

Course Title	ANALYSIS OF STRUCTURES	Semester	IV
Course Code	MVJ19CV42	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 10 : 10	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs.

Course objective is to:

- Impart the principles of elastic structural analysis and behaviour of determinate & indeterminate structures.
- Impart knowledge about various methods involved in the analysis of determinate & indeterminate structures.
- Apply the methods for analyzing the structures to evaluate the response of structures
- Enable the student get a feel of how real-life structures behave
- Make the student familiar with latest computational techniques and software used for structural analysis.

Module-1

L3, L4

12 Hrs.

Introduction: *Statically determinate and indeterminate structures, Concept of equilibrium and compatibility (Online mode)*, determination of degree of static and kinematic indeterminacies of structures.

Analysis of Plane Trusses: *Types of trusses, Assumptions in analysis (Online mode)*, analysis of determinate trusses by method of joints and method of sections.

Slope and Deflection of Determinate Beams: Moment area method, Conjugate beam method, Numerical problems.

Laboratory Sessions/ Experimental learning: (Self Study)

- Experiments on truss using Virtual labs
- Analysis of trusses by method of sections.
- Formulation of Excel Sheet program for Method of joint to analyze simple truss

Applications: (Self Study)

- Behaviour of determinate and indeterminate structures.
- Various methods to analyse the beam
- Analysis of truss can be done

Video link / Additional online information: (Self Study)

- <https://nptel.ac.in/courses/112103108/3>
- <https://nptel.ac.in/courses/105105108/33>
- <https://nptel.ac.in/courses/105105166/32>

Module-2

L3, L4

12 Hrs.

Energy Principles and Energy Theorems:

Principle of Virtual work, Strain energy & Resilience (Online mode), Strain energy due to axial force, bending, shear and torsion, Deflection at the point of application of single load, Castigliano's theorems and its application to estimate the deflections of trusses, bent frames, Dummy unit load method.

Laboratory Sessions/ Experimental learning: (Self Study)

- Strain energy charts: for different materials
- Computation of Deflection for determinate beams using Excel Sheet

Applications: (Self Study)

- Knowledge about the energy principles and energy theorems and its applications to determine the deflections of trusses and bent frames.

Video link / Additional online information: (Self Study)

- <https://nptel.ac.in/courses/112103108/3>
- <https://nptel.ac.in/courses/105105108/33>
- <https://nptel.ac.in/courses/105105166/32>

Module-3

L3, L4

12 Hrs.

Statically indeterminate structures: Analysis of propped cantilever and fixed beam by consistent deformation methods, Analysis of continuous beams by Clapeyron's theorem of three moments, Numerical Problems.

Slope Deflection Method: **Assumptions and development of slope-deflection equations (Online mode)**, analysis of statically indeterminate beams and rigid-jointed plane frames with side sway. Numerical problems.

Laboratory Sessions/ Experimental learning: (Self Study)

Using Virtual Lab,

- Single Span Beams Experiment
- Continuous Beams Experiment

- Rigid Joints Experiment

Applications: (Self Study)

- Knowledge about the Analysis of determinate structure

Video link / Additional online information: (Self Study)

- <https://nptel.ac.in/courses/112103108/3>
- <https://nptel.ac.in/courses/105105108/33>
- <https://nptel.ac.in/courses/105105166/32>

Module-4

L3, L4

12 Hrs.

Moment Distribution: Introduction, distribution and carry over factors (Online mode), Method of analysis with and without side sway, Numerical problems.

Kani's Method: Introduction, rotation and displacement contribution factors, Method of analysis with and without side sway. No numerical problems (Online mode).

Matrix Method of Analysis (Flexibility Method) : Introduction, Axes and coordinates (Online mode), Flexibility matrix, Analysis of simple orthogonal rigid frames using system approach with Static Indeterminacy ≤ 3 .

Laboratory Sessions/ Experimental learning: (Self Study)

- Portal frame experiments using Virtual labs.
- Analysis of beams, frames and trusses using MS Excel.
- Construction of matrices using MATLAB, PYTHON etc.

Applications: (Self Study)

- Understanding the various analysis method of indeterminate structures

Video link / Additional online information: (Self Study)

- <https://nptel.ac.in/courses/112103108/3>
- <https://nptel.ac.in/courses/105105108/33>
- <https://nptel.ac.in/courses/105105166/32>

Module-5

L3, L4

12 Hrs.

Matrix Method of Analysis (Stiffness Method): Introduction, Stiffness matrix (Online mode), Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with kinematic indeterminacy ≤ 3

Laboratory Sessions/ Experimental learning: (Self Study)

- Portal frame exercised using Virtual labs.
- Analysis of problems using software's like MATLAB, PYTHON etc.

Applications: (Self Study)

- Knowledge about the analysis of indeterminate structures- beams and truss.

Video link / Additional online information: (Self Study)

- <https://nptel.ac.in/courses/112103108/3>
- <https://nptel.ac.in/courses/105105108/33>
- <https://nptel.ac.in/courses/105105166/32>

Course outcomes: On completion of the course, students would be able to

CO1	Calculate the member forces indeterminate trusses by method of joints.
CO2	Restate the concept of Principle of Virtual Work
CO3	Describe the energy principles and energy theorems and its applications to determine the deflections of trusses and bent frames.
CO4	Determine the moment in indeterminate beams and frames having variable moment of inertia and subsidence using slope deflection method.
CO5	Construct the Stiffness matrix for the analysis of simple rigid frames

Reference Books:

1.	L S Negi and R S Jangid, "Structural Analysis", Tata McGraw-Hill Publishing Company Ltd., 6 th edition, 2004
2.	Muthu K U. et al, Basic Structural Analysis, 2 nd edition, IK International Pvt. Ltd., New Delhi, 2015.
3.	Bhavikatti, Structural Analysis, Vikas Publishing House Pvt. Ltd, New Delhi, 4 th edition, 2002.
4.	Reddy C S, "Basic Structural Analysis", Tata McGraw-Hill Publishing Company Ltd., 3 rd edition, 2010
5.	Hibbeler R C, Structural Analysis, Prentice Hall, 6th edition (2005)
6.	Devadas Menon, Structural Analysis, Narosa Publishing House, New Delhi, 2 nd edition, 2008.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	1	1	-	1
CO2	3	3	-	1	-	-	-	-	1	1	-	1
CO3	3	3	-	1	-	-	-	-	1	1	-	1
CO4	3	3	1	2	1	-	-	-	1	1	-	1
CO5	3	3	1	2	1	-	-	-	1	1	-	1

High-3, Medium-2, Low-1

Course Title	APPLIED HYDRAULICS	Semester	IV
Course Code	MVJ19CV43	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 10 : 10	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to:

- State the Principles of dimensional analysis and design hydraulic models.
- Design of open channels of different cross sections through concept of economical sections.
- Develop Water surface profiles at different bed slope condition using Energy concepts of fluid in open channel.
- Make student to Explain on working principles of the hydraulic machines and analysing the performance of turbines under design condition.
- Gain the knowledge on working principles of Pumps

Module-1

L3

12 Hrs.

Prerequisites: Knowledge on units and dimensions

Dimensional analysis:

Dimensional analysis and similitude: Dimensional homogeneity, Non Dimensional parameter (Online Mode), Rayleigh methods and Buckingham π theorem, dimensional analysis, choice of variables, examples on various applications.

Model analysis:

Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification (Online Mode), Reynolds model, Froude's model, Euler's Model, Weber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynold's, and Froude's Model.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Model making and comparison between different classified models
- Formulation of Excel Sheet program for Reynold's and Frude's Model analysis

Applications: (Self Learning)

- Dynamic Characteristics of the System
- Design of alternative water resource design

Video link / Additional online information: (Self Learning)

- Hydraulics: <https://nptel.ac.in/courses/105103096/>
- Model Analysis: <https://nptel.ac.in/courses/105103021/>

Module-2

L3

12 Hrs.

Buoyancy and Floatation:

Buoyancy, Force and Centre of Buoyancy, Metacentre and Metacentric height, Stability of submerged and floating bodies (Online Mode), Determination of Metacentric height, Experimental and theoretical method, Numerical problems.

Open Channel Flow Hydraulics (Uniform Flow):

Introduction, Classification of flow through channels (Online Mode), Chezy's and Manning's equation for flow through open channel, Most economical channel sections, Uniform flow through Open channels, Numerical Problems.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Determination of Metacentric height to check the stability of partially submerged boat (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 14)
- Formulation of Excel Sheet program for Chezy's and Manning's method

Applications: (Self Learning)

- Stability Analysis of Submarine
- Arrive the optimum weight of Hot-Air Balloon
- Measure Relative density by Hydrometer

Video link / Additional online information: (Self Learning)

- Buoyancy, Metacentre, Stability and Rigid body motion: <https://nptel.ac.in/courses/105103192/>
- Open Channel Flow: <https://nptel.ac.in/courses/105107059/>

Module-3

L3

12 Hrs.

Open Channel Flow Hydraulics (Non-Uniform Flow):

Specific Energy and Specific energy curve, Critical flow and corresponding critical parameters, Metering flumes (Online Mode), Numerical Problems. Hydraulic Jump, Expressions for conjugate depths and Energy loss, Numerical Problems. Gradually varied flow, Equation, Back water curve and afflux, Description of water curves or profiles, Mild, steep, critical, horizontal and adverse slope profiles, Numerical problems.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Gradually Varied Flow profiles for a given slope pattern
- Model Making of Hydraulic Jump under different Froude Number
- Calculation of Critical depth and energy using Excel sheet

Applications: (Self Learning)

- Flow Measuring into a reservoir
- Hydraulic Critical Zones

Video link / Additional online information: (Self Learning)

- Open Channel Flow: <https://nptel.ac.in/courses/105107059/>
- Free Surface flow: <https://nptel.ac.in/courses/105106114/>

Module-4

L3

12 Hrs.

Hydraulic Machines:

Introduction, Impulse-Momentum equation. Direct impact of a jet on stationary and moving curved vanes (Online Mode), Introduction to concept of velocity triangles, impact of jet on a series of curved vanes- Problems.

Turbines – Impulse Turbines:

Introduction to turbines, General lay out of a hydro-electric plant, Heads and Efficiencies, classification of turbines (Online Mode). Pelton wheel-components, working principle and velocity triangles. Maximum power, efficiency, working proportions – Numerical problems.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Determination of impact force on a curved vane by jet of water (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 7)
- Model making of hydro-electric power plant in Indira Sagar Dam
- Formulation of Excel Sheet program for performance analysis of turbine

Applications: (Self Learning)

- Flow through bend pipes
- Jet Propulsion and propellers
- Hydraulic Jump in open channel

Video link / Additional online information: (Self Learning)

- Momentum Equation: <https://nptel.ac.in/courses/112105269/>
- Power Plant Engineering: <https://nptel.ac.in/courses/112107291/>

Module-5		L3	12 Hrs.
<p>Reaction Turbines: Radial flow reaction turbines: Francis turbine- Descriptions, working proportions and design (Online Mode), Numerical problems. Kaplan turbine- Descriptions, working proportions and design, Numerical problems. Draft tube theory and unit quantities. (No problems)</p> <p>Centrifugal pumps: Components and Working of centrifugal pumps, Types of centrifugal pumps (Online Mode), Work done by the impeller, Heads and Efficiencies, Minimum starting speed of centrifugal pump, Numerical problems, Multi-stage pumps.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Development of Operational Curves for Single Stage Centrifugal Pump (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 9) • Development of Operational Curves for Impulse and Reaction Turbines (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 10 & 13) • Formulation of Excel Sheet program for performance analysis of centrifugal pump <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Power Plant to generate electricity • Wastewater Processing Plants • Fire protection Sprinkler System <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • Turbines: https://nptel.ac.in/courses/112104117/ • Pumps: https://nptel.ac.in/courses/112105206/ 			
Course outcomes: On completion of the course, students would be able to			
CO1	Create mathematical model of hydraulics variables using dimensional analysis		
CO2	Analyze the relationship between dependent and independent model parameters		
CO3	Apply the Energy concepts to compute the flow in open channel sections		
CO4	Draw the water surface profiles at different bed slope conditions		
CO5	Design turbines for the given data with their operation characteristics		

Reference 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, 2010
3.	S K SOM and G Biswas, “Introduction to Fluid Mechanics and Fluid Machines”, Tata

	McGraw Hill, New Delhi. 2006
4.	J.B. Evett, and C. Liu, "Fluid Mechanics and Hydraulics", McGraw-Hill Book Company.- 2009.
5.	K Subramanya, "Flow in Open Channels", McGraw Hill Publishing Co. Ltd. 4 th Edition 2015.
6.	Jagdish Lal , "Hydraulic Machines (Including Fluidics)", Metropolitan Book Co Pvt Ltd, 1994

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	-	-	1	-	1	1	-	1
CO2	2	2	1	2	-	1	1	-	-	1	1	1
CO3	2	1	1	1	-	1	-	-	1	1	-	1
CO4	2	1	1	2	-	1	1	-	1	1	-	1
CO5	2	1	1	2	-	1	1	-	-	1	1	1

High-3, Medium-2, Low-1

Course Title	BASIC GEOTECHNICAL ENGINEERING	Semester	IV
Course Code	MVJ19CV44	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 10 : 10	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to:

- Appreciate basic concepts of soil mechanics as an integral part in the knowledge of civil engineering.
- Familiar broadly with geotechnical engineering problems such as, foundation engineering, flow of water through soil medium and terminologies associated with geotechnical engineering.
- 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.
- Determine the improvement in mechanical behaviour by densification of soil deposits using compaction.

Module-1

L3

12 Hrs.

Introduction: Introduction, origin and formation of soil, Phase Diagram, phase relationships, definitions and their inter relationships (Online Mode). 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.

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 (Online Mode). Common clay minerals in soil and their structures Kaolinite, Illite and Montmorillonite and their application in Engineering

Laboratory Sessions/ Experimental learning: (Self Learning)

- Determination of Index properties of soil sample
- Solution to problems on three phase system using EXCEL Sheets.

Applications: (Self Learning)

- Chemical Analysis on Clay minerals

Video link: (Self Learning)

- <https://nptel.ac.in/courses/105101201/>

Module-2

L3

12 Hrs.

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 (Online Mode) - compactive effort & method of compaction, lift thickness and number of passes, Proctor's needle, Compacting equipment's and their suitability.

Flow through Soils: Darcy's law- assumption and validity, coefficient of permeability (Online Mode) and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity, superficial velocity and coefficient of percolation, Capillary Phenomena, Seepage velocity, superficial velocity and coefficient of percolation, Capillary Phenomena.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Standard and Modified Proctor test
- Constant head and falling head permeability test
- Solution to problems on Permeability and compaction of soils using Excel software.

Applications: (Self Learning)

- Model Making of Compacting equipments.
- Field methods of determining permeability test

Video link: (Self Learning)

- <https://nptel.ac.in/courses/105101201>

Module-3

L3

12 Hrs.

Seepage Analysis: Laplace equation, assumptions, limitations and its derivation. Flow nets-characteristics and applications (Online Mode). 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 (Online Mode), quick sand phenomena.

Laboratory Sessions: (Self Learning)

- Case study on Flow net by making a working model

- Drawing Flow net using software's like SEEP2D.

Applications: (Self Learning)

- Earthen dam
- Sheet pile

Video link: (Self Learning)

- <https://nptel.ac.in/courses/105101201/>

Module-4

L3

12 Hrs.

Consolidation of Soil: Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory - assumption and limitations (Online Mode). 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 (Online Mode) and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method). Primary and secondary consolidation.

Laboratory Sessions/ Experimental learning: (Self Learning)

- One dimensional consolidation test
- Determination of Consolidation characteristics of soil using Excel software

Applications: (Self Learning)

- Foundation settlement

Video link: (Self Learning)

- <https://nptel.ac.in/courses/105101201/>

Module-5

L3

12 Hrs.

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 (Online Mode). Thixotropy 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.

Laboratory Sessions: (Self Learning)

- Shear parameters of soil

Video link: (Self Learning)

- <https://nptel.ac.in/courses/105101201/>

Course outcomes: On completion of the course, students would be able to

CO1	Acquire an understanding of the procedures to determine index properties of any type of soil, classify the soil based on its index properties
CO2	Determine compaction characteristics of soil and apply that knowledge to assess field compaction procedures
CO3	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 structures.
CO4	Solve practical problems related to estimation of consolidation settlement of soil deposits also time required for the same.
CO5	Estimate shear strength parameters of different types of soils using the data of different shear tests and comprehend Mohr-Coulomb failure theory.

Reference Books:

1.	Punmia B C, Soil Mechanics and Foundation Engineering- (2012) ,LaxmiPulications.
2.	GopalRanjan and Rao A.S.R., Basic and Applied Soil Mechanics- (2000), New Age International (P) Ltd., Newe Delhi.
3.	Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering- (1996), 4 th Edition, UBS Publishers and Distributors, New Delhi.
4.	Braja, M. Das, Geotechnical Engineering; (2002), Fifth Edition, Thomson Business Information India (P) Ltd., India
5.	NarasimhaRao A. V. &Venkatrahmaiah C, Numerical Problems, Examples and objective questions in Geotechnical Engineering-. (2000), Universities Press., Hyderabad.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	1	1	-	1	1
CO2	2	2	1	2	2	-	-	1	1	1	1	1
CO3	2	2	1	1	2	-	1	1	1	-	1	1
CO4	2	3	1	1	-	-	-	-	-	-	1	1
CO5	3	3	2	1	2	-	-	1	1	1	1	1

High-3, Medium-2, Low-1

Course Title	ADVANCED GEO- INFORMATICS & LABORATORY	Semester	IV
Course Code	MVJ19CV45	CIE	50
Total No. of Contact Hours	60 L : T : P :: 30 : 00 : 30	SEE	50
No. of Contact Hours/week	2+2	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to:

- Develop the Database for Working with Geographic Information System (GIS) and Global Positioning System (GPS)
- Apply concept of SQL in Database management for rectifying the issues
- Gain the knowledge on working principle of Arc GIS using spatial data and conduct spatial analysis
- Apply the concept of Geo-informatics in Natural Disasters Management
- Arrive the solution for Issued related to Water Resource Management

Module-1

L3, L5

20 Hrs.

Prerequisites: Knowledge of Indian and international Geography

Spatial Database, Analysis and Modeling:

Introduction, Definition, purpose, data abstraction, instances, schema, DDL (Data Definition Language), DML (Data Manipulation Language), database manager, database administrator, and basic concepts of entity, relationship and primary key. Basic components of computers, Hardware, Software requirements for GIS Processors, Internet, Operating Systems, Programming languages GIS and Remote Sensing data, Formats & exchange, Data Structures, Data base structure, Data Quality and Errors in GIS, Handling Errors in GIS, Normalization in GIS, Levels of Measurements (Online Mode).

Laboratory Sessions: (Self Learning)

Following Experiments are to be performed under Database Analysis

1. Concept of entity and relationship
2. Creation of Tables
3. Concept of SQL (Structured Query Language)
4. Performing various actions over table
5. Merging of tables by using primary key

6. Maintaining database

Applications: (Self Learning)

- Multimedia Information system
- Computer Aided Design

Video link / Additional online information: (Self Learning)

- Data model: <https://nptel.ac.in/courses/105102015/>
- Spatial Data model: <https://nptel.ac.in/courses/106105219/>
- Database: <https://nptel.ac.in/courses/105108073/>

Module-2

L3, L5

20 Hrs.

Prerequisites: Knowledge of Image Resolution and Analysis

Digital Image Processing:

Concepts, characteristics, Spectral, Spatial, Radiometric and Temporal resolution, Visual vs. Digital methods, Image data storage and retrieval, Types of image displays and FCC (False Color Composite). System design considerations, Sources of image degradation Pre-processing of satellite image, Radiometric and Geometric correction technique, Interpolation methods – linear and non-linear transformation for geometric corrections Look-up Tables (LUT) and Image display, radiometric enhancement techniques, Spatial enhancement techniques, Contrast stretching: Linear and non-linear methods.

Low Pass Filtering: Image smoothing, High Pass Filtering: Edge enhancement and Edge detection , Gradient filters , Directional and non-directional filtering Band ratio, Types of Vegetation indices, Principal Component Analysis, Multi dated data analysis and Change detection Basics of Pattern Recognition, Spectral discrimination, Signature bank, Parametric and Non-Parametric classifiers, Unsupervised classification methods, Supervised classification techniques, Limitations of standard classifiers. (Online Mode)

Laboratory Sessions: (Self Learning)

Following Experiments are to be carried out under Digital Image Processing

1. Introduction to Arc GIS IMAGINE Study
2. Import / Export of files using Arc GIS IMAGINE Geo-reference of the toposheet and imageries
3. Display, Analysis and interpretation of black & white images and FCC
4. Low Pass Filter: Compression of the high frequency component & enhancement of the low frequency component
6. High Pass Filter: Compression of the low frequency component and enhancement of the high

frequency component

7. Sub-setting of area of interest from the satellite image

8. Principal Component Analysis

9. Resolution Merging

10. Unsupervised Classification

11. Supervised Classification

12. Map composition

Applications: (Self Learning)

- Pavement Distress Assessment
- Microstructure of cement based materials
- Evaluation of soil fabric

Video link / Additional online information: (Self Learning)

- Image Processing: <http://cse19-iiith.vlabs.ac.in/piping.php>
- Image Analysis: <http://vlab.amrita.edu/?sub=3&brch=278&sim=1482&cnt=1>

Module-3

L3, L5

20 Hrs.

Prerequisites: Knowledge on impact of Natural Disasters

Applications of Geo-informatics:

Emergence of geo-informatics technology in application areas, advantage over conventional techniques, Recent trends in geo-informatics applications.

Application in Land Resource, Water Resources, Disaster Management, Urban Planning, Geo-technical Engineering, Environmental Management, Hazard Zonation. (Online Mode)

Laboratory Sessions:

Following Experimental Studies are performed

1. Satellite image based hydro-geomorphological interpretation for ground water targeting.
2. Open cast mining impacts on land resources using satellite images.
3. Mapping flood hazards in a region using satellite images
4. Mapping landslide hazards in a region using satellite images
5. Urban sprawl mapping of a township using satellite images
6. Utility-facility mapping for regional development analysis in GIS
7. Application of Geo-informatics for identification of waste disposal sites.
8. Digital terrain models for selection of dam site and road infrastructure.

Applications: (Self Learning)

- Accidental Analysis and hot spot analysis
- Agricultural Applications

Video link / Additional online information: (Self Learning)

- Transportation :<https://nptel.ac.in/courses/105108073/>

Course outcomes: On completion of the course, students would be able to

CO1	Create the Database and perform the vector operations
CO2	Import and Export the files from Arc GIS
CO3	View, design and interpret the images and FCC
CO4	Find the solution to mining impact using satellite images
CO5	Arrive the correct decision on natural disaster management

Reference Books:

1.	Schultz, G. A. and Engman, E. T. 2000. Remote Sensing in Hydrology and Water Management, Springer-Verlag, Berlin, Germany.
2.	P.S. Roy (2000). Natural Disaster and their mitigation. Published by Indian Institute of Remote Sensing (IIRS), 2000.
3.	Mac Donald, A. 1999, Building a Geodatabase, Redlands CA: ESRI Press.
4.	Thomas M. Lillesand & Kiefer, Ralph W., Remote Sensing and Image Interpretation, John Wiley & Sons, New York.2000
5.	Jenson, J.R. 2000. Remote Sensing of the environment – An Earth Resource Perspective,Prentice Hall Inc.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	2	1	1	1	-	2	-	1	1
CO2	1	2	1	2	2	1	1	-	2	-	2	2
CO3	2	2	2	2	1	1	1	-	2	-	2	2
CO4	2	2	2	2	-	1	1	-	2	-	2	2
CO5	2	2	2	2	2	1	1	-	2	-	2	3

High-3, Medium-2, Low-1

Course Title	CONCRETE TECHNOLOGY	Semester	IV
Course Code	MVJ19CV46	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 00 : 20	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to:

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

Module-1

L3

15 Hrs.

Cement – Cement manufacturing process flow chart, steps to reduce carbon footprint, chemical composition and their importance (Online Mode), hydration of cement, Effect of heat of hydration during mass concreting at project sites, Testing of cement.

Fine aggregate: Functions, requirement (Online Mode), alternatives to River sand, M-sand introduction and manufacturing.

Coarse aggregate: Importance of size, shape and texture (Online Mode). Grading and blending of aggregate. Recycled aggregates. Water – qualities of water.

Chemical admixtures – plasticizers, superplasticizers, accelerators, retarders and air entraining agents.

Mineral admixtures – Fly ash, GGBS, silica fumes, Metakaolin and rice husk ash.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Conduct field tests on cement.
- Conduct soundness test on cement.
- Determine zone of fine aggregate (CONCRETE TECHNOLOGY LABORATORY_MVJ19CVL48_Expt. No. 2d)
- Determine flakiness index and elongation index of aggregate.
- Classify aggregates according to shapes.

Applications: (Self Learning)

- Assess quality of materials for using in concrete

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/102/105102012/>
 - <https://nptel.ac.in/courses/105104030/>

Module-2

L3

10 Hrs.

Workability-factors affecting workability (Online Mode). Measurement of workability–slump, Compaction factor, Vee-Bee Consistometer tests and flow tests. Segregation and bleeding.

Process of manufacturing of concrete- Batching, Mixing, Transporting, Placing and Compaction (Online Mode). Curing – Methods of curing – Water curing, membrane curing, steam curing, accelerated curing, self- curing. Good and Bad practices of making and using fresh concrete.

Applications: (Self Learning)

- Assess quality of fresh concrete before laying (CONCRETE TECHNOLOGY LABORATORY_MVJ19CVL48_Expt. No. 4a(ii))

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/102/105102012/>
 - <https://nptel.ac.in/courses/105104030/>

Module-3

L3

11 Hrs.

Concept of Mix Design with and without admixtures, Selection criteria of ingredients used for mix design (Online Mode), Procedure of mix proportioning using IS10262 and current American (ACI)/ British (BS) methods. Numerical Examples of Mix Proportioning using IS-10262.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Create excel sheet for mix design

Applications: (Self Learning)

- Design concrete mix of required strength.

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/102/105102012/>
 - <https://nptel.ac.in/courses/105104030/>
 - <https://nptel.ac.in/courses/105106176/>

Module-4

L3

12 Hrs.

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 (Online Mode). Definition and significance of durability.

Internal and external factors influencing durability, Thermal conductivity, thermal diffusivity, specific heat. Alkali Aggregate Reaction, Mechanisms- Sulphate attack – chloride attack, carbonation, efflorescence, freezing and thawing. Corrosion, Durability requirements as per IS-456.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Create excel sheet for durability study

Applications: (Self Learning)

- Design concrete mix of required strength.

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/102/105102012/>
 - <https://nptel.ac.in/courses/105104030/>
 - <https://nptel.ac.in/courses/105106176/>

Module-5

L3

12 Hrs.

RMC- manufacture and requirement as per QCI-RMPCS, properties, advantages and disadvantages, quality control (Online Mode), Self Compacting concrete – concept, materials, tests, properties, application, typical mix and quality control. Fiber reinforced concrete - Fibers types, properties, application of FRC.

Light weight concrete - material properties and types. Typical light weight concrete mix and applications. (Online Mode)

In-situ testing of concrete- penetration and pull out test. Rebound hammer test, ultrasonic pulse velocity, core extraction- principal, application and limitations.

Laboratory Sessions/ Experimental learning: (Self Learning)

- RMC site visit and preparing layout.

Applications: (Self Learning)

- Design special concrete.

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/102/105102012/>
 - <https://nptel.ac.in/courses/105104030/>

Course outcomes: On completion of the course, students would be able to

CO1	Select suitable materials for making concrete
CO2	Distinguish concrete behaviour based on its fresh and hardened properties.
CO3	Illustrate proportioning of different types of concrete mixes for required fresh and hardened

	properties using professional codes.
CO4	Measure workability and strength of concrete for using in real time structures.
CO5	Evaluate the strength of existing structures using nondestructive tests.

Reference Books:

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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	-	-	-	2	-	-	-
CO3	3	2	-	-	-	-	-	-	2	-	-	-
CO4	3	2	2	-	-	-	-	-	2	1	-	-
CO5	3	2	2	2	-	-	-	-	2	1	-	-

High-3, Medium-2, Low-1

Course Title	APPLIED HYDRAULICS LABORATORY	Semester	IV
Course Code	MVJ19CVL47	CIE	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective is to:

- Demonstrate the Bernoulli's theorem and applications
- Measure the open channel flow using notches and weirs
- Determine the head losses in pipelines
- Calculate the efficiency of the pumps
- Compare the performance of the Pelton wheel, Francis and Kaplan Turbine

Prerequisites: Bernoulli's theorem, Discharge of the flow, Volumetric method for calculating the flow discharge, Pressure, Working principle of Pump and Turbine.

S.NO	Experiments	L3
1	Calibration of Venturimeter (FLUID MECHANICS_MVJ19CV33_Module 1&3)	
2	Calibration of rectangular and triangular notches. (FLUID MECHANICS_MVJ19CV33_Module 4)	
3	Determination of Friction Factor of the Pipe Materials (Major losses). (FLUID MECHANICS_MVJ19CV33_Module 1)	
4	Determination of head losses for different pipe fittings (Minor losses: Sudden Enlargement, Bends and Contraction Only). (FLUID MECHANICS_MVJ19CV33_Module 1)	
5	Measurement of Flow through Orifice (FLUID MECHANICS_MVJ19CV33_Module 4)	
6	Calibration of Ogee and Broad crested weir	
7	Experimental determination of force exerted by a jet on flat and curved plates (APPLIED HYDRAULICS_MVJ19CV43_Module 4)	
8	Determination of Cd for Venturiflume	
9	Performance characteristics of centrifugal pump. (APPLIED HYDRAULICS_MVJ19CV43_Module 5)	
10	Performance characteristics of Pelton wheel. (APPLIED	

	HYDRAULICS_MVJ19CV43_Module 5)
11	Performance characteristics of Francis turbine.
12	Demo experiment on Verification of Bernoulli's theorem
13	Demo experiment on Performance characteristics of Kaplan turbine (APPLIED HYDRAULICS_MVJ19CV43_Module 5)
14	Demo experiment on Multi stage centrifugal pump, Metacentric height Apparatus (APPLIED HYDRAULICS_MVJ19CV43_Module 2)

Video link / Additional online information:

- <http://eerc03-iiith.vlabs.ac.in/List%20of%20experiments.html?domain=Civil%20Engineering>
- <http://fm-nitk.vlabs.ac.in/>

Course outcomes: On completion of the course, students would be able to

CO 1	Verify the Bernoulli s Theorem
CO 2	Calibrate the flow measuring devices
CO 3	Determine the losses for different pipes and fittings Verify the Bernoulli s Theorem
CO 4	Measure the flow through pipe and open channel
CO 5	Calculate and draw the characteristic curves of the Hydraulic Machines

Reference Books:

1.	Modi, P.N& Seth ,S.M Hydraulics and Fluid Mechanics' Standard Book House- New Delhi, 2009 Edition
2.	Sarbjit Singh , Experiments in Fluid Mechanics - PHI Pvt. Ltd.- New Delhi,2009
3.	Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press, 2015

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	1	-	2	-	-	-
CO2	3	3	2	1	2	1	1	-	2	1	-	-
CO3	3	3	2	1	2	1	1	-	2	2	-	-
CO4	3	3	2	1	2	2	1	-	2	2	-	-
CO5	3	3	2	1	2	1	1	-	2	2	-	-

High-3, Medium-2, Low-1

Course Title	CONCRETE TECHNOLOGY LABORATORY	Semester	IV
Course Code	MVJ19CVL48	CIE	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective is to:

- Assess quality and suitability of materials used for making concrete.
- Proportion ingredients of Concrete.
- Ascertain and measure engineering properties of concrete in fresh and hardened state which meet the requirement of real time structures.

S.NO	Experiments	L3,L4
1	Tests on Cement: a. Determination of Normal Consistency of Cement b. Determination of Setting time of Cement c. Estimation of Compressive strength of Cement d. Determination of fineness of Cement e. Determination of specific gravity of Cement	
2	Tests on Fine aggregate: a. Determination of Moisture content of fine aggregate b. Determination of Specific gravity of fine aggregate c. Determination of Bulk density of fine aggregate d. Determination of Sieve analysis of fine aggregate (CONCRETE TECHNOLOGY_MVJ19CV46_Module 1) e. Determination of Bulking of fine aggregate	
3	Tests on Coarse aggregate: a. Determination of Absorption of Coarse aggregate b. Determination of Moisture content of Coarse aggregate c. Determination of specific gravity of Coarse aggregate d. Determination of Bulk density of Coarse aggregate e. Determination of Sieve analysis of Coarse aggregate	
4	Tests on Concrete: a. Tests on fresh concrete: i. Determination of Slump of fresh concrete (CONCRETE TECHNOLOGY_MVJ19CV46_Module 2) ii. Determination of compaction factor of fresh concrete iii. Determination of consistency of fresh concrete by Vee Bee test	

	<p>b. Tests on hardened concrete:</p> <p>i. Determination of compressive strength of hardened concrete</p> <p>ii. Determination of split tensile strength of hardened concrete</p> <p>iii. Determination of flexural strength of hardened concrete</p> <p>c. NDT tests</p> <p>i. Estimation of elastic property of concrete by Re bound hammer test</p> <p>ii. Evaluate the quality and homogeneity of concrete by pulse velocity test</p>
5	<p>Tests on Self Compacting Concrete:</p> <p>a. Design of self-compacting concrete as per IS 10262:2019</p> <p>b. Conducting slump flow test to determine the workability of self-compacting concrete</p> <p>c. Conducting V-funnel test to determine the flow time of self-compacting concrete</p> <p>d. Conducting J-Ring test to determine the passing ability of self-compacting concrete</p> <p>e. Conducting U Box test to determine the filling ability of self-compacting concrete</p> <p>f. Conducting L Box test to determine the filling and passing ability of self-compacting concrete</p>

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102012/>
- <https://nptel.ac.in/courses/105104030/>
- <https://nptel.ac.in/courses/105106176/>

Course outcomes: On completion of the course, students would be able to

CO 1	Assess quality of materials used for making concrete
CO 2	Distinguish concrete behaviour based on its fresh properties.
CO 3	Determine strength and quality of concrete
CO 4	Evaluate the strength of structural elements using nondestructive tests.
CO 5	Design appropriate concrete mix

Reference Books:

1.	M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi.
2.	Kumar Mehta. P and Paulo J.M. Monteiro “Concrete-Microstructure, Property and Materials”, 4th Edition, McGraw Hill Education, 2014
3.	Neville A.M. “Properties of Concrete”-4th Ed., Long man.
4.	A.R. Santha Kumar, “Concrete Technology”, Oxford University Press, New Delhi (New Edition)
5.	M L Gambir, “Concrete Technology”, McGraw Hill Education, 2014.
6.	IS456:2000, IS10262:2009

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	1	-	-	2	-	-	-
CO2	3	2	-	-	-	1	-	-	2	-	-	-
CO3	3	2	-	-	-	1	-	-	2	-	-	-
CO4	3	2	2	-	2	1	-	-	2	1	-	-
CO5	3	2	2	2	-	1	-	-	2	1	-	-

High-3, Medium-2, Low-1