components and Working of centrifugal pumps, Types of centrifugal pumps, Work done by the impeller, Heads and Efficiencies, Minimum starting speed of centrifugal pump, Numerical problems, Multi-stage pumps.	**06** **04**	**L1,L2, L3,L4**

COURSE OUTCOMES:

After a successful completion of the course, the student will be able to:

1. Apply dimensional analysis to develop mathematical modeling and compute the parametric values in prototype by analyzing the corresponding model parameters
2. Design the open channels of various cross sections including economical channel sections
3. Apply Energy concepts to flow in open channel sections, Calculate Energy dissipation, Compute water surface profiles at different conditions
4. Design turbines for the given data, and to know their operation characteristics under different operating conditions

Program Objectives

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Analyse and development of Solutions

Question Paper Pattern:

- Total number of Questions to be set is 10. Two full questions are to be set from each module.
- Not more than 3 sub questions are to be set under any main question
- Questions are to be set such that the entire module is covered and further, should be answerable for the set marks.
- Each question should be set for 16 marks
- Students should answer 5 full questions selecting at least 1 from each module.

Text Books:

1. P N Modi and S M Seth, "Hydraulics and Fluid Mechanics, including Hydraulic Machines", 20th edition, 2015, Standard Book House, New Delhi
2. R.K. Bansal, "A Text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi
3. S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill,New Delhi

Reference Books:

1. K Subramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Co. Ltd.
2. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press
3. C.S.P. Ojha, R. Berndtsson, and P.N. Chandramouli, *"Fluid Mechanics and Machinery"*, Oxford University Publication – 2010
4. J.B. Evett, and C. Liu, *"Fluid Mechanics and Hydraulics*", McGraw-Hill Book Company.- 2009.

Course Title: Concrete Technology

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CV44	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

1. Recognize the importance of material characteristics and their contributions to strength development in Concrete
2. Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete.
3. Ascertain and measure engineering properties of concrete in fresh and hardened state which meet the requirement of real time structures.

Contents	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module-1: Concrete Ingredients		
Cement – Cement manufacturing process, steps to reduce carbon footprint, chemical composition and their importance, hydration of cement, types of cement. Testing of cement. Fine aggregate: Functions, requirement, Alternatives to River sand, M-sand introduction and manufacturing. Coarse aggregate: Importance of size, shape and texture. Grading and blending of aggregate. Testing on aggregate, requirement. Recycled aggregates Water – qualities of water. Chemical admixtures – plasticizers, accelerators, retarders and air entraining agents. Mineral admixtures – Pozzolanic and cementitious materials, Fly ash, GGBS, silica fumes, Metakaolin and rice husk ash.	10 Hours	L1, L2, L3
Module -2: Fresh Concrete		
Workability-factors affecting workability. Measurement of workability–slump, Compaction factor and Vee-Bee Consistometer tests, flow tests. Segregation and bleeding. Process of manufacturing of concrete- Batching, Mixing, Transporting, Placing and Compaction. Curing – Methods of curing – Water curing, membrane curing, steam curing, accelerated curing, self-curing. Good and Bad practices of making and using fresh concrete and Effect of heat of hydration during mass concreting at project sites.	10 Hours	L1, L2, L3
Module -3: Hardened Concrete		
Factors influencing strength, W/C ratio, gel/space ratio, Maturity concept, Testing of hardened concrete, Creep –factors affecting creep. Shrinkage of concrete – plastic shrinking and drying shrinkage, Factors affecting shrinkage. Definition and significance of durability. Internal and external factors influencing durability, Mechanisms- Sulphate attack – chloride attack, carbonation, freezing and thawing. Corrosion, Durability requirements as per	10 Hours	L1, L2, L3

IS-456, Insitu testing of concrete- Penetration and pull out test, rebound hammer test, ultrasonic pulse velocity, core extraction – Principal, applications and limitations.		
Module -4: Concrete Mix Proportioning		
Concept of Mix Design with and without admixtures, variables in proportioning and Exposure conditions, Selection criteria of ingredients used for mix design, Procedure of mix proportioning. Numerical Examples of Mix Proportioning using IS-10262	10 Hours	L1, L2, L3, L4
Module -5: Special Concretes		
RMC- manufacture and requirement as per QCI-RMCPCS, properties, advantages and disadvantages. Self-Compacting concrete- concept, materials, tests, properties, application and typical mix Fiber reinforced concrete - Fibers types, properties, application of FRC. Light weight concrete-material properties and types. Typical light weight concrete mix and applications	10 hours	L1, L2, L3, L4

Course Outcomes:

After studying this course, students will be able to:

CO1: Relate material characteristics and their influence on microstructure of concrete. (L2,L3)(PO1)

CO 2: Distinguish concrete behaviour based on its fresh and hardened properties. [L2, L4] (PO1, PO2)

CO 3: Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes. [L3] (PO1, PO2, PO3)

Program Objectives (as per NBA):

- Engineering Knowledge (PO1)
- Problem Analysis (PO2)
- Design / development of solutions (PO3)

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Neville A.M. “Properties of Concrete”-4th Ed., Longman.
2. M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi.
3. Kumar Mehta. P and Paulo J.M. Monteiro “Concrete-Microstructure, Property and Materials”, 4th Edition, McGraw Hill Education, 2014
4. A.R. Santha Kumar, “Concrete Technology”, Oxford University Press, New Delhi (New Edition)

Reference Books:

1. M L Gambir, “Concrete Technology”, McGraw Hill Education, 2014.
2. N. V. Nayak, A. K. Jain Handbook on Advanced Concrete Technology, ISBN: 978-81-8487-186-9
3. Job Thomas, “Concrete Technology”, CENGAGE Learning, 2015
4. IS 4926 (2003): Code of Practice Ready-Mixed Concrete [CED 2: Cement and Concrete]

5. Criteria for RMC Production Control, Basic Level Certification for Production Control of Ready Mixed Concrete-BMTPC
6. Specification and Guidelines for Self-Compacting Concrete, EFNARC, Association House

Course Title: Basic Geotechnical Engineering
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV

Subject Code	15CV45	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students

- To appreciate basic concepts of soil mechanics as an integral part in the knowledge of civil engineering. Also to become familiar broadly with geotechnical engineering problems such as, foundation engineering, flow of water through soil medium and terminologies associated with geotechnical engineering.
- To know the basic engineering properties and the mechanical behaviour of different types of soil. This includes strength-deformation characteristics under shearing stresses. Also consolidation properties of clayey soils.
- To determine the improvement in mechanical behaviour by densification of soil deposits using compaction.
- To know how the properties of soils that can be measured in the lab

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1: Introduction: Introduction, origin and formation of soil, Phase Diagram, phase relationships, definitions and their inter relationships. Determination of Index properties-Specific gravity, water content, in-situ density and particle size analysis (sieve and sedimentation analysis) Atterberg's Limits, consistency indices, relative density, activity of clay, Plasticity chart, unified and BIS soil classification.	**10 Hours**	**L1, L2**
Module -2 : Soil Structure and Clay Mineralogy		
Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite and their application in Engineering **Compaction of Soils:** Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control - compactive effort & method of compaction, lift thickness and number of passes, Proctor's needle, Compacting equipments and their suitability.	**10 Hours**	**L1, L2**
Module -3: Flow through Soils:		
Darcy's law- assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity,	**10 Hours**	**L1, L2, L3**

superficial velocity and coefficient of percolation, Capillary Phenomena **Seepage Analysis:** Laplace equation, assumptions, limitations and its derivation. Flow nets- characteristics and applications. Flow nets for sheet piles and below the dam section. Unconfined flow, phreatic line (Casagrande's method –with and without toe filter), flow through dams, design of dam filters. **Effective Stress Analysis**: Geostatic stresses, Effective stress concept-total stress, effective stress and Neutral stress and impact of the effective stress in construction of structures, quick sand phenomena		
Module -4: Consolidation of Soil:		
Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory - assumption and limitations. Derivation of Governing differential Equation Pre-consolidation pressure and its determination by Casagrande's method. Over consolidation ratio, normally consolidated, under consolidated and over consolidated soils. Consolidation characteristics of soil (C_c, a_v, m_v and $C_{v.}$ Laboratory one dimensional consolidation test, characteristics of e-log(σ') curve, Determination of consolidation characteristics of soils-compression index and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method). Primary and secondary consolidation.	**10 Hours**	**L1, L2, L3, L4**
Module -5: Shear Strength of Soil:		
Concept of shear strength, Mohr–Coulomb Failure Criterion, Modified Mohr–Coulomb Criterion Concept of pore pressure, Total and effective shear strength parameters, factors affecting shear strength of soils. Thixotrophy and sensitivity, Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Test under different drainage conditions. Total and effective stress paths.	**10 Hours**	**L2, L3**

Course outcomes:

On the completion of this course students are expected to attain the following outcomes;

1. Will acquire an understanding of the procedures to determine index properties of any type of soil, classify the soil based on its index properties
2. Will be able to determine compaction characteristics of soil and apply that knowledge to assess field compaction procedures
3. Will be able to determine permeability property of soils and acquires conceptual knowledge about stresses due to seepage and effective stress; Also acquire ability to estimate seepage losses across hydraulic structure
4. Will be able to estimate shear strength parameters of different types of soils using the data of different shear tests and comprehend Mohr-Coulomb failure theory.
5. Ability to solve practical problems related to estimation of consolidation settlement of soil deposits also time required for the same.

Program Objectives (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics- (2000), New Age International (P) Ltd., Newe Delhi.
2. Punmia B C, Soil Mechanics and Foundation Engineering- (2012) , Laxmi Pulications.
3. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering- (1996), 4th Edition, UBS Publishers and Distributors, New Delhi.
4. Braja, M. Das, Geotechnical Engineering; (2002), Fifth Edition, Thomson Business Information India (P) Ltd., India

Reference Books:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley & Sons, 1969.
2. Donold P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi
3. Shashi K. Gulathi & Manoj Datta, Geotechnical Engineering-. (2009), "Tata Mc Graw Hill.
4. Narasimha Rao A. V. & Venkatrahmaiah C, Numerical Problems, Examples and objective questions in Geotechnical Engineering-. (2000), Universities Press., Hyderabad.
5. Muni Budhu ,Soil Mechanics and Foundation Engg.- (2010), 3rd Edition, John Wiely & Sons

Course Title: **Advanced Surveying** [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV			
Subject Code	15CV46	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to:

1. Apply geometric principles to arrive at solutions to surveying problems.
2. Analyze spatial data using appropriate computational and analytical techniques.
3. Design proper types of curves for deviating type of alignments.
4. Use the concepts of advanced data capturing methods necessary for engineering practice

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1: Curve Surveying		
Curves – Necessity – Types, Simple curves, Elements, Designation of curves, Setting out simple curves by linear methods (numerical problems on offsets from long chord & chord produced method), Setting out curves by Rankines deflection angle method (numerical problems). Compound curves, Elements, Design of compound curves, Setting out of compound curves (numerical problems). Reverse curve between two parallel straights (numerical problems on Equal radius and unequal radius). Transition curves Characteristics , numerical problems on Length of Transition curve, 7.5 Vertical curves –Types – (theory).	**10 Hours**	**L1,L3,L5**
Module -2: Geodetic Surveying and Theory of Errors		
Geodetic Surveying: Principle and Classification of triangulation system, Selection of base line and stations, Orders of triangulation, Triangulation figures, Reduction to Centre, Selection and marking of stations Theory of Errors: Introduction, types of errors, definitions, laws of accidental errors, laws of weights, theory of least squares, rules for giving weights and distribution of errors to the field observations, determination of the most probable values of quantities.	**10 Hours**	**L1,L2, L3**
Module -3: Introduction to Field Astronomy:		
Earth, celestial sphere, earth and celestial coordinate systems, spherical triangle, astronomical triangle, Napier's rule	**10 Hours**	**L4,L5**
Module -4: Aerial Photogrammetry		
Introduction, Uses, Aerial photographs, Definitions, Scale of vertical and tilted photograph (simple problems), Ground Co-ordinates (simple problems), Relief Displacements (Derivation), Ground control, Procedure of aerial survey, overlaps and mosaics,	**10 Hours**	**L2,L3, L5**

Stereoscopes, Derivation Parallax(Derivation) .		
Module -5: Modern Surveying Instruments		
Introduction, Electromagnetic spectrum, Electromagnetic distance measurement, Total station, Lidar scanners for topographical survey. Remote Sensing: Introduction, Principles of energy interaction in atmosphere and earth surface features, Image interpretation techniques, visual interpretation. Digital image processing, Global Positioning system Geographical Information System: Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, spatial information system Geospatial analysis, Integration of Remote sensing and GIS and Applications in Civil Engineering(transportation, town planning).	**10 Hours**	**L2,L3, L5**

Course outcomes:

After a successful completion of the course, the student will be able to:

1. Apply the knowledge of geometric principles to arrive at surveying problems
2. Use modern instruments to obtain geo-spatial data and analyse the same to appropriate engineering problems.
3. Capture geodetic data to process and perform analysis for survey problems with the use of electronic instruments;
4. Design and implement the different types of curves for deviating type of alignments.

Program Objectives (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Interpretation of data.

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. B.C. Punmia, “Surveying Vol.2”, Laxmi Publications pvt. Ltd., New Delhi.
2. Kanetkar T P and S V Kulkarni , Surveying and Levelling Part 2, Pune Vidyarthi Griha Prakashan,
3. K.R. Arora, “Surveying Vol. 1” Standard Book House, New Delhi.
4. Sateesh Gopi, Global Positioning System, Tata McGraw Hill Publishing Co. Ltd. New Delhi

Reference Books:

1. S.K. Duggal, “Surveying Vol.I & II”, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. R Subramanian, Surveying and Leveling, Second edition, Oxford University Press, New Delhi.
3. David Clerk, Plane and Geodetic Surveying Vol1 and Vol2, CBS publishers
4. B Bhatia, Remote Sensing and GIS , Oxford University Press, New Delhi.
5. T.M Lillesand,. R.W Kiefer,. and J.W Chipman, Remote sensing and Image interpretation , 5th edition, John Wiley and Sons India

6. James M Anderson and Adward M Mikhail, Surveying theory and practice, 7th Edition, Tata McGraw Hill Publication.
7. Kang-tsung Chang, Introduction to geographic information systems, McGraw Hill Higher Education

Course Title: Fluid Mechanics and Hydraulic Machines Laboratory (0:1:2)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CVL47	IA Marks	20
Number of Lecture Hours/Week	03 (1hr tutorial + 2hr laboratory)	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to;

1. calibrate flow measuring devices
2. determine the force exerted by jet of water on vanes
3. measure discharge and head losses in pipes
4. understand the fluid flow pattern

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. Verification of Bernoulli's equation	**3 Hours**	**L1, L2**
2. Determination of C_d for Venturimeter and Orifice meter	**3 Hours**	**L1, L2**
3. Determination of hydraulic coefficients of small vertical orifice	**3 Hours**	**L1, L2**
4. Calibration of Rectangular and Triangular notch	**3 Hours**	**L1, L2**
5. Calibration of Ogee and Broad crested weir	**3 Hours**	**L1, L2**
6. Determination of C_d for Venturiflume	**3 Hours**	**L1, L2**
7. Experimental determination of force exerted by a jet on flat and curved plates (Hemispherical Vane).	**3 Hours**	**L1, L2**
8. Experimental determination of operating characteristics of Pelton turbine	**3 Hours**	**L1, L2**
9. Determination of efficiency of Francis turbine	**3 Hours**	**L1, L2**
10. Determination of efficiency of Kaplan turbine	**3 Hours**	**L1, L2**
11. Determination of efficiency of centrifugal pump.	**3 Hours**	**L1, L2**
12. Determination of Major and Minor Losses in Pipes	**3 Hours**	**L1, L2**
13. Demonstration Experiments: a. Reynold's experiment to understand laminar and turbulent flow b. Flow Visualization c. Calibration of Sutro-weir	**6 Hours**	**L1, L2**

Course outcomes:

During the course of study students will develop understanding:

- Properties of fluids and the use of various instruments for fluid flow measurement.
- Working of hydraulic machines under various conditions of working and their characteristics.

Program Objectives (as per NBA):

- Engineering Knowledge.

- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- All experiments are to be included in the examination except demonstration exercises.
- Candidate to perform experiment assigned to him
- Marks are to be allotted as per the split up of marks shown on the cover page of answer script

Text Books:

1. Sarbjit Singh , *Experiments in Fluid Mechanics* - PHI Pvt. Ltd.- New Delhi
2. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press

Reference Books:

1. Hydraulics and Fluid Mechanics' – Dr. P.N. Modi & Dr S.M. Seth, Standard Book House- New Delhi. 2009 Edition

Course Title: Engineering Geology Laboratory (0:1:2)

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV

Subject Code	**15CVL48**	IA Marks	20
Number of Lecture Hours/Week	03 (1hr tutorial + 2hr laboratory)	Exam Marks	80
Total Number of Lecture Hours	42	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students

1. To identify the minerals and rocks based on their inherent properties and uses in civil engineering
2. To interpret the geological maps related to civil engineering projects.
3. To learn the dip and strike, borehole problems, thickness of geological formation related to foundation, tunnels, reservoirs and mining.
4. To understand subsurface geological conditions through a geophysical techniques and watershed management.
5. To visit the civil engineering projects like dams, reservoirs, tunnels, quarry sites etc.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. Identification of minerals as mentioned in theory, their properties, uses and manufacturing of construction materials.	**6 Hours**	L1, L2
2. Identification of rocks as mentioned in theory, their engineering properties and uses in construction and decorative purposes	**6 Hours**	L2, L3
3. Dip and Strike problems: Determination of dip and strike direction in Civil Engineering projects (Railway lines, tunnels, dams, reservoirs) –graphical or any other method.	**6 Hours**	L4
4. Bore hole problems: Determination of subsurface behavior of rocks, their attitude related to foundation, tunnels, reservoirs and mining. Triangular and Square land, assuming ground is horizontal.	**6 Hours**	L3, L4, L5
5. Calculation of Vertical, True thickness and width of the outcrops.	**6 Hours**	L4, L5
6. Interpretation of Electrical resistivity curves to find out subsurface information such as thickness of soil, weathered zone, depth of hard rock and saturated zone	**4 Hours**	L3, L4
7. Interpretation of Toposheets and geological maps related to Civil Engineering projects.	**8 Hours**	L5, L6

Course outcomes:

During this course, students will develop expertise in;

1. Identifying the minerals and rocks and utilize them effectively in civil engineering practices.
2. Understanding and interpreting the geological conditions of the area for the

implementation of civil engineering projects.

3. Interpreting subsurface information such as thickness of soil, weathered zone, depth of hard rock and saturated zone by using geophysical methods.
4. The techniques of drawing the curves of electrical resistivity data and its interpretation for geotechnical and aquifer boundaries

Program Objectives (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- All are individual experiments
- Instructions as printed on the cover page of answer script for split up of marks to be strictly followed.
- All exercises are to be included for practical examination.

Question Paper Pattern		
Qn. No.	**EXPERIMENT**	**MARKS (80)**
1	Identification of Minerals by giving their physical properties and civil engineering applications (5 minerals)	**20 (5 x 4)**
2	Identification of rocks by giving their physical properties, classification and their civil engineering applications (5 rocks)	**20 (5 x 4)**
3	Dip and strike problems	**6**
4	Bore hole problems (3 point method)	**10**
5	Thickness of strata problems including calculation of vertical, true thickness and its width of out crop.	**4**
6	Electrical resistivity curves drawing and its interpretation for Geotechnical and Aquifer investigations.	**6**
7	Interpretation of Toposheets	**5**
8	Geological maps, their cross sections and description	**10**
9	Viva voce	**5**

Note:
1) Question nos. 1,2,4,5.7, 8 & 9 are compulsory.
2) Among question no. 3 &6 any one shall be given.
3) Internal Assessment Marks=20: By conducing at least one test for 10 marks and remaining 10 marks for record.

Reference Books:

1. M P Billings, Structural Geology , CBS Publishers and Distributors, New Delhi
2. B.S.Satyanarayana Swamy , Engineering Geology Laboratory Manual , Dhanpat Rai Sons, New Delhi.
3. L R A Narayan, Remote sensing and its applications, University Press.
4. P.K.MUKERJEE, Text book of Geology , World Press Pvt. Ltd., Kolkatta
5. John I Platt and John Challinor, Simple Geological Structures, Thomas Murthy & Co, London