

Course Title	FOURIER SERIES , TRANSFORMS, NUMERICAL AND OPTIMIZATION TECHNIQUES	Semester	III
Course Code	MVJ20MCV31	CIE	50
Total No. of Contact Hours	40 L : T : P :: 2 : 2 : 0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hours

Course Objective is to: This course will enable students to

- Comprehend and use of analytical and numerical methods in different engineering fields
- Apprehend and apply Fourier Series
- Realize and use of Fourier transforms and Z-Transforms
- Use of statistical methods in curve fitting applications
- Use of numerical methods to solve algebraic and transcendental equations, vector integration and calculus of variation

Module-1

L1,L2 & L3

8 Hours

Laplace Transforms: Definition and Laplace transforms of Elementary functions.

Laplace transforms of $e^{at}f(t)$, $t^n f(t)$ and $f(t)/t$, periodic functions and unit step function – problems.

Inverse Laplace Transforms: Inverse Laplace Transforms – Problems, Convolution theorem to find the inverse Laplace transforms and problems, solution of linear differential equations using Laplace Transforms.

Applications: The Laplace transform is particularly useful in solving linear ordinary differential equations.

Module-2

L1,L2 & L3

8 Hours

Fourier Series: Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period 2π and with arbitrary period $2c$. Fourier series of even and odd functions. Half range Fourier Series, Practical harmonic Analysis.

Applications: The Fourier series has many such applications in harmonic analysis, vibration analysis, acoustics, optics etc.

Video link / Additional online information (related to module if any):

- <https://nptel.ac.in/courses/111106111/>

Experimental learning(Videos):

- <http://esg.mit.edu/videos/fourier-series-modeling-nature/>

Module-3		L1,L2 & L3	8 Hours
<p>Fourier transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Inverse Fourier transforms, Inverse Fourier sine and cosine transforms, Convolution theorem and problems.</p> <p>Applications: Fourier Transformation (FT) has huge application in studying to study vibrations in building/structures. Any kind of spectroscopy applied in chemical engineering (CE) is based in Fourier techniques.</p>			
Module-4		L1,L2 & L3	8 Hours
<p>Numerical Methods: Numerical solution of ordinary differential equations of first order and first degree, Taylor's series method, modified Euler's method. Runge - Kutta method of fourth order, Milne's and Adams-Bashforth predictor and corrector methods (No derivations of formulae-single step computation only).</p> <p>Applications: Numerical Methods are used to provide 'approximate' results for the differential equation problems being dealt with and their necessity is felt when it becomes impossible or extremely difficult to solve a given problem analytically.</p>			
Module-5		L1,L2 & L3	8 Hours
<p>Numerical Methods: Numerical solution of second order ordinary differential equations, Runge-Kutta method and Milne's method. (No derivations of formulae-single step computation only).</p> <p>Optimization Techniques: Linear Programming, Mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, Simplex Method.</p> <p>Applications: Linear Programming is used in a variety of fields including food and agriculture, engineering, transportation problems, manufacturing and energy.</p>			
Course outcomes:			
CO1	Use Laplace transform and inverse transforms techniques in solving differential equations.		
CO2	Know the use of periodic signals and Fourier series to analyze circuits and system		
CO3	Demonstrate Fourier Transform as a tool for solving Integral equations.		
CO4	Identify appropriate numerical methods to solve ODE.		
CO5	Solve the mathematical formulation of linear programming problem.		

CIE Assessment:	
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (10 marks) Assignments (10 Marks)	
SEE Assessment:	
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.	
Text Books:	
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43 rd Edition 2013.
2	S. D. Sharma, "Operations Research", Kedar Nath and Ram Nath Publishers, Seventh Revised Edition 2014.
Reference Books:	
1	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
2	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8 th Edition
3	Jain R. K. & Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publishing House, 2002.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	0	1
CO2	3	3	0	3	0	0	0	0	0	0	0	0
CO3	2	3	0	3	0	0	0	0	0	0	0	1
CO4	3	3	0	3	0	0	0	0	0	0	0	0
CO5	3	3	0	2	0	0	0	0	0	0	1	1

High-3, Medium-2, Low-1

Course Title	SOLID MECHANICS	Semester	III
Course Code	MVJ20CV32	CIE	50
Total No. of Contact Hours	50 L : T : P :: 3 : 2 : 0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs

Course objective is to:

- Provide basic knowledge in mechanics of materials so that the students can solve real engineering problems and design engineering systems.
- Explain the basic concepts of the stresses and strains for different materials
- State the development of internal forces and resistance mechanism for one dimensional and two-dimensional structural element.
- Evaluate the behaviour of torsional members, columns and struts.

Module-1

L1,L2 & L3

10 Hrs.

Prerequisites: Engineering Mechanics

Concepts of Stress and Strain: Properties of materials, Normal stress, Shear stress, Bearing stress, Normal strain, Shearing strain; Hooke's law; Poisson's ratio; Stress-strain diagram of ductile and brittle materials; Elastic limit; Ultimate stress; Yielding; Modulus of elasticity; Factor of safety (Online mode), Elongation of uniform bar and tapering bar due to self-weight, Compound bars, Temperature stresses, Compound section subjected to temperature stresses, volumetric strain, expression for volumetric strain, Elastic constants and their relationship.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Determination of Tensile strength of mild steel and HYSD bars by Tension test. (SOLID MECHANICS LABORATORY_MVJ19CVL38_EXPT1)
- Determination of Compressive strength of mild steel, cast iron and wood by Compression test. (SOLID MECHANICS LABORATORY_MVJ19CVL38_ EXPT 2)
- Experimental test on compound section subjected to temperature stresses. (SOLID MECHANICS LABORATORY_MVJ19CVL38_ EXPT 11)
- Computation of Stresses and Deformation of Compound section using

EXCEL Sheet Applications: (Self Learning)

- Understanding the scope of the subject.

<ul style="list-style-type: none"> Identifying different material properties. Knowledge about Stress-strain characteristics and its practical use. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ 		
Module-2	L1,L2 & L3	10 Hrs.
<p>Compound Stresses: Two-Dimensional Stress Problems (Online Mode): Principal stresses, maximum shear stresses, Mohr's circle of stresses and its construction, Theories of failure</p> <p>Thick and Thin Cylinders: Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume (Online Mode). Thick cylinders: Lamé's equation, cylinder's subjected to both internal and external pressure, radial and hoop stress distribution.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Mohr's Circle – Graphical Computation of Principles Stresses Computation of Compound Stresses by using Excel Sheet Plotting of Radial and Hoop stress distribution using Excel Sheet Applications: (Self Learning) <ul style="list-style-type: none"> Knowledge about the behaviour and strength of structural elements under the action of compound stresses and thus understand the failure concepts. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ 		
Module-3	L1,L2 & L3	10 Hrs.
<p>Beam Statics: Support reactions, Definition of bending moment and shear force, sign conventions, relationship between load intensity, bending moment and shear force (Online Mode). Shear force and bending moment diagrams for concentrated, uniformly distributed, linearly varying load, concentrated moments for determinate beams.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Experimental checking of the behavior of different types of beams subjected to different loads and the Model making of Types of beams & reactions Shear force variation with various loading condition (SOLID MECHANICS 		

<p>LABORATORY_MVJ19CVL38_ EXPT 5)</p> <ul style="list-style-type: none"> • Compute the Relationship between Shear force and Bending moment at particular section using Excel Sheet <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Behavior of different types of beams and its reactions. • Behavior beams subjected various types of loading. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105105108/ • https://nptel.ac.in/courses/105/102/105102090/ 		
Module-4	L1,L2 & L3	10 Hrs.
<p><i>Prerequisites: Concept of moment of inertia, Centroid</i></p> <p>Bending and Shear Stresses in Beams: Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity (Online Mode). Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', 'T' and Symmetrical Built-up sections.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Effect of force of different magnitude on the bending stresses in beam (SOLID MECHANICS LABORATORY_MVJ19CVL38_ EXPT 4) • Develop expression for transverse shear stress in beam using Excel Sheet Applications: (Self Learning) <ul style="list-style-type: none"> • Understanding bending and shear stresses in beams subjected to simple bending Video link / Additional online information: (Self Learning) • https://nptel.ac.in/courses/105105108/ • https://nptel.ac.in/courses/105/102/105102090/ 		
Module-5	L1,L2 & L3	10 Hrs.
<p><i>Prerequisites: Concept of power & Torque, Integration</i></p> <p>Columns and Struts: Introduction, short and long columns (Online Mode). Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.</p> <p>Torsion in Circular Shaft: Introduction, pure torsion, Assumptions, derivation Introduction, pure torsion, Assumptions (Online Mode), rigidity and polar modulus, Power transmitted by solid and hollow circular shaft.</p>		

Laboratory Sessions/ Experimental learning: (Self Learning)

- Model Making of Euler’s Buckling load for different end conditions
- Determination of Torsion in a Circular shaft
- Develop Conditional equations for Column Analysis using

Excel Sheet Applications: (Self Learning)

- Understanding short and long columns and its buckling against different end conditions.
- Computation of torsional stress induced in circular members.

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105105108/>
- <https://nptel.ac.in/courses/105/102/105102090/>

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

CO1	Restate the concepts of stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials.
CO2	Evaluate the behaviour and strength of structural elements under the action of compound stresses and thus understand the failure concepts.
CO3	Compute shear force and bending moment in loaded statically determinate beams
CO4	Compute bending and shear stresses in beams subjected to simple bending
CO5	Describe the critical buckling load of prismatic columns with different end conditions and able to compute torsional stress induced in circular members

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests/Case Studies (10 marks)
- Assignments (10 Marks)

SEE Assessment:

- Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
- One question must be set from each unit. The duration of examination is 3 hours.

Textbooks:	
1.	B.S. Basavarajaiah, P.Mahadevappa "Strength of Materials" in SI Units, University Press (India) Pvt. Ltd., 3 rd Edition, 2010
2.	R K Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010

Reference Books:	
1.	D.H. Young, S.P. Timoshenko " Elements of Strength of Materials" East West Press Pvt. Ltd., 5 th Edition (Reprint 2014)
2.	S.S. Rattan " Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 2 nd Edition (Sixth reprint 2013).
3.	Vazirani, V N, Ratwani M M. and S K Duggal "Analysis of Structures Vol. I", 17 th Edition, Khanna Publishers, New Delhi, 2006.
4.	Ferdinand P. Beer, E. Russell Johnston Jr. "Mechanics of Materials", 8 th Edition (in SI Units), 2020.

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	FLUID MECHANICS	Semester	III
Course Code	MVJ20CV33	CIE	50
Total No. of Contact Hours	40 L : T : P :: 2 : 2 : 0	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- Provide the Fundamental properties of fluids and its applications
- Make the students to explain on Hydrostatic laws and application to solve practical problem
- Gain the knowledge on Principles of Kinematics and Hydrodynamics for practical applications.
- Basic design of pipes and pipe networks considering flow, pressure and its losses
- Arrive the basic flow rate measurements

Module-1	L1,L2 & L3	8 Hrs.
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Prerequisites: Knowledge on basic Fluid Properties, Newton's Laws

Fluids & Their Properties:

Historical Development of Fluid Mechanics, Concept of fluid, Systems of units, Fluid as a continuum, Properties of fluid - Mass density, Specific weight, Specific gravity, Specific volume, Viscosity, Newton's law of viscosity (theory & problems), Cohesion, Adhesion, Surface tension, Pressure inside a water droplet, soap bubble and liquid jet (Online Mode), Numerical problems. Capillarity, Capillary rise in a vertical tube & between two plane surfaces, Numerical problems. Vapour pressure of liquid, Cavitation, Compressibility and bulk modulus.

Fluid Pressure and Its Measurements:

Definition of pressure, Pressure at a point, Pascal's law, Variation of pressure with depth on fluid at rest (Online Mode). Types of pressure. Measurement of pressure using simple, differential & inclined manometers, Numerical problems. Introduction to Mechanical and electronic pressure measuring devices.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Determination of Capillary Rise of water and Capillary fall of mercury in a vertical tube
- Measurement of Pressure in Differential U-tube Mercury Manometer (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 1,3 & 4)
- Calculation of pressure under curved surface using Excel Sheet

Applications: (Self Learning) <ul style="list-style-type: none"> • Lifting Mechanism of hydraulic Jack and Hydraulic Press • Pressure in Artesian Wells, Water Tower and Dams Video link / Additional online information: (Self Learning) • Fluid Pressure : https://nptel.ac.in/courses/112105171/ 		
Module-2	L1,L2 & L3	8 Hrs.
<p><i>Prerequisites: Knowledge on Centroid, Moment of Inertia, Knowledge of Calculus, Partial Derivative Equations</i></p> <p>Hydrostatic forces on Surfaces: Definition, Total pressure, centre of pressure, total pressure on horizontal, vertical and inclined plane surface submerged in liquid (Online Mode), total pressure on curved surfaces, water pressure on gravity dams, Lock gates, Numerical Problems.</p> <p>Kinematic Flow: Introduction, Methods of describing fluid motion, types of fluid flow, rate of flow, basic principles of fluid flow, three-dimensional continuity equation in Cartesian coordinate system (Online Mode), Velocity and Total acceleration of a fluid particle, Derivation for Rotational and irrotational motion. Potential function, stream function, orthogonality of streamlines and equipotential lines. Numerical problems on Stream function and velocity potential function. Introduction to flow net.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Model Making of Streamline and Potential line under Gravity Dam • Draw the Flow net diagram for upstream storage of Barrage • Formulation of Design steps for Lock Gate Analysis using Excel Sheet Applications: (Self Learning) • Design of different parts of Hydraulic Equipment • Pressure on Water Control Structures like Gravity Dam • Steady Flow Analysis in Turbines <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • Kinematic Flow : https://nptel.ac.in/courses/105101082/ 		
Module-3	L1,L2 & L3	8 Hrs.
<p><i>Prerequisites: Knowledge on basic dynamic principles.</i></p> <p>Fluid Dynamics: Introduction, Forces acting on fluid in motion, Euler's equation of motion along a streamline, Bernoulli's equation, Assumptions and limitations of Bernoulli's equation, Modified Bernoulli's</p>		

equation (real fluid) (Online Mode), Numerical Problems (with and without losses).
Momentum equation, Numerical problems on pipe bends.

Application of Bernoulli's Equation: Introduction. Venturi meter, Orifice meter, Pitot tube, Numerical Problems.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Model Making Flow through pipe and calculation of energy loss under given slope
- Determine the dimension of parts of Venturimeter for the given discharge (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 1)
- Formulate and analyze the pipe bend by momentum equation using

Excel Sheet Applications: (Self Learning)

- Liquid ejection instruments like Paint Gun and Insect-Sprayer
- Dynamic lift acts on the Plane

Video link / Additional online information: (Self Learning)

- Bernoulli's Theorem : <https://nptel.ac.in/courses/112105269/>

Module-4

L1,L2 & L3

8 Hrs.

Orifice and Mouthpiece:

Introduction, classification (Online Mode), flow through orifice, hydraulic coefficients, experimental determination of hydraulic coefficients, Numerical problems. Mouthpiece, classification, Borda's Mouthpiece (No Numerical problems).

Notches and Weirs:

Introduction, Classification (Online Mode), discharge over rectangular, triangular, trapezoidal notches, Cippoletti notch, broad crested weirs, submerged weirs, Numerical problems. Ventilation of weirs.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Model Making of Rectangular, Triangular, Trapezoidal and Cippoletti notches under given Discharge (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 2)
- Experimental determination of hydraulic coefficients of given vertical orifice (APPLIED HYDRAULICS LABORATORY_MVJ19CVL47_Expt. No. 5)
- Analyze the Cippoletti notch using Excel Sheet

programming Applications: (Self Learning)

- Stream discharge or a River discharge calculation

<ul style="list-style-type: none"> Emptying of Fluid Storage Tanks <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> Flow Through Orifice and Mouthpieces: https://nptel.ac.in/content/storage2/courses/112104118/ui/Course_home-5.htm 		
Module-5	L1,L2 & L3	8 Hrs.
<p>Flow through Pipes: Introduction, Major and minor losses in pipe flow (Online Mode), Darcy- Weisbach equation for head loss due to friction in a pipe, Pipes in series, pipes in parallel, equivalent pipe, Head loss due to sudden expansion, contraction, Numerical problems. Hydraulic gradient line, energy gradient line, Numerical problems. Pipe Networks, Hardy Cross method (No Numerical Problems) (Online Mode). Surge Analysis in Pipes: Water hammer in pipes (Online Mode), equations for pressure rise due to gradual valve closure and sudden closure for rigid and elastic pipes, Numerical Problems.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Determination of distribution of flow rate by Hardy Cross Method for a Residential Buildings Converting Water supply line into Single Equivalent pipe system Formulate Excel Sheet Program for Hardy Cross <p>Method Applications: (Self Learning)</p> <ul style="list-style-type: none"> Design of Water Supply Network for a Village Create a simple Water Pump (Hydraulic Ram) Leaks detection in Pipelines Identification of enclosed air packets in pipelines <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> Flow Through pipes: https://nptel.ac.in/courses/105101082/ 		
Course outcomes: On completion of the course, students would be able to		
CO1	Recall the fundamental properties of fluids and fluid Continuum	
CO2	Solve problems on hydrostatics and kinematic flow	
CO3	State the kinematic concepts related to fluid flow	
CO4	Apply Bernoulli's principle for Orifice, Mouthpiece, Notches and Weirs.	
CO5	Compute the discharge through pipes in a Pipe Network	

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests <ul style="list-style-type: none"> • Quizzes/mini tests/Case Studies (10 marks) • Assignments (10 Marks)
SEE Assessment:
<p>i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.</p> <p>ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.</p> <p>iii. One question must be set from each unit. The duration of examination is 3 hours.</p>

Textbooks:	
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 Textbook of Fluid Mechanics and Hydraulic Machines", 9th Edition, 2015, Laxmi Publications, New Delhi.

Reference Books:	
1.	Victor L Streeter, Benjamin Wylie E and Keith W Bedford, "Fluid Mechanics", Tata McGraw Hill Publishing Co Ltd., New Delhi, 2008.
2.	S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, New Delhi, 2017.
3.	K Subramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Co. Ltd., 2011.
4.	Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press, 2015.
5.	J. F. Douglas, J. M. Gasoriek, John Swaffield, Lynne Jack, "Fluid Mechanics", Pearson, Fifth Edition, 5th Edition, 2006.

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

High-3, Medium-2, Low-1

Course Title	GEODETIC INFORMATION	Semester	III
Course Code	MVJ20CV34	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- Provide basic knowledge about principles of surveying for location, design and construction of engineering projects
- Develop skills for using surveying instruments including, levelling instruments, plane tables, theodolite, compass
- Make students to familiar with cooperative efforts required in acquiring surveying data and applying fundamental concepts to eliminate errors and set out the works
- Provide information about new technologies that are used to abstracting the information of earth surface

Module-1

L1,L2,L3

8 Hrs.

Prerequisites: Basic knowledge of Trigonometry, Geometry, and Integration

Introduction to Surveying

Importance of surveying to Civil Engineering, Concepts of plane and geodetic surveying Principles of surveying –Plans and maps (Online Mode) – Surveying equipment's, Meridians, Bearings, Dip, Declination, Local attraction, Calculation of bearings and included angles.

Compass surveying: Prismatic and surveyor's compasses (Online Mode), temporary adjustments.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Measuring Bearings using Prismatic Compass (GEODETIC INFORMATION PRACTICE_ MVJ19CVL38 _ Expt. No: 3)

Applications: (Self Learning)

- Highway Alignment and Centre line Marking
- Plotting of Existing Layout of a Village / Town

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/content/storage2/courses/105107122/modules/module10/html/3-16.htm>

Module-2	L1,L2,L3	8 Hrs.
<p>Levelling – Principles and basic definitions – Types of Levels – Types of adjustments and objectives – Types of levelling (Online Mode) – Simple, Differential, Fly, Reciprocal, Profile, Cross sectioning Booking of levels – Rise & fall and H. I methods (Numerical)</p> <p>Areas and volumes: Measurement of area (Online Mode) – by dividing the area into geometrical figures, area from offsets, mid ordinate rule, trapezoidal and Simpson’s one third rule, area from co- ordinates, introduction to planimeter, digital planimeter. Measurement of volumes - trapezoidal and Prismoidol formula.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Using Auto level conducting fly, reciprocal and profile levelling in field (GEODETIC INFORMATION PRACTICE _ MVJ19CVL38 _ Expt. No: 7) <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Volume calculations in contour maps <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105107122/ http://nptel.ac.in/courses/Webcourse/contents/IIT%20Bombay/Mathematics%20I/TOC-middle-M8.html 		
Module-3	L1,L2,L3	8 Hrs.
<p>Theodolite Surveying: Theodolite and types, fundamental axes and parts of theodolite (Online Mode), temporary adjustments of transit theodolite, Horizontal and Vertical angle measurements by repetition and reiteration</p> <p>Trigonometric levelling: Single and Double plane for finding elevation of objects Computation of distances and elevations using Tacheometric method.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Theodolite surveying conduction in field (GEODETIC INFORMATION PRACTICE _ MVJ19CVL38 _ Expt. No: 10) <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Measuring of angle with and without the help of a theodolite <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105107122/ 		
Module-4	L1,L2,L3	8 Hrs.
<p>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) (Online Mode), Setting out curves by Rankine’s deflection angle method (Numerical problems). Compound curves,</p>		

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 (Online Mode), numerical problems on Length of Transition curve, Vertical curves –Types – (theory).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Curve designing with necessary

field data Applications: (Self Learning)

- Highways and railways construction

Video link / Additional online information (related to module if any): (Self Learning)

- <https://nptel.ac.in/courses/105104101/>

Module-5	L1,L2,L3	8 Hrs.
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Contours -Contours and their characteristics – Methods of contour plotting (Online Mode) – Interpolation – Grade contour – application of contours. Numerical examples on calculation of reservoir capacity.

Aerial Photogrammetry-Introduction, Uses, Aerial photographs, Definitions, Scale of vertical photograph (Online Mode), Ground Co-ordinates (Numerical), Relief Displacements (Derivation), Ground control, Procedure of aerial survey, overlaps and mosaics, Stereoscopes, Derivation Parallax.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Contour map plotting and calculation of area and volume of an area (GEODETIC INFORMATION PRACTICE _ MVJ19CVL38 _ Expt. No: 9)

Applications: (Self Learning)

- Introduction to new technologies for extracting geodetic information

Video link / Additional online information (related to module if any): (Self Learning)

- <https://www.digimat.in/nptel/courses/video/105104167/L04.html>
- https://swayam.gov.in/nd1_noc19_ce34/
- <https://nptel.ac.in/courses/105103176/>

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

CO1	Execute survey using compass.
CO2	Find the level of ground surface and Calculation of area and volumes
CO3	Operate theodolite for field execution
CO4	Estimate the capacity of reservoir
CO5	Interpret satellite imageries

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests/Case Studies (10 marks)
- Assignments (10 Marks)

SEE Assessment:

- i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
- iii. One question must be set from each unit. The duration of examination is 3 hours.

Textbooks:

1.	Dr. B.C. Punmia , Ashok Kumar Jain & Arun Kumar Jain – Surveying I & II , Laxmi publications (P) Ltd , 2005
2.	R.Agor - A Textbook of Surveying and Levelling, Khanna Publishers, 2005

Reference Books:

1.	S.K. Duggal - Surveying Vol. II, Tata McGraw Hill Ltd ,Reprint 2015
2.	Chang, K , "Introduction to Geographic Information Systems", Tata McGraw-Hill Publishing Co. Ltd, 2008
3.	George Joseph, "Fundamentals of Remote Sensing", University Press, 2003

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	GEO-INFORMATICS & LABORATORY	Semester	III
Course Code	MVJ20CV35	CIE	50
Total No. of Contact Hours	40 L : T : P :: 2 : 0 : 2	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- Provide the Basic Working Principles of Remote Sensing (RS), Geographic Information System (GIS) and Global Positioning System (GPS)
- Make the students to Achieve the skill on interpretation of images and rectifying the issues
- Gain the knowledge on collection of spatial data and conduct spatial analysis
- Collection of Spatial Data and integration to different forms
- Creating Codes and Attribute Tables for Spatial Analysis

Module-1

L1, L2, L4

14 Hrs.

Prerequisites: Knowledge of Map Scale, Map Projection

Principles of Remote Sensing:

Definition, basic concepts, Advantages and limitations, Remote sensing process, Electromagnetic spectrum-Energy interactions with atmosphere and earth surface features-spectral reflectance of vegetation, soil and water- Classification of sensors- Active and Passive, Resolution-spatial, spectral radiometric and Temporal resolution, Multi spectral scanning-Along track and across track scanning.(Online Mode)

Laboratory Sessions:

Following Experimental Study is to be carried out by using Remote Sensing

1. Introduction to Working Principles of software
2. Aerial photograph interpretation
3. Visual interpretation of multispectral image
4. Image rectification
5. Image classification, supervised and unsupervised classifications
6. Image fusion

Applications: (Self Learning)

- Land use pattern of large areas for regional development

- Whether Forecasting
 - Study of Natural Hazards like earthquake, landslides and floods
- Video link / Additional online information: (Self Learning)
- Basic Concepts of Remote Sensing: <https://nptel.ac.in/courses/105108077/>
 - Different platform of Remote Sensing: <https://nptel.ac.in/courses/121107009/>

Module-2

L1, L2, L4

13 Hrs.

Principles of Geographic Information Systems (GIS):

Prerequisites: Knowledge of Basic key operations in Software

Definition, Components of GIS, GIS operations, Map projections- methods, Coordinate systems- Geographic and Projected coordinate systems, Data Types- Spatial and attribute data, Fundamentals of Data Storage, Image storage formats, Data retrieval, Data compression, Raster and vector data representation-Data Input methods-Geometric Transformation-RMS error, Vector data Analysis- buffering, overlay, GIS and Remote Sensing data Integration, Thematic Mapping , GIS and Integration of other types of data. (Online Mode)

Laboratory Sessions:

Following Experimental Study is to be carried out by using GIS

1. Introduction to Working Principles of software
2. Analog to Digital Conversion – Scanning methods
3. Digital database creation – Point features, Line features, Polygon features
4. Data Editing-Removal of errors – Overshoot & Undershoot, Snapping
5. Data Collection and Integration, Non-spatial data attachment working with tables
6. Dissolving and Merging
7. Clipping, Intersection and Union
8. Buffering techniques
9. Spatial and Attribute query and Analysis
10. Contouring and DEM
11. Demo on QGIS (Open Source Software)

Applications: (Self Learning)

- Environmental Impact Analysis
- Agricultural Applications
- Disaster Management and Mitigation

Video link / Additional online information: (Self Learning)

<ul style="list-style-type: none"> • Introduction to GIS: https://nptel.ac.in/courses/105102015/ • Map Projections: https://nptel.ac.in/courses/105107155/ 		
Module-3	L1, L2, L4	13 Hrs.
<p><i>Prerequisites: Knowledge on Basic Geography</i></p> <p>Basics of Global Positioning System(GPS): Introduction, Fundamentals of Geodesy, Geoid, Reference Ellipsoid, Satellite constellation, GPS signals and data, Geo-positioning, Control Segment, Space Segments, User Segment, GPS Positioning Types- Absolute Positioning, Differential positioning, Methods, Selection of Reference Station, Reference Station Equipment- GPS receiver, GPS antenna. Radio and its types, Radio Antenna. Introduction to PYTHON (Online Mode)</p> <p>Laboratory Sessions: Following Experimental Study is to be carried out by using GPS</p> <ol style="list-style-type: none"> 1. Introduction to Working Principles of GPS and its initial setting 2. Creating codes and attribute table for GPS receiver 3. Point Data collection using GPS with different datum 4. Line data collection using GPS and measurements 5. GPS data collection for area calculation 6. GPS and GIS integrations output preparation 7. Observations using GPS (Virtual Lab) <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Commercial Fleet Management • Guide and track heavy vehicles • In-car Navigation <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • Introduction to GPS: https://nptel.ac.in/courses/105107062/ • Measurement using GPS: http://sl-iitr.vlabs.ac.in/exp11/index.php 		
Course outcomes: On completion of the course, students would be able to		
CO1	Restate the Working Principles of Remote Sensing, GIS and GPS	
CO2	Read and interpret the Aerial Photographs	
CO3	Prepare the Digital Database and perform its integration	
CO4	Develop the contour map and Digital Elevation model	
CO5	Create codes and attribute tables for spatial analysis	

CIE Assessment:	
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests	
<ul style="list-style-type: none"> • Quizzes/mini tests/Case Studies (10 marks) • Assignments (10 Marks) 	
SEE Assessment:	
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.	
ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.	
iii. One question must be set from each unit. The duration of examination is 3 hours.	
Textbooks:	
1.	Jensen, J.R., "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi, 2000.
2.	George Joseph, "Fundamentals of remote sensing", Universities press (India) Pvt. Ltd., Hyderabad, 2003.
Reference Books:	
1.	Kang-tsung Chang, "Introduction to Geographic Information Systems" Tata McGraw Hill, New Delhi, 2002.
2.	C.P.Lo and Albert K.W.Yeung "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India, New Delhi, 2005.
3.	Terry-Karen Steede, "Integrating GIS and the Global Positioning System", ESRI Press, 2002

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	BUILDING MATERIALS AND CONSTRUCTION	Semester	III
Course Code	MVJ20CV36	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- Recognize the good materials for the building construction
- Supervise different types of masonry
- Select type of materials, design and supervise suitable types of walls, floor and roof.
- Gain knowledge about plastering, damp proofing, formwork, scaffolding, shoring and underpinning with suitable engineering measures.

Module-1

L1,L2,L3

8 Hrs.

Prerequisites: Elements of Civil Engineering

Functions of buildings and structure in general - Various components of a building (Online mode) - Loads on buildings as per IS 875, IS 1893 and NBC.

Building Materials: Bricks, Cement concrete blocks, stabilized mud blocks, AAC blocks and mortar for masonry - Additives for mortar (Online mode) - IS recommendations for mortar - Stones and timber- requirements - Concrete-ingredients - Sustainable materials and alternatives.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Verification of dimensions of different types of brick
- Determination of water absorption of brick
- Determination of efflorescence of brick
- Find the soundness and hardness of

brick Applications: (Self Learning)

- Assess quality of bricks

Video link / Additional online information: (Self Learning)

- Masonry materials: <https://nptel.ac.in/courses/105102088/> Module 1, 2 and Module 10

Module-2

L1,L2,L3

8 Hrs.

Masonry: Definition and terms used in masonry. Strength of masonry. Brick masonry- characteristics and requirements of good brick masonry (Online mode), Bonds in brick work,

Header, Stretcher, English, Flemish bond- Stone masonry- Requirements of good stone masonry, Classification- Ashlar, Rubble- coursed, uncoursed - Joints in stone masonry - Types of walls.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Arrange bricks according to different bonds- Header, stretcher, English and Flemish. Identify various types of stone masonry in the campus.

Applications: (Self Learning)

- Select suitable masonry for a structure.

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105102088/> Module 10.

Module-3

L1,L2,L3

8 Hrs.

Plastering and Pointing: Mortar for masonry (Types and Uses), Purpose, Materials and method of plastering and pointing. Defects in Plastering.

Painting: Purpose, Types, Technical terms, ingredients, and Defects. Preparation and applications of paints to new and old plastered surfaces, wooden and steel surfaces.

Varnish: Characteristics and Types

Laboratory Sessions/ Experimental learning: (Self Learning)

- Assess the quality of different surfaces

Applications: (Self Learning)

- Select suitable methods of painting in various surfaces

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105102088/> Module 10

Module-4

L1,L2,L3

8 Hrs.

Formwork: Introduction to form work, mivan shuttering; Scaffolding – Types. Shoring, Under pinning.

Roof : functions, flat roof, pitched roof, roofing materials.

Damp proofing in ground floor, Floor- flooring materials, Thermal performance, fire resistance and acoustics of buildings (Online mode).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Diagnose causes of dampness in a building.

Applications: (Self Learning)

- Select suitable roofing material, flooring material and other materials according to the requirement.
- Take suitable measures to improve functional performance and durability of structure.

Video link / Additional online information: (Self Learning)		
<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105102088/ Module 10. 		
Module-5	L1,L2,L3	8 Hrs.
<p>Sustainable materials and alternatives - Cement concrete blocks, stabilized mud blocks, AAC blocks</p> <p>Steel in construction – Factors affecting physical properties, uses, market forms of steel.</p> <p>Plastic-classification, properties, FRP</p> <p>Glass- Composition, Manufacturing and varieties of glass</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Identify various materials used in the residential building and institutional building. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Select suitable sustainable materials for construction <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105102088/ Module 11, 12, 13 and 14 		
Course outcomes: On completion of the course, students would be able to		
CO1	Select suitable materials for buildings and adopt suitable construction techniques.	
CO2	Identify various components and requirement needed for building construction.	
CO3	Assess strength and stability of masonry.	
CO4	Design masonry wall.	
CO5	Diagnose problems and suitable repair and maintenance work to enhance durability of buildings.	

CIE Assessment:
<p>CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests</p> <ul style="list-style-type: none"> • Quizzes/mini tests/Case Studies (10 marks) • Assignments (10 Marks)
SEE Assessment:
<p>i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.</p> <p>ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.</p>

iii. One question must be set from each unit. The duration of examination is 3 hours.

Textbooks:

1.	Dr. B.C.Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) Ltd.,2005, New Delhi.
2.	Sushil Kumar "Building Materials and construction", 20th edition, reprint 2015, Standard Publishers.

Reference Books:

1.	Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford & IBH, 1987.
2.	Henry, A.W., "Structural Masonry", Macmillan Education Ltd., 1990.
3.	M. L. Gambhir, "Building and Construction Materials", McGraw Hill education Pvt. Ltd
4.	S.K.Duggal, "Building Materials", (Fourth Edition)New Age International (P) Limited, 2016.
5.	IS 1905–1987 "Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi.
6.	SP 20 (S&T) – 1991, "Handbook on masonry design and construction (1st revision) BIS, New Delhi.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	GEODETIC INFORMATION PRACTICE	Semester	III
Course Code	MVJ20CVL37	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective is to:

- Apply the basic principles of engineering surveying and measurements
- Follow effectively field procedures required for a professional surveyor
- Use techniques, skills, and conventional surveying instruments necessary for engineering practice.

Prerequisites: Theory of levelling, ranging concepts, compass surveying

S.NO	Experiments	L3,L4
1	a) Measurements of distances using tape along with horizontal planes and slopes, direct ranging. b) Setting out perpendiculars. Use of cross staff, optical square.	
2	Identification of Obstacles in chaining and ranging – Chaining but not ranging, ranging but not chaining, both ranging and chaining.	
3	Measurements of bearings / directions using prismatic compass, setting of geometrical figures using prismatic compass. (GEODETIC INFORMATION_MVJ19CV34_ Module 1)	
4	Measurement of bearings of sides of a closed traverse and adjustment of closing error by Bowditch method.	
5	Determination of distance between two inaccessible points using compass and accessories	
6	Determination of reduced levels of points using dumpy level/auto level (simple leveling)	
7	Determination of reduced levels of points using dumpy level/auto level (differential leveling and inverted leveling) (GEODETIC INFORMATION_MVJ19CV34_ Module 2)	

8	Determination of difference in elevation between two points using Reciprocal leveling and to determine the collimation error
9	Conducting profile leveling, cross sectioning and block leveling. Plotting profile and cross sectioning in excel. Block level and contour by using Total Station (GEODETIC INFORMATION_MVJ19CV34_ Module 5)
10	Measurement of horizontal angle by repetition and reiteration methods and Measurement of vertical angles using theodolite. (GEODETIC INFORMATION_MVJ19CV34_ Module 3)
11	Determination of horizontal distance and vertical height to a base inaccessible object using theodolite by single plane and double plane method.
12	Determination of distance and elevation using tachometric surveying with horizontal and inclined line of sight.
13	Conducting Closed traverse surveying using Theodolite and applying corrections for error of closure by transit rule.
14	Demonstration of Minor instruments like Clinometer, Ceylon Ghat tracer, Box sextant, Hand level, Planimeter, nautical sextant and Pentagraph.
15	Plotting of Layout for the Street by using Plane Table Survey
Video link / Additional online information: (Self Learning)	
<ul style="list-style-type: none"> • http://sl-iitr.vlabs.ac.in 	
Course outcomes: On completion of the course, students would be able to	
CO1	Apply the basic principles of engineering surveying and for linear and angular measurements.
CO2	Comprehend effectively field procedures required for a professional surveyor.
CO3	Use techniques, skills, and conventional surveying instruments necessary for engineering practice
Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks
Textbooks:	
1.	B.C. Punmia, "Surveying Vol.1", Laxmi Publications pvt. Ltd., New Delhi – 2009.

2.	S.K. Duggal, "Surveying Vol.1", Tata McGraw Hill Publishing Co. Ltd. New Delhi. – 2009.
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Reference Books:

1.	Kanetkar T P and S V Kulkarni , Surveying and Levelling Part I, Pune Vidyarthi Griha Prakashan, 1988
2.	K.R. Arora, "Surveying Vol. 1" Standard Book House, New Delhi. – 2010

**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	SOLID MECHANICS LABORATORY	Semester	III
Course Code	MVJ20CVL38	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective is to:

- Apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials.
- Function on multi-disciplinary teams in the area of materials testing.
- Understanding of professional and ethical responsibility in the areas of material testing.
- Effectively communicate the mechanical properties of materials.

Prerequisites: Material properties, theory of stress & strain

S.NO	Experiments	L3,L4
1	Determination of Tensile strength of mild steel and HYSD bars by Tension test (SOLID MECHANICS_ MVJ19CV32_Module 1)	
2	Determination of Compressive strength of mild steel, cast iron and wood by Compression test (SOLID MECHANICS_ MVJ19CV32_Module 1)	
3	Estimation of Torsional strength by Torsion test on mild steel circular sections. (SOLID MECHANICS_ MVJ19CV32_Module 5)	
4	Conducting Bending Test on Wood Under two point loading. (SOLID MECHANICS_ MVJ19CV32_Module 4)	
5	Conducting Shear Test on Mild steel- single and double shear. (SOLID MECHANICS_ MVJ19CV32_Module 3)	
6	Determination of Impact strength by Impact test on Mild Steel (Charpy&Izod).	
7	Estimation of surface resistance by Hardness tests on ferrous and non-ferrous metals-Brinell's, Rockwell and Vicker's.	
8	Determination of Strength of Bricks & Tiles.	
9	Demonstration of Strain gauges and Strain indicators. (SOLID MECHANICS_ MVJ19CV32_Module 1)	

Video link / Additional online information: (Self Learning)

- <http://sm-nitk.vlabs.ac.in>

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

CO1	Reproduce the basic knowledge of mathematics and engineering in finding the
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	strength in tension, compression, shear and torsion
CO2	Identify, formulate and solve engineering problems of structural elements subjected to flexure.
CO3	Evaluate the impact of engineering solutions on the society and also will be aware of contemporary issues regarding failure of structures due to unsuitable materials

Scheme of Evaluation

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

Textbooks:	
1.	Kukreja C B, Kishore K. and Ravi Chawla "Material Testing Laboratory Manual", Standard Publishers & Distributors 1996.
2.	M L Gambhir and NehaJamwal, "Building and construction materials-Testing and quality control", McGraw Hill education(India)Pvt. Ltd., 2014

Reference Books:	
1.	Holes K A, "Experimental Strength of Materials", English Universities Press Ltd. London.
2.	Davis, Troxell and Hawk, "Testing of Engineering Materials", International Student Edition – McGraw Hill Book Co. New Delhi.

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	SAMSKRUTHIKA KANNADA	Semester	III
Course Code	MVJ20SK39	CIE	50
Total No. of Contact Hours	15 L : T : P :: 1 : 0 : 0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	2 Hrs

Course objective : This course will enable students to understand Kannada and communicate in Kannada language

- Samskruthika Kannada –Parichaya (Introduction to Adalitha kannada)
- Kannada Kavyagala parichaya (Kannada D Ra Bendre, Siddalingaiha)
- Adalithdalli Kannada Padagalu (Kannada Kagunitha Balake, Patra Lekhana, Prabhandha)
- Kannada Computer Gnyana (Kannada Shabdha Sangraha, Computer Paribashika padagalu)
- Activities in Kannada.

Module - 1	L1	3 Hrs
೧. ಕನ್ನಡ ಭಾಷೆ-ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ. 2. ಭಾಷಾ ಪ್ರಯೋಗಲಗ್ನಗುವ ಲೋಪದೋಷಗಲು ಮತ್ತು ಅವುಗಲ ನಿವಾರಣೆ		
Module - 2	L1	3 Hrs
೧. ಲೇಖನ ಚಿಹ್ನೆಗಲು ಮತ್ತು ಅವುಗಲ ಉಪಯೋಗ 2. ಪತ್ರ ವ್ಯವಹಾರ.		
Module - 3	L1	3 Hrs
೧. ಆಡಳಿತ ಪತ್ರಗಲು. 2. ಸರ್ಕಾರದಆದೇಶ ಪತ್ರಗಲು		
Module - 4	L1	3 Hrs
೧. ಸಂಕೀಪ್ತ ಪ್ರಬಂಧರಚನೆ, ಪ್ರಬಂಧ ಮತ್ತು ಭಾಷಾಂತರ 2. ಕನ್ನಡ ಶಬ್ದಸಂಗ್ರಹ		
Module - 5	L1	3 Hrs
೧. ಕಂಪ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿತಂತ್ರಜ್ಞಾನ 2. ಪಾರಿಭಾಷಿಕ ಆಡಳಿತ ಕನ್ನಡ ಪದಗಲು ಮತ್ತು ತಾಂತ್ರಿಕ/ಕಂಪ್ಯೂಟರ್ ಪಾರಿಭಾಷಿಕ ಪದಗಲು.		

Scheme of Evaluation:

Details	Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50) 30

Assignment / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
	Total	100

Textbooks:	
1.	Adalitha Kannada – Dr. L Thimmesh, Prof. V Keshav Murthy

Course Title	BALIKE KANNADA	Semester	III
Course Code	MVJ20BK39	CIE	50
Total No. of Contact Hours	15 L : T : P :: 1 : 0 : 0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	2 Hrs

Course objective : This course will enable students to understand Kannada and communicate in Kannada language

- Vyavharika Kannada –Parichaya (Introduction to Vyavharika kannada)
- Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronunciation.
- Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).
- Kannada Grammar in Conversations(Sambhasaneyalli Kannada Vyakarana)
- Activities in Kannada

Module – 1	L1	3 Hrs
Vyavharika Kannada –Parichaya (Introduction to Vyavharika Kannada)		
Module – 2	L1	3 Hrs
Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronunciation)		
Module – 3	L1	3 Hrs
Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).		
Module – 4	L1	3 Hrs
Kannada Grammar in Conversations(Sambhasaneyalli Kannada Vyakarana)		
Module – 5	L1	3 Hrs
Activities in Kannada		

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Assignment / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
	Total	100

Textbooks:

1.	Adalitha Kannada – Dr. L Thimmesh, Prof. V Keshav Murthy
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Course Title	UNIVERSAL HUMAN VALUES I	Semester	III
Course Code	MVJ20UHV310	CIE	50
Total No. of Contact Hours	15 L: T : P :: 1 : 0 :0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	2 Hrs.

Course objective is to: This course will enable the students to

- Perceive the need for developing a holistic perspective of life
- Sensitise the scope of life – individual, family (inter-personal relationship), society and nature/existence, Strengthening self-reflection
- Develop more confidence and commitment to understand, learn and act accordingly

Module-1

L1,L2

3 Hrs

Welcome and Introductions: Getting to know each other (Self-exploration)

Aspirations and Concerns: Individual academic, career, Expectations of family, peers, society, nation, Fixing one's goals (Basic human aspirations Need for a holistic perspective Role of UHV)

Self-Management: Self-confidence, peer pressure, time management, anger, stress, Personality development, self-improvement (Harmony in the human Being)

Health: Health issues, healthy diet, healthy lifestyle, Hostel life (Harmony of the Self and Body Mental and physical health)

Relationships: Home sickness, gratitude, towards parents, teachers and, others Ragging and interaction, Competition and cooperation, Peer pressure (Harmony in relationship Feelings of trust, respect, gratitude, glory, love)

Society: Participation in society (Harmony in the society)

Natural Environment: Participation in nature (Harmony in nature/existence)

Video link:

- https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV
- <https://youtube.com/playlist?list=PLYwzG2fd7hzcZz1DkrAegkKF4TseekPFv>

Presentation: https://fdp-si.aicte-india.org/AicteSipUHV_download.php

Module-2

L1,L2

3 Hrs

Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario.

Video link:		
<ul style="list-style-type: none"> • https://www.youtube.com/watch?v=85XCw8SU084 • https://www.youtube.com/watch?v=E1STJJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		
Module-3		L1,L2
3 Hrs		
<p>Introduction to Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body.</p>		
Video link:		
<ul style="list-style-type: none"> • https://www.youtube.com/watch?v=GpuZo495F24 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		
Module-4		L1,L2
3 Hrs		
<p>Introduction to Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.</p>		
Video link:		
<ul style="list-style-type: none"> • https://www.youtube.com/watch?v=F2KVV4WNnS8 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		
Module-5		L1,L2
3 Hrs		
<p>Introduction to Implications of the Holistic Understanding: Natural Acceptance of Human Values, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models- Typical Case Studies.</p>		
Video link:		
<ul style="list-style-type: none"> • https://www.youtube.com/watch?v=BikdYub6RY0 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		
Course outcomes: On completion of the course, students would be able to		
CO1	Develop a holistic perspective about life	
CO2	Explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society as an unit in nature	
CO3	Become more responsible in life, and in handling problems with sustainable solutions	
CO4	Have better critical ability	
CO5	Become sensitive to their commitment	

Scheme of Evaluation		
Details		Marks
CIE (Average of three IA each carries 40 Marks)	CIE(50)	40
Activities / Assignment		10
Semester End Examination	SEE (50)	50
Total		100

Text Books:

1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV_download.php
2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	ADDITIONAL MATHEMATICS-I (Common to all branches)	Semester	III
Course Code	MVJ20MATDIP31	CIE	50
Total No. of Contact Hours	40 L:T:P :: 2:1:0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	-	Exam. Duration	3hrs

Course objective is to: This course viz., aims to prepare the students:

- To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analyse the engineering problems.

Module-1	L1,L2	8Hrs.
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Differential calculus: Recapitulations of successive differentiations - n^{th} derivative -Leibnitz theorem and Problems, Mean value theorem -Rolle's theorem, Lagrange's Mean value theorem , Cauchy's theorem and Taylor's theorem for function of one variables.

Video Link:

- <https://users.math.msu.edu/users/gnagy/teaching/ode.pdf>

Module-2	L1,L2	8 Hrs.
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Integral Calculus:

Review of elementary Integral calculus, Reduction formula

$$\int_0^{\frac{\pi}{2}} \sin^m x \, dx, \int_0^{\frac{\pi}{2}} \cos^m x \, dx, \int_0^{\frac{\pi}{2}} \sin^m \cos^n x \, dx \quad \text{and problems.}$$

Evaluation of double and triple integrals and Simple Problems.

Video Link:

- <https://nptel.ac.in/courses/111/105/111105122/>

Module-3	L1,L2	8Hrs.
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Vector Calculus: Derivative of vector valued functions, Velocity, Acceleration and related problems, Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. Vector identities - $\text{div}(\phi A)$, $\text{curl}(\phi A)$, $\text{curl}(\text{grad } \phi)$, $\text{div}(\text{curl } A)$.

Video Link:

- https://www.whitman.edu/mathematics/calculus_online/chapter16.html
- <https://www.math.ust.hk/~machas/vector-calculus-for-engineers.pdf>

Module-4	L1,L2,L3	8 Hrs.
Probability: Introduction-Conditional Probability, Multiplication theorem, Independent events ,Baye's theorem and Problems. Video Link: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/111/105/111105041/ 		
Module-5	L1,L2,L3	8 Hrs.
Differential equation: Homogenous differential equation, Linear differential equation, Bernoulli's differential equation and Exact differential equation. Video Link: <ul style="list-style-type: none"> • https://www.mathsisfun.com/calculus/differential-equations.html 		

Course outcomes:	
CO1	Apply the knowledge of Differential calculus in the modeling of various physical and engineering phenomena
CO2	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO3	Study on Vector calculus to understand the various solution to Application to Engineering problems.
CO4	Understand the basic Concepts of Probability
CO5	Solve first order linear differential equation analytically using standard methods.
CIE Assessment:	
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests <ul style="list-style-type: none"> - Quizzes/mini tests (10 marks) - Assignments (10 marks) 	
SEE Assessment:	
<ul style="list-style-type: none"> i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours. 	

Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43 rd Edition, 2013.
2.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

Reference Books:	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition, 2014.
2.	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

.CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	1	1
CO2	2	3	0	3	0	0	0	0	0	0	1	1
CO3	2	2	0	2	0	0	0	0	0	0	1	0
CO4	3	2	0	3	0	0	0	0	0	0	0	1
CO5	3	3	0	2	0	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

Course Title	COMPLEX ANALYSIS, PROBABILITY AND SAMPLING THEORY	Semester	IV
Course Code	MVJ20MCV41	CIE	50
Total No. of Contact Hours	40 L : T : P :: 2 : 2 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hours

Course Objective is to: The purpose of this course is to make students well conversant with numerical methods to solve ordinary differential equations, complex analysis, sampling theory and joint probability distribution and stochastic processes arising in science and engineering.

Module-1	L1,L2 & L3	8 Hours
<p>Complex Variables-I: Review of a function of a complex variable, limits, continuity, and differentiability. Analytic functions-Cauchy-Riemann equations in Cartesian and polar forms. Properties and construction of analytic functions. Complex line integrals-Cauchy's theorem and Cauchy's integral theorem. Conformal transformations-Discussion of transformations: $w=z^2$, $w=e^z$, $w=z+(1/z)$ ($z \neq 0$)</p> <p>Applications: It is useful in many branches of mathematics, including algebraic geometry, applied mathematics; including the branches of hydrodynamics, thermodynamics, and particularly quantum mechanics.</p>		
Module-2	L1,L2 & L3	8 Hours
<p>Statistical Methods: Introduction, Correlation and coefficient of correlation, Regression, line of regression problems.</p> <p>Curve Fitting: Curve fitting by the method of least squares- fitting of the curves of the form,</p> $y = ax + b, y = ax^2 + bx + c \text{ and } y = ae^{bx}.$ <p>Applications: Correlation and Regression is used to see whether two variables are associated, without necessarily inferring a cause-and-effect relationship. Another important application is to estimate the value of one variable corresponding to a particular value of the other variable. Curve Fittings such as parabola and hyperbola are used in architecture to design arches in buildings.</p>		
Module-3	L1,L2 & L3	8 Hours
<p>Probability Distributions: Random variables (discrete and continuous), probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems.</p> <p>Applications: Few of the application areas include in industries, quality control, in errors correction, medicine, agriculture, engineering, for analysis and interpretations of basic</p>		

data obtained from experiments.		
Module-4		L1,L2 & L3
<p>8 Hours</p> <p>Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance.</p> <p>Stochastic Process: Probability vector, Stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability – problems.</p> <p>Applications: Stochastic processes are widely used as mathematical models of systems and phenomena that appear to vary in a random manner.</p>		
Module-5		L1,L2 & L3
<p>8 Hours</p> <p>Sampling Theory and Statistical Inference: Sampling, Sampling Distributions, Type I and Type II errors, standard error, Z – test, student’s t- distribution , test of hypothesis for means, test for hypothesis for proportions, confidence limits for means, Chi-square distribution as a test of goodness of fit.</p> <p>Applications: A large number of analyses for process control, product quality control for consumer safety, and environmental control purposes are using Sampling Theory..</p>		
Course outcomes:		
CO1	State and prove Cauchy - Riemann equation with its consequences and demonstrate Con-formal Transformation.	
CO2	Illustrate Complex Integration using Cauchy’s Integral theorem, Cauchy’s Integral formula and Cauchy’s Residue theorem.	
CO3	Use Method of Least Square for appropriate Curves. And Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data.	
CO4	Develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, information theory and design engineering	
CO5	Demonstrate testing of hypothesis of sampling distributions and illustrate examples related to discrete parameters.	
Text Books:		
1	B.S. Grewal, “Higher Engineering Mathematics” Khanna Publishers, 43 rd Edition 2013.	
2	Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley-India publishers, 10th edition,2014.	
Reference Books:		
1	Ramana B. V., “Higher Engineering Mathematics”, Tata Mc Graw-Hill, 2006.	
2	Bali N. P. & Manish Goyal, “A text book of Engineering Mathematics”, Laxmi	

	Publications, 8 th Edition
3	Jain R. K. & Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publishing House, 2002.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (10 marks)
- Assignments (10 Marks)

SEE Assessment:

- i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
- iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	0	1
CO2	3	3	0	3	0	0	0	0	0	0	0	1
CO3	3	2	0	1	0	0	0	0	0	0	0	1
CO4	3	3	0	3	0	0	0	0	0	0	0	1
CO5	2	3	0	2	0	0	0	0	0	0	0	1

High-3, Medium-2, Low-1

Course Title	ANALYSIS OF DETERMINATE STRUCTURES	Semester	IV
Course Code	MVJ20CV42	CIE	50
Total No. of Contact Hours	50 L : T : P :: 3: 2 :0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs.

Course objective is to:

- Analyze different forms of structural systems.
- Use concept of ILD and moving loads.
- Impart principles of elastic structural analysis and behaviour of determinate structures.
- Impart knowledge about various methods involved in the analysis of determinate structures.
- Apply the methods for analyzing the structures to evaluate the response of structures.

Module-1

L3, L4

10 Hrs.

Introduction: Structural forms, Conditions of equilibrium, Compatibility conditions, Degree of freedom, Linear and non linear analysis, Static and kinematic Indeterminacy of structural systems.

Analysis of Plane Trusses: Types of trusses, Assumptions in analysis, Analysis of determinate trusses by method of joints and method of sections.

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 structures.
- Determination of axial forces in 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>

Module-2

L3, L4

10 Hrs.

Influence Lines: Concepts of influence lines- ILD for reactions, SF and BM for determinate beams-ILD for axial forces in determinate trusses and numerical problems.

Moving Loads: Reactions, BM and SF in determinate beams, axial forces in determinate

trusses for rolling loads using ILD (Max. values and absolute max. values for beams subjected to multiple loads).

Laboratory Sessions/ Experimental learning: (Self Study)

- Computation of Loads using a model making
- Computation of Deflection for determinate beams using Excel Sheet

Applications: (Self Study)

- Calculation of Forces in Design of Bridges

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	10 Hrs.
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Deflection of Beams: 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

Laboratory Sessions/ Experimental learning: (Self Study) Using Virtual Lab,

- Single Span Beams Experiment
- Continuous Beams Experiment

Deflection check at different points

Applications: (Self Study)

- Knowledge on Behaviour 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	10 Hrs.
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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.

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-5

L3, L4

10 Hrs.

Arches and Cable Structures: Three hinged parabolic and circular 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.

Laboratory Sessions/ Experimental learning: (Self Study)

- Computation of forces in Arches and Cables using Excel sheet.
- Analysis of problems using model making

Applications: (Self Study)

- Knowledge about the analysis of Arches and Cables.

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

CO1	Calculate the member forces in trusses by method of joints and method of sections.
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 determinate beams and frames having variable moment of inertia
CO5	Construct the shear force and bending moment in Arches and Cables.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (10 marks)

Assignments (10 Marks)	
SEE Assessment:	
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.	
ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.	
iii. One question must be set from each unit. The duration of examination is 3 hours.	
Textbooks:	
1.	Bhavikatti, Structural Analysis, VikasPublishing House Pvt. Ltd, New Delhi, 4 th edition, 2002.
2.	Reddy C S, "Basic Structural Analysis" , Tata McGraw-Hill Publishing CompanyLtd.,3 rd edition, 2010.

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. etal, Basic Structural Analysis, 2 nd edition, IK International Pvt. Ltd., New Delhi, 2015.
3	Hibbeler R C, Structural Analysis, Prentice Hall, 6th edition (2005)
4.	Devadas Menon, Structural Analysis, Narosa Publishing House, New Delhi, 2 nd edition, 2008.
5.	Kenneth Leet, Chia-Ming Uang, Anne M. Gilbert, "Fundamentals of Structural Analysis", (2008)

CO-PO Mapping												
CO/P O	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	MVJ20CV43	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	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 analyzing the performance of turbines under design condition.
- Gain the knowledge on working principles of Pumps

Module-1

L1, L2, L3

8 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	L1, L2, L3	8 Hrs
<p>Buoyancy and Floatation: Buoyancy, Force and Centre of Buoyancy, Metacenter and Metacentric height, Stability of submerged and floating bodies (Online Mode), Determination of Metacentric height, Experimental and theoretical method, Numerical problems.</p> <p>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.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Determination of Metacentric height to check the stability of partially submerged boat • Formulation of Excel Sheet program for Chezy's and Manning's method <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Stability Analysis of Submarine • Arrive the optimum weight of Hot-Air Balloon • Measure Relative density by Hydrometer <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • Buoyancy, Metacenter, Stability and Rigid body motion: https://nptel.ac.in/courses/105103192/ • Open Channel Flow: https://nptel.ac.in/courses/105107059/ 		
Module-3	L1, L2, L3	8 Hrs.
<p>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.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • 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

8 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

8 Hrs.

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)

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.

Laboratory Sessions/ Experimental learning: (Self Learning)

- 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 Applications: (Self Learning)

- Power Plant to generate electricity
- Wastewater Processing Plants
- Fire protection Sprinkler System

Video link / Additional online information: (Self Learning)

- 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

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (10 marks)
- Assignments (10 Marks)

SEE Assessment:

- Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
- One question must be set from each unit. The duration of examination is 3 hours.

Textbooks:

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 Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2010

Reference Books:

1	S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, New Delhi. 2006
2.	J.B. Evett, and C. Liu, "Fluid Mechanics and Hydraulics", McGraw-Hill Book Company.- 2009.
3.	K Subramanya, "Flow in Open Channels", McGraw Hill Publishing Co. Ltd. 4 th Edition 2015.
4.	Jagdish Lal , "Hydraulic Machines (Including Fluidics)", Metropolitan Book Co Pvt Ltd, 1994

CO-PO Mapping

	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	MVJ20CV44	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	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.
- Determine the improvement in mechanical behavior by densification of soil deposits using compaction.
- 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 behavior of different types of soil. This includes strength-deformation characteristics under shearing stresses. Also, consolidation properties of clayey soils.

Module-1

L3

08 Hrs.

Prerequisite: Integration and Differentiation

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, BIS soil classification, Plasticity Chart.

Laboratory Sessions/ Experimental learning: (Self Learning)

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

Video link: (Self Learning)

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

Module-2

L3

08 Hrs.

Soil Structure and Clay Mineralogy: Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Common clay minerals in soil and their structures Kaolinite, Illite and Montmorillonite

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, Proctor's needle, Compacting equipment and their suitability.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Standard and Modified Proctor test
- Solution to problems on Permeability and compaction of soils using Excel

software. **Applications: (Self Learning)**

- Model Making of Compacting equipment.

Video link: (Self Learning) :

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

Module-3	L3	08 Hrs.
<p>Flow through Soils: Darcy's law- assumption and validity, Coefficient of permeability (Online Mode) and its determination (laboratory method only), factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and Coefficient of percolation.</p> <p>Seepage Analysis: Laplace equation, assumptions, limitations and its derivation. Flow nets- characteristics and applications (Online Mode). Flow nets for sheet piles, dam section., phreatic line (Casagrande's method –with toe filter only),</p> <p>Effective Stress Analysis: Geostatic stresses, Effective stress concept-total stress, effective stress and Neutral stress (Online Mode), quick sand phenomena.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> • Case study on Flow net by making a working model • Drawing Flow net using software's like SEEP2D. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Earthen dam • Sheet pile <p>Video link: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105101201/ 		
Module-4	L3	08 Hrs.
<p>Consolidation of Soil: Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory - assumption and limitations (Online Mode). 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, Primary and secondary consolidation.</p> <p>Determination of consolidation characteristics of soils compression index (Online Mode) and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method).</p>		

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

08 Hrs.

Shear Strength of Soil: Concept of shear strength, Mohr–Coulomb Failure 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, Classification of shear tests based on drainage conditions.

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.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30

marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (10 marks)
- Assignments (10 Marks)

SEE Assessment:

- i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
- iii. One question must be set from each unit. The duration of examination is 3 hours.

Text Books:

1.	Punmia B C, Soil Mechanics and Foundation Engineering- (2012), Laxmi Publications.
2.	Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics- (2000), New Age International (P) Ltd., Newe Delhi.

Reference Books:

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

CO-PO Mapping

CO/P O	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	ENGINEERING GEOLOGY & LABORATORY	Semester	IV
Course Code	MVJ20CV45	CIE	50
Total No. of Contact Hours	40 L : T : P :: 2 : 0 : 2	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- To understand the internal structure and composition of the earth and learn about geo-morphological agents such as river, wind, sea waves, and their implications in implementing civil engineering projects by the application of Topographic maps, remote sensing and GIS
- To comprehend the properties, occurrence, uses of minerals and rocks in various industries
- To gain knowledge about the structures of the rocks and their considerations in the selection of site for dams, tunnels, bridges and highways

Module-1

L1, L2, L3

15 Hrs.

Prerequisites: Basic knowledge on geography & Remote sensing techniques

Introduction to Geology, Geomorphology and Seismology:

Introduction: Geology in civil engineering, branches of geology; Understanding the earth, internal structure and composition and Introduction to Plate tectonics

Landforms – Classification, Rock weathering, types and its effects on Civil Engineering Projects. Study of Geo-morphological aspects in the selection of sites for Dams, Reservoirs, Tunnels, Highways and Bridges; Watershed management, Floods and their control, River valley, Drainage pattern – parameters and development; Coastlines and their engineering considerations.

Earthquake – Causes and Effects, Seismic waves, Engineering problems related to Earthquakes, Earthquake intensity, Richter Scale, Seismograph, Seismic zones- World and India, Tsunami – causes and effects. Early warning system. Reservoir Induced Seismicity; Landslides – causes and their control.

Laboratory Sessions:

Following Experiments are to be carried out for identification of suitable site selection for civil engineering structures

- Interpretation of Toposheets for Civil Engineering Projects
- Interpretation of geological maps Civil Engineering Projects

- Electrical resistivity curves drawing and its interpretation for Geotechnical and Aquifer investigations.

Module-2

L1, L2, L3 & L5

15 Hrs.

Mineralogy and Petrology:

Prerequisites: Physiographical divisions & mineral wealth of India

Minerals: Properties that affect the strength of minerals. Physical properties and chemical

composition of following minerals - **Quartz, Feldspars** (orthoclase and plagioclase), **Micas** (biotite and muscovite), **Amphibole** (hornblende), **Pyroxene** (augite and hypersthene), **Gypsum, Calcite, Clay minerals** (kaolinite) and their chemical formulae.

Introduction to petrology: Rock Cycle, broad classification of rocks. **Igneous Petrology:** Plutonic, Hypabyssal and Volcanic rocks, Structure, Texture and Classification of Igneous rocks. Study of common rock types prescribed in practical work and their engineering applications. **Sedimentary Petrology:** Rock weathering, Genetic classification of secondary rocks and grain size classification and Textures, Sedimentary Structures, Diagenesis Process. Study of common rock types prescribed in practical work and their engineering applications. **Metamorphic Petrology:** Agents, Types of metamorphism, Texture and structures. Study of common rock types prescribed in practical work and their engineering applications.

Laboratory Sessions:

Following Experiments are to be carried out under Digital Image Processing

- Identification of physical properties - Quartz group of minerals
- Identification of physical properties – Feldspar group of minerals
- Identification of physical properties – Mica group of minerals
- Identification of physical properties – Carbonate group of minerals
- Identification of physical properties – Economic minerals
- Identification of Important rock types – Igneous rocks
- Identification of Important rock types – Metamorphic rocks
- Identification of Important rock types – Sedimentary rocks

Module-3

L1, L2, L3 & L5

10 Hrs.

Structural and Engineering Geology:

Prerequisites: Formation, classification of minerals and rocks

Outcrop, stratification, dip and strike relation, Unconformity, joints their types and genesis Faults and folds with their types and causes, Engineering consideration of joints, folds and faults

Geotechnical investigations for civil engineering projects: Study of toposheets and geological maps, importance of lithological and structural features studies for the

construction of Dams, Reservoirs, Tunnels, Bridges and Highways

Laboratory Sessions:

Following Experimental Studies are performed

- Calculation of Vertical, True thickness and width of the outcrops
- Dip and Strike problems: Determination of dip and strike direction in Civil Engineering projects (Railway lines, tunnels, dams, reservoirs) – graphical or any other method.
- Geological cross section and study of geological map

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

CO1	Students will able to apply the knowledge of geology and its role in Civil Engineering
CO2	The students will know the significance of geological investigations for civil engineering projects and site selection as well as for the preparation of feasibility reports and others
CO3	Students will effectively utilize earth's materials such as mineral, rocks and water in civil engineering practices
CO4	Assess various structural features and geological tools in ground water exploration, Natural resource estimation and solving civil engineering problems
CO5	Apply and asses use of building materials in construction and assess their properties

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (10 marks)

Assignments (10 Marks)

SEE Assessment:

- Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
- Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
- One question must be set from each unit. The duration of examination is 3 hours.

Text Books:	
1.	P.K. Mukerjee, "A Text Book of Geology", World Press Pvt., Ltd. Kolkatta.
2.	Parbin Singh, "Text Book of Engineering and General Geology", Published by S.K.Kataria and Sons, New Dehli

Reference Books:	
1.	D. Venkata Reddy, "Engineering Geology", New Age International Publications, New Delhi
2.	S.K Duggal, H.K Pandey and N Rawal, "Engineering Geology", McGraw Hill Education (India) Pvt, Ltd. New Delhi.
3.	M.P Billings, "Structural Geology", CBS Publishers and Distributors, New Delhi.

Web Link and Video Lectures:	
1.	http://nptel.iitm.ac.in/video.php?subjectId=105105106
2.	http://nptel.iitm.ac.in/courses.php?branch=Civil
3.	http://nptel.iitm.ac.in/video.php?courseId=1055&p=1
4.	http://nptel.iitm.ac.in/video.php?courseId=1055&p=3
5.	http://nptel.iitm.ac.in/video.php?courseId=1055&p=4

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	MVJ20CV46	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	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

08 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)		
<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/102/105102012/ • https://nptel.ac.in/courses/105104030/ 		
Module-2	L3	08 Hrs.
<p>Workability–factors affecting workability (Online Mode). Measurement of workability– slump, Compaction factor, Vee-Bee Consistometer tests and flow tests. Segregation and bleeding.</p> <p>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.</p> <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Assess quality of fresh concrete before laying (CONCRETE TECHNOLOGY LABORATORY_MVJ19CVL48_Expt. No. 4a(ii)) <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/102/105102012/ • https://nptel.ac.in/courses/105104030/ 		
Module-3	L3	08 Hrs.
<p>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.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Create excel sheet for mix design <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Design concrete mix of required strength. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/102/105102012/ • https://nptel.ac.in/courses/105104030/ • https://nptel.ac.in/courses/105106176/ 		
Module-4	L3	08 Hrs.
<p>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).</p>		

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

08 Hrs.

RMC- manufacture and requirement as per QCI-RMCPCS, 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.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests <ul style="list-style-type: none"> - Quizzes/mini tests (10 marks) - Assignments (10 Marks)
SEE Assessment:
<p>i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.</p> <p>ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.</p> <p>iii. One question must be set from each unit. The duration of examination is 3 hours.</p>

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

CO-PO Mapping												
CO/P O	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	MVJ20CVL47	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	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,L4
1	Calibration of Venturi meter (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 Venturi flume	
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 Multistage centrifugal pump, Metacentric height Apparatus (APPLIED HYDRAULICS_MVJ19CV43_Module 2)
Video link / Additional online information:	
<ul style="list-style-type: none"> • http://eerc03-iith.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, Determine the losses for different pipes and fittings Verify the Bernoulli's Theorem
CO 3	Measure the flow through pipe and open channel
CO 4	Calculate and draw the characteristic curves of the Hydraulic Machines

Scheme of Evaluation

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

Textbooks:

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

Reference Books:

1. Sarbjit Singh, Experiments in Fluid Mechanics - PHI Pvt. Ltd.- New Delhi, 2009
2. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press, 2015

CO-PO Mapping

	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	-	-

High-3, Medium-2, Low-1

Course Title	CONCRETE TECHNOLOGY LABORATORY	Semester	IV
Course Code	MVJ20CVL48	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objectives 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	<p>Tests on Concrete:</p> <p>a. Tests on fresh concrete:</p> <p>i. Determination of Slump of fresh concrete (CONCRETE TECHNOLOGY_MVJ19CV46_Module 2)</p> <p>ii. Determination of compaction factor of fresh concrete</p> <p>iii. Determination of consistency of fresh concrete by Vee Bee test</p>
	<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>
<p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105102012/ • https://nptel.ac.in/courses/105104030/ • https://nptel.ac.in/courses/105106176/ 	
<p>Course outcomes: On completion of the course, students would be able to</p>	
CO 1	Assess quality of materials used for making concrete
CO 2	Distinguish concrete behavior 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

Textbooks:	
1.	M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi. 2010
2.	M L Gambir, "Concrete Technology", McGraw Hill Education, 2014.

Reference Books:	
1.	Kumar Mehta. P and Paulo J.M. Monteiro "Concrete-Microstructure, Property and Materials", 4th Edition, McGraw Hill Education, 2014
2	Neville A.M. "Properties of Concrete"-4th Ed., Long man.2010
3	A.R. Santha Kumar, "Concrete Technology", Oxford University Press, New Delhi (New Edition), 2009
4	IS456:2000, IS10262:2009

Scheme of Evaluation

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

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

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW	Semester	IV
Course Code	MVJ20CPH49	CIE	50
Total No. of Contact Hours	15 L : T : P :: 1 : 0 : 0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	2 hrs

Course objective is :

- To know the fundamental political codes, structure, procedures, powers, and duties of Indian constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens.
- To provide overall legal literacy to the young technocrats to manage complex societal issues in the present scenario.
- To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society.

Module-1

L1,L2,L3

3 Hrs

Introduction to Indian Constitution

The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian Constitution, The Making of the Constitution, The role of the Constituent Assembly – Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and Limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and Significance in Nation Building.

Module – 2

L1,L2,L3

3 Hrs

Union Executive and State Executive

Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Article 370, 371, 371J) for some States.

Module – 3

L1,L2,L3

3 Hrs

Elections, Amendments and Emergency Provisions

Elections, Electoral Process, and Election Commission of India, Election Laws.

<p>Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44,61,73,74,75,86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgements with Explanation and its impact on society (from the list of Supreme Court Judgements).</p> <p>Emergency Provisions, types of Emergencies and it's consequences.</p> <p>Constitutional Special Provisions: Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.</p>		
Module – 4	L1,L2,L3	3 Hrs
<p>Professional / Engineering Ethics Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India) : Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering - Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.</p>		
Module – 5	L1,L2,L3	3 Hrs
<p>Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship, Cybercrimes and enforcement agencies.</p>		

Scheme of valuation:		
Details		
Average of three Internal Assessment (IA) tests of 40 Marks each i.e., $\Sigma(\text{Marks obtained in each test})/3$	CIE (50)	40
Assignment / Case Studies / Quiz		10
Semester End Examination	SEE (50)	50
Total		100

Course Outcomes: On completion of this course, students will be able to	
CO1	Have constitutional knowledge and legal literacy
CO2	Understand Engineering and Professional ethics and responsibilities of Engineers.
CO3	Understand the cyber crimes and cyber laws for cyber safety measure.

Text Books:	
1.	Constitution of India and Professional Ethics, T.S. Anupama, Sunstar Publisher
Reference Books:	
1.	Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19 th /20 th Edn., (Latest Edition) or 2008.
2.	Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" by Cengage Learning India Private Limited, Latest Edition – 2018.
3	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004.
4.	M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
5.	Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

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

High-3, Medium-2, Low-1

Course Title	ADDITIONAL MATHEMATICS-II (Common to all branches)	Semester	IV
Course Code	MVJ20MATDIP41	CIE	50
Total No. of Contact Hours	40 L:T:P : : 2: 1 :0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	-	Exam. Duration	3 Hours

Course objective is to: This course viz., aims to prepare the students:

- To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analyse the engineering problems.

Module-1	L1,L2	8Hrs.
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Linear Algebra: Introduction, Rank of a matrix-echelon form. Solution of system of linear equations – consistency. Gauss-elimination method and problems. Eigen values and Eigen vectors of square matrix and Problems.

Video Link:

- <https://www.math.ust.hk/~machas/matrix-algebra-for-engineers.pdf>
- <https://nptel.ac.in/content/storage2/courses/122104018/node18.html>

Module-2	L1,L2	8 Hrs.
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Differential calculus: Tangent and normal, sub tangent and subnormal both Cartesian and polar forms. Increasing and decreasing functions, Maxima and Minima for a function of one variable. Point of inflections and Problems

Beta and Gamma functions: Beta functions, Properties of Beta function and Gamma function ,Relation Between beta and Gamma function-simple problems.

Video Link:

- <http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx>

Module-3	L1,L2	8Hrs.
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Analytical solid geometry :

Introduction –Directional cosine and Directional ratio of a line, Equation of line in space-different forms, Angle between two line, shortest distance between two line, plane and equation of plane in different forms and problems.

Video Link:

<ul style="list-style-type: none"> • https://www.toppr.com/guides/maths/three-dimensional-geometry/ • https://www.toppr.com/guides/maths/three-dimensional-geometry/distance-between-skew-lines/ 		
Module-4	L1,L2,L3	8 Hrs.
<p>Probability: Random variable, Discrete probability distribution, Mean and variance of Random Variable, Theoretical distribution-Binomial distribution, Mean and variance Binomial distribution -Problems. Poisson distribution as a limiting case of Binomial distribution, Mean and variance of Poisson distribution. Normal Distribution-Basic properties of Normal distribution –standard form of normal distribution and Problems.</p> <p>Video Link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/111/105/111105041/ • https://www.mathsisfun.com/data/probability.html 		
Module-5	L1,L2,L3	8 Hrs.
<p>Partial differential equation: Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.</p> <p>Video Link:</p> <ul style="list-style-type: none"> • http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx • https://www.studyjaar.com/index.php/module-video/watch/233-cauchys-legendres-de-a-method-of-variation-of-parameters 		
Course outcomes:		
CO1	Apply the knowledge of Matrices to solve the system of linear equations and to understand the concepts of Eigen value and Eigen vectors for engineering problems.	
CO2	Demonstrate various physical models ,find Maxima and Minima for a function of one variable., Point of inflections and Problems .Understand Beta and Gamma function	
CO3	Understand the 3-Dimensional geometry basic, Equation of line in space- different forms, Angle between two line and studying the shortest distance.	
CO4	Concepts OF Probability related to engineering applications.	
CO5	Construct a variety of partial differential equations and solution by exact methods.	

Text Books:	
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43 rd Edition, 2013.
2	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
Reference Books:	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10 th edition, 2014.
2	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

CIE Assessment:	
<p>CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests</p> <ul style="list-style-type: none"> - Quizzes/mini tests (10 marks) - Assignments (10 marks) 	
SEE Assessment:	
<p>i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.</p> <p>ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.</p> <p>One question must be set from each unit. The duration of examination is 3 hours.</p>	

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	2	0	0	0	0	0	0	1	1
CO2	3	3	0	2	0	0	0	0	0	0	1	1
CO3	3	3	0	3	0	0	0	0	0	0	0	1
CO4	2	2	0	3	0	0	0	0	0	0	1	1
CO5	2	2	0	2	0	0	0	0	0	0	0	1

High-3, Medium-2, Low-1

Course Title	ENTREPRENEURSHIP AND ENGINEERING MANAGEMENT	Semester	V
Course Code	MVJ20EEM51	CIE	50
Total No. of Contact Hours	40 L: T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to: This course will enable the students to

- Introduce the field of management, task of the manager, importance of planning and types of planning, staff recruitment and selection process.
- Explain need of coordination between the manager and staff, the social responsibility of business and leadership.
- Explain the role and importance of the entrepreneur in economic development and the concepts of entrepreneurship.
- Discuss the importance of Small-Scale Industries and the related terms and problems involved.
- Explain project feasibility study and project appraisal and discuss project financing.

Module-1	L1 ,L2	8Hrs.
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Management: Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management & Administration, Management as a Science, Art & Profession.

Planning: Nature, Importance and Purpose of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.

Laboratory Sessions/ Experimental learning

- Case study on decision making process in a corporate.

Applications

- Planning in engineering field.

Web Link and Video Lectures

- <https://nptel.ac.in/courses/110/105/110105146/>
- <https://nptel.ac.in/courses/122/108/122108038/>

Module-2	L1, L2	8Hrs.
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Organizing and Staffing: Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees – meaning, Types of Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control, Nature and Importance of Staffing, Process of Selection and Recruitment.

<p>Directing and Controlling: Meaning and Nature of Directing-Leadership Styles, Motivation Theories, Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination. Controlling – Meaning, Steps in Controlling.</p> <p>Laboratory Sessions/ Experimental learning</p> <ul style="list-style-type: none"> • Case study of steel plant departmentalization. <p>Applications</p> <ul style="list-style-type: none"> • Effective communication in a corporate. <p>Web Link and Video Lectures</p> <ul style="list-style-type: none"> • https://nptel.ac.in/content/storage2/courses/122106031/slides/3_2s.pdf • https://www.slideshare.net/100005130728571/27-nature-of-directing 		
Module 3	L1,L2	8Hrs.
<p>Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance.</p> <p>Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Intrapreneur – An Emerging Class, Comparison between Entrepreneur and Intrapreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.</p> <p>Laboratory Sessions/ Experimental learning</p> <ul style="list-style-type: none"> • Case study of a startup. <p>Application</p> <ul style="list-style-type: none"> • Social auditing in a software company <p>Web Link and Video Lectures</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/106/110106141/ • https://nptel.ac.in/courses/127/105/127105007/ 		
Module 4	L1,L2	8Hrs.
<p>Modern Small Business Enterprises: Role of Small-Scale Industries, Concepts, and definitions of SSI Enterprises, Government policy and development of the Small-Scale sector in India, Growth and Performance of Small-Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry (Definition only).</p> <p>Institutional Support for Business Enterprises: Introduction, Policies & Schemes of Central– Level Institutions, State-Level Institutions.</p> <p>Laboratory Sessions/ Experimental learning</p> <ul style="list-style-type: none"> • Case study on the growth of small-scale industries. 		

Application <ul style="list-style-type: none"> • Small Scale Industries 		
Web Link and Video Lectures <ul style="list-style-type: none"> • https://www.slideshare.net/syedmubarak15/institutional-support-for-business-enterprises • https://www.wto.org/english/docs_e/legal_e/gatt47_01_e.htm 		
Module-5	L1,L2	8Hrs.
Project Management: Meaning of Project, Project Objectives & Characteristics, Project Identification- Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents, Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation. New Control Techniques- PERT and CPM, Steps involved in developing the network, Uses and Limitations of PERT and CPM.		
Laboratory Sessions/ Experimental learning <ul style="list-style-type: none"> • Investigation on the market in correspondence to project. 		
Application <ul style="list-style-type: none"> • Preparations of project report. 		
Web Link and Video Lectures <ul style="list-style-type: none"> • https://www.projectmanager.com/project-scheduling • https://kissflow.com/project/basics-of-project-scheduling/ 		
Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100
Course outcomes: At the end of the course, the student will be able to		
CO1	Describe the concept of Management	
CO2	Assess staffing process	
CO3	Identify the social responsibilities of business towards Different Groups	
CO4	Explain the Role of Small Scale Industries	

CO5	Interpret the Project Objectives
Textbooks:	
1.	Tripathy PC & Reddy PN, "Principles of Management" , Tata McGraw Hill, 1999
2.	Management and Entrepreneurship by NVR Naidu and T. Krishna Rao, I.K. International Publishing House Pvt, Ltd. New Delhi
Reference Books:	
1.	Stephen P. Robbins & Mary Coulter, Management , Prentice Hall (India) Pvt. Ltd., 10 th Edition, 2009
2.	JAF Stoner, Freeman R.E and Daniel R Gilbert , Management , Pearson Education,6th Edition, 2004.
3.	Stephen A. Robbins & David A. Decenzo& Mary Coulter, Fundamentals of Management Pearson Education, 7th Edition, 2011.
4.	Robert Kreitner& Mamata Mohapatra, Management , Biztantra, 2008.
5.	Harold Koontz & Heinz Weihrich , "Essentials of management", Tata McGraw Hill,1998.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	ANALYSIS OF INDETERMINATE STRUCTURES	Semester	V
Course Code	MVJ20CV52	CIE	50
Total No. of Contact Hours	50 L : T : P :: 3 : 2 : 0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs

Course objective is to: This course will enable the students to

- Apply knowledge of mathematics and engineering in calculating slope, deflection, bending moment and shear force using slope deflection, moment distribution method and Kani's method.
- Identify, formulate and solve problems in structural analysis.
- Analyze structural system and interpret data.
- Use the techniques, such as stiffness and flexibility methods to solve engineering problems.
- Communicate effectively in design of structural elements.

Module-1	L1, L2,L3	10 Hrs.
Slope Deflection Method: Introduction, sign convention, development of slope deflection equation, analysis of continuous beams including settlements, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3 .		
Module-2	L1, L2,L3	10 Hrs.
Moment Distribution Method: Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3 .		
Module-3	L1, L2,L3	10 Hrs.
Kani's Method: Introduction, Concept, Relationships between bending moment and deformations, Analysis of continuous beams with and without settlements, Analysis of frames with and without sway.		
Module-4	L1, L2,L3	10 Hrs.
Matrix Method of Analysis (Flexibility Method) : Introduction, Axes and coordinates, Flexibility matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with static indeterminacy ≤ 3 .		
Module-5	L1, L2,L3	10 Hrs.
Matrix Method of Analysis (Stiffness Method): Introduction, Stiffness matrix, Analysis of		

continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with kinematic indeterminacy ≤ 3 .

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

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

CO1	Determine the moment in indeterminate beams and frames having variable moment of inertia and subsidence using slope deflection method.
CO2	Determine the moment in indeterminate beams and frames of no sway and sway using moment distribution method.
CO3	Construct the bending moment diagram for beams and frames by Kani's method.
CO4	Construct the bending moment diagram for beams and frames using flexibility method.
CO5	Analyze the beams and indeterminate frames by system stiffness method.

Text Books:

1.	Hibbeler R C, "Structural Analysis", Pearson Publication. 2009
2.	L S Negi and R S Jangid, "Structural Analysis", Tata McGraw-Hill Publishing Company Ltd.2010

Reference Books:

1.	Reddy C S, "Basic Structural Analysis", Tata McGraw-Hill Publishing Company Ltd. 2009
2.	Gupta S P, G S Pundit and R Gupta, "Theory of Structures", Vol II, Tata McGraw Hill Publications company Ltd.2006
3.	V N Vazirani and M M Ratwani, "Analysis Of Structures ", Vol. 2, Khanna Publishers.2001
4.	Wang C K, "Intermediate Structural Analysis", McGraw Hill, International Students Edition.2002

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

High-3, Medium-2, Low-1

Course Title	APPLIED GEOTECHNICAL ENGINEERING	Semester	V
Course Code	MVJ20CV53	CIE	50
Total No. of Contact Hours	50 L : T : P :: 3 : 2 : 0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs

Course objective is to: This course will enable the students to

- Understand the importance of Subsurface investigation in various Civil Engineering Projects.
- Compute the stresses in soil due to various types of loading.
- Conceptually use various theories related to bearing capacity of soil and their application in the design of shallow foundations and estimation of load carrying capacity of pile foundation
- Estimate internal stresses in the soil mass and application of this knowledge in proportioning of shallow and deep foundation fulfilling settlement criteria.
- Design of Pile foundation

Module -1	L3	10 Hrs.
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Prerequisites: Index and Engineering properties of soil

Soil Exploration: Objectives of soil exploration, Methods of exploration-Boring, Geophysical method- Seismic refraction method -Problems, Types of samples- Undisturbed, disturbed and representative samples , bore hole log, Depth, Number and disposition of bore holes

Drainage and Dewatering: .Objectives of Dewatering- Methods of Dewatering- Ditches and sumps, well point system, Vacuum Method, Electro- Osmosis method.

Demonstration of auger boring

Laboratory Sessions/ Experimental learning: (Self Learning)

- Demonstration of auger boring

Applications: (Self Learning)

- Understanding the scope of the subject.
- Identifying different types of soil.
- Knowledge about dewatering, soil exploration and its practical use.

Video link / Additional online information: (Self Learning)

- <https://www.digimat.in/nptel/courses/video/105105185/L55.html>
- <https://nptel.ac.in/courses/105/105/105105168/>

Module-2	L3	10 Hrs.
<p><i>Prerequisites: Effective stress, Total stress, and Pore water pressure</i></p> <p>Stress in Soils: Boussinesq's and Westergaard's Analysis for concentrated load Boussinesq's analysis –circular,, equivalent method,, rectangular loading, pressure distribution diagrams-On horizontal and vertical planes due to Boussinesq's point load Newmark's chart – Construction and Use</p> <p>Settlement: Computation of immediate and consolidation settlement</p> <p>Graphical method: Newmark's chart</p> <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Design of foundation for various civil structures: • As foundation resting on soil carries load of any particular structure, geotechnical engineering is applicable to design such stable foundations for various loads. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105105185/L55.html • https://nptel.ac.in/courses/105/105/105105168/ 		
Module-3	L3	10 Hrs.
<p><i>Prerequisites: Effective stress, Total stress, and Pore water pressure</i></p> <p>Lateral Earth Pressure: Active, Passive and earth pressure at rest, Rankine's theory for cohesion-less and cohesive soils, Coulomb's theory-Rebhann's and Culmann's graphical construction.-Only for coarse grained soils.</p> <p>Stability of Slopes: Assumptions, infinite and finite slopes, Use of Taylor's stability charts, Swedish slip circle method for C and C-ϕ (Method of slices) soils, Friction Circle method.</p> <p>Graphical method: Method of slices, Rebhann's and Culmann's method .</p> <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Design of earth retaining structures: Geotechnical engineering is also applicable to design and construct earth retaining structures like retaining wall and sheet pile useful for hill roads, landslides. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105105185/L55.html • https://nptel.ac.in/courses/105/105/105105168/ 		
Module-4	L3	10 Hrs.
<p><i>Prerequisites: Types of shallow and deep foundation</i></p> <p>Bearing Capacity of Shallow Foundation: Types of foundations, Determination of bearing capacity by Terzaghi's and BIS method (IS: 6403), General, Local and Punching shear failure. Effect of water table and eccentricity on Bearing capacity, Plate load test.</p>		

<p>Proportioning of shallow foundations: Isolated and combined footings (only two columns)</p> <p>Model making : Different types of shallow foundation</p> <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> To determine the bearing capacity of the soil of the selected foundation <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://www.digimat.in/nptel/courses/video/105105185/L55.html https://nptel.ac.in/courses/105/105/105105168/ 		
Module-5	L3	10 Hrs.
<p>Prerequisites: <i>Types of shallow and deep foundation</i></p> <p>Pile Foundations: Types and classification of piles, Pile load capacity in cohesion-less and cohesive soils by static formula, efficiency of pile group, group capacity of piles in cohesion-less and cohesive soils , negative skin friction, Settlement of piles, under-reamed piles (only introductory concepts – no derivation)</p> <p>Model making: Under-reamed pile foundation</p> <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Design of foundation for various structures: Foundation is required to transfer the load of super structure to foundation soil and to give stability to the super structure. The size and type of foundation is affected by the bearing capacity of soil. The GTE helps in design of foundation by investigating bearing capacity of soil. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://www.digimat.in/nptel/courses/video/105105185/L55.html https://nptel.ac.in/courses/105/105/105105168/ 		

Course outcomes: On completion of the course, students would be able to	
CO1	Plan and execute geotechnical site investigation program for different civil engineering projects
CO2	Explain stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
CO3	Estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
CO4	Determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure
CO5	Capable of estimating load carrying capacity of single and group of piles

Textbooks:												
1.	GopalRanjan and Rao A.S.R., Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi.											
2.	Punmia B C, Soil Mechanics and Foundation Engineering, Laxmi Publications co., New Delhi.											
Reference Books:												
1.	Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering, UBS Publishers and Distributors, New Delhi.											
2.	Braja, M. Das, Geotechnical Engineering; Thomson Business Information India (P) Ltd., India											
3.	T.W. Lambe and R.V. Whitman, Soil Mechanics-, John Wiley & Sons											
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	WATER SUPPLY AND TREATMENT ENGINEERING	Semester	V
Course Code	MVJ20CV54	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to: This course will enable the students to

- Analyze the variation of water demand and to estimate water requirement for a community.
- Evaluate the sources and conveyance systems for raw and treated water.
- Relate drinking water quality standards and to illustrate qualitative analysis of water.
- Design physical, chemical and biological treatment methods to ensure safe and potable water Supply.
- To have adequate knowledge on operation and maintenance of water supply and treatment process.

Prerequisites: *Environmental Studies, Introduction to Environmental engineering.*

Module-1	L1, L2	8 Hrs
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Introduction: Need for protected water supply. Demand of Water: Types of water demands - domestic demand, industrial, institutional, and commercial, public use, fire demand estimation factors affecting per capita demand, Variations in demand of water, Peak factor.

Design period and factors governing design period. Methods of population forecasting and numerical problems.

Laboratory Sessions/ Experimental learning:

- Population Forecasting and Urban Planning Practice: A Case Study

Applications:

- Water treatment

Video link:

- <https://nptel.ac.in/courses/105105201/>

Module-2	L1,L2,L3	8 Hrs
<p>Sources, Collection and Conveyance of Water: Surface and subsurface sources and Suitability with regard to quality and quantity.</p> <p>Intake structures – types. Factors to be considered in selection of site for intake structures.</p> <p>Collection and Conveyance of water: Types of pumps with working principles and numerical problems. Design of the economical diameter for the rising main.</p> <p>Pipe appurtenances, Valves, Fire hydrants and different pipe materials with their advantages and disadvantages. Factors affecting selection of pipe material.</p> <p>Laboratory Sessions/ Experimental learning: Based on population and per capita demand selection of water source, and design a intake structure to withdraw water from source: A Case Study</p> <p>Applications:</p> <ul style="list-style-type: none"> • Water treatment <p>Video link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105105201/ 		
Module-3	L1	8 Hrs
<p>Quality of Water: Objectives of water quality management. Concept of safe water, wholesome & palatability, water borne diseases. Sampling: Objectives, methods, and preservation techniques Examination of water: Objectives-physical, chemical, and microbiological Examinations (BIS 3025 and BIS 1622) using analytical and instrumental techniques. Drinking water standards BIS and WHO guidelines.</p> <p>Water Treatment: Objectives, Unit flow diagrams – significance of each unit: Aeration process, and Types.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Determine the physical and chemical characteristics of the given ground water sample. <p>Applications:</p> <ul style="list-style-type: none"> • Water treatment <p>Video link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105105201/ 		
Module-4	L1,L3	8 Hrs
<p>Sedimentation: Theory, settling tanks, types, and design. Coagulation and flocculation, Clari-flocculators (circular and rectangular). Theory, types of coagulants, coagulant feeding devices. Jar test apparatus</p> <p>Filtration: mechanism, theory of filtration, types of filters: slow sand, rapid sand, and pressure filters. Operation, cleaning. Operational problems in filters. Design of slow and rapid sand filter</p>		

without under drainage system.

Laboratory Sessions/ Experimental learning:

- Design and fabricate low-cost potable filtration unit for the treatment of surface water source.

Applications:

- Water treatment

Video link:

- <https://nptel.ac.in/courses/105105201/>

Module-5

L1,L2

8 Hrs

Miscellaneous treatment Process: Softening: Lime soda and Zeolite process. Estimation of Hardness. Fluoridation and De-fluoridation, Nalgonda Technique.

Disinfection: Theory of disinfection. Methods of disinfection with merits and demerits.

Chlorination: Types, Forms of application of Chlorination, Chlorine Demand, Break – point Chlorination.

Distribution system: Methods: Gravity, Pumping and Combined gravity and pumping system
Types of Distribution system. Service reservoirs and their capacity determination.

Laboratory Sessions/ Experimental learning:

- Determination of fluoride in the given ground water sample

Applications:

- Water treatment

Video link:

- <https://nptel.ac.in/courses/105105201/> <https://nptel.ac.in/courses/105105201/>

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

CO1	Estimate average and peak water demand for a community
CO2	Evaluate available sources of water, quantitatively and qualitatively and make appropriate choice for a community
CO3	Evaluate water quality and environmental significance of various parameters and plan suitable treatment system.
CO4	Design a comprehensive water treatment process to purify water to the required quality standards.
CO5	Design a network of water distribution system and operation and maintenance of water supply

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	S. K. Garg, Environmental Engineering vol-I, Water supply Engineering – M/s Khanna Publishers, New Delhi 2015
2.	B.C. Punmia and Ashok Jain, Environmental Engineering I-Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi 2016.

Reference Books:

1.	Howard S. Peavy, Donald R. Rowe, George T, Environmental Engineering - McGraw Hill International Edition, New York 2000
2.	CPHEEO Manual on water supply and treatment engineering, Ministry of Urban Development, Government of India, New Delhi.
3.	Mark.J Hammer, Water & Wastewater Technology, John Wiley & Sons Inc., New York, 2008.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	NUMERICAL METHODS AND APPLICATIONS	Semester	V
Course Code	MVJ20CV551	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable the students to

- Provide the necessary basic and advanced concepts in Transportation Problems
- Illustrate on assignments problems, game theory, decision analysis and numerical methods
- State the procedures for solving different kinds of problems occurring in engineering and technology

Module-1	L1, L2, L3	8 Hrs.
Transportation Problems The initial Basic feasible solution to transportation problem: North-West Corner Rule, The Row Minima Method, The Column Minima Method, Matrix Minima method, Vogel's Approximation Method.		
Module-2	L1, L2, L3	8 Hrs.
Assignment Problems Mathematical formulation of Assignment Problem, Solution of assignment problem: Complete Enumeration Method, Transportation Method, Simplex Method, Hungarian Assignment Method		
Module-3	L1, L2, L3	8 Hrs.
Game Theory Introduction, two-person zero-sum game, some basic terms, the maxmin and minmax principle, Pure Strategy problems, games without saddle points-mixed strategies problems, graphical solutions of $2 \times n$ and $m \times 2$ games, dominance property. CPM & PERT- project scheduling, critical path calculations, Crashing		
Module-4	L1, L2, L3	8 Hrs.
Decision Analysis Types of Decisions, Components of Decision-Making, Decision-making problems, Laplace Criterion (Bayes' Criterion Rationality), Maximin, Minmax, Maximax, Minimax, Savage, Hurwicz criterion, The expected Monetary Value, Expected value of perfect information, the expected		

opportunity loss, marketing problem production problem, Inventory problem, reliability and newspaper problem and steel production problem.

Module-5	L1, L2, L3	8 Hrs.
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Numerical Methods:
 Boundary Value Problems in Ordinary and Partial Differential Equations: Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two-dimensional Laplace's.
 Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

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

CO1	Build and solve Transportations models by Approximation method
CO2	Build and solve Assignment models by Simplex method
CO3	Solve with two players game and end of the module, students can able to find the value of the game & gain the knowledge to solve the real life problems
CO4	Identify the alternative course of action is a direct effect to decision theory.
CO5	Solve the numerical problems in engineering and technology.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. \sum (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	S.D. Sharma, "OPERATIONS RESEARCH Theory, Methods & Applications, ISBN: 978-93- 80803-38-8, KNRN Publications, 17 TH Edition, New Delhi.2009
2.	SankaraRao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, New Delhi, 2007.

Reference Books:

1.	Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2010.
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2.	Ravindran A, Philips D.T & Solbery. J.J, Operations Research: Principles and practise, John Wiley & Sons, New Yark, 1987.
3.	Hillier. F. S & Liberman. G. J, Operations Research, Second Edition, Holden Day inc, 1974

CO-PO Mapping

CO/P O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12
CO1	2	3	1	2	-	1	-	-	2	-	-	1
CO2	1	2	1	2	-	1	-	-	2	-	-	1
CO3	1	2	1	2	-	1	-	-	2	-	-	1
CO4	1	2	1	2	-	1	-	-	2	-	-	1
CO5	1	2	1	2	-	1	-	-	2	-	-	1

High-3, Medium-2, Low-1

Course Title	GROUND IMPROVEMENT TECHNIQUES	Semester	V
Course Code	MVJ20CV552	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable students to

- State the engineering behavior of natural soils & various methods adopted for Evaluation of soil conditions
- Apply knowledge of mathematics, Science and Geotechnical Engineering to solve problems in the field of modification by adopting Mechanical and Geo-synthesis methods for construction of civil engineering structures
- Explain the techniques and methods adopted for dewatering and grouting methods
- Apply the knowledge on stabilization of soils.
- Illustrate the various reinforcement techniques adopted for stabilization of soils.

Prerequisites: Knowledge on formation of soil, types of soil and its various geotechnical characteristics.

Module-1

L1,L2,L3

8Hrs

Rock cycle: classification of rocks and rocks forming minerals; Weathering process and formation of soil; Role of ground improvement in foundation Engineering; Methods of Ground improvement – Geotechnical Problems in alluvial, lateritic, and black cotton soils. Selection of Suitable ground improvement techniques based on soil conditions- In situ and laboratory tests to characterize problematic soils; Mechanical, Hydraulic, Physico-chemical, Electrical, Thermal methods, etc. and their applications

Laboratory Sessions:

- Identification of various soils and their characteristics

Applications:

- Study on physical and chemical characteristics of various soils
- Based upon the soil nature, find out the suitable method adopted for stabilization of soils

Module-2

L1,L2,L3

8Hrs

Mechanical Modification – Principles of soil densification – Properties of Compacted soil, Compaction control tests, Specification of compaction requirements, Blasting, Vibro-compaction, Dynamic Tamping and Compaction piles.

Geo-synthetics – Types - general applications - types of geotextiles and geo-grids -

physical and strength properties of geotextiles and geo-grids - behavior of soils on reinforcing with geotextiles and geo-grids - design aspects with geotextiles and geo-grid.

Laboratory Sessions:

- Analyzing the various mechanical methods adopted for various types of soil

Applications:

- Understand the various mechanical instruments used for stabilization
- Type and method adopted for stabilization of soils

Video link / Additional online information:

- Water resource system : <https://nptel.ac.in/courses/105108130/>

Module-3

L1,L2,L3

8Hrs

Hydraulic Modification – Objectives and techniques, traditional dewatering methods and their choice, Design of dewatering system, Electro-osmosis, Filtration, Drainage and seepage control with Geo- synthetics, Preloading and vertical drains, Electro-kinetic dewatering, capacity of pumps and pumps design, installation and operation of dewatering systems – single line, two-line, flow to a single well, multiple well systems

Grouting: Introduction, effect on properties of soils, Grouting – types - desirable characteristics of grouts

- grouting methods - grouting pressure - grouting materials - grouting technology; - permeation grouting - compaction grouting - soil fracture grouting - jet grouting - application and limitations - slab jacking, grouted columns - application to dams.

Laboratory Sessions:

- Identification of dewatering and grouting methods for stabilization of soils

Applications:

- Decision making for selection of suitable pumping methods
- Grouting methods adopted for Dam, Reservoir and tunnel construction

Module-4

L1,L2,L3

8Hrs

Stabilization of soils: Mechanical Stabilization -Soil aggregate mixtures, properties and proportioning techniques, soft aggregate stabilization, compaction, field compaction control; Cement Stabilization- Mechanism, factors affecting and properties, use of additives, design of soil cement mixtures, construction techniques; Lime and Bituminous Stabilization- Type of admixtures, mechanism, factors affecting, design of mixtures, construction methods

Laboratory Sessions:

- Verification of suitable chemical methods for stabilization of soils.

Applications:

- Justification of suitable additives used for chemical stabilization

<ul style="list-style-type: none"> Evaluation of effective utilization of chemicals in the soil stabilization 		
Module-5		L1,L2,L3
8Hrs		
<p>Soil improvement by using Reinforcing Elements - Introduction to Reinforced Earth - Load Transfer Mechanism and Strength Development - Soil Types - Reinforcing Materials - Reinforced Earth Retaining walls - Reinforced Embankments - Soil Nailing.</p> <p>Ground Improvement Techniques for Geotechnical Earthquake Engineering, Case studies on ground improvement techniques</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> Design the suitable method of Reinforcement. <p>Applications:</p> <ul style="list-style-type: none"> Stabilization of soil by adopting of various reinforcement techniques Evaluation of Ground improvement techniques in Seismic Hazard zones 		

Course outcomes:

CO1	Restate the natural processes involved in the formation of soil as well as find out the suitable method for stabilization of soils.
CO2	Address the mechanical modifications and geo-synthesis effects on soil
CO3	Implement the various dewatering methods and grouting methods
CO4	Analysis the various chemical methods adopted for Stabilization of soils
CO5	Select the suitable method for stabilization of soil by Reinforcement techniques.

Scheme of Evaluation

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	Purushothama Raj P, "Ground Improvement Techniques", Laxmi Publications, New Delhi.
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2.	Manfred Hausmann , "Engineering principles of ground modification", Mc Graw Hill Pub. Co.
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Reference Books:	
1.	Koerner R.M, "Construction and Geotechnical Method in Foundation Engineering", Mc Graw Hill Pub. Co.
2.	Bell, F.G., "Methods of treatment of unstable ground", Butterworths, London
3.	Ingles. C.G. and Metcalf J.B , "Soil Stabilization; Principles and Practice", Butterworths
4.	Principles and Practice of Ground Improvement, Jie Han (Indian Edition), Wiley Publishers

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

High-3, Medium-2, Low-1

Course Title	ALTERNATE BUILDING MATERIALS	Semester	V
Course Code	MVJ20CV553	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable the students to

- Relate environmental issues due to building materials and the energy consumption in manufacturing building materials
- Demonstrate the various masonry blocks, masonry mortar and structural behavior of masonry under compression.
- Relate the alternative building materials in the present context.
- Explain the alternative building technologies which are followed in present construction field.

Module-1

L1 L2

8 Hrs.

Prerequisites: Basic Knowledge of different building materials.

Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global Warming, and construction industry. Green concepts in buildings, green building ratings – IGBC and LEED manuals – mandatory requirements.

Rainwater harvesting & solar passive architecture. Environmentally friendly and cost-effective building technologies.

Laboratory Sessions/ Experimental learning (Self Learning):

- Developing models for Rainwater harvesting.

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105102195/>

Module-2

L1 L2

8 Hrs.

Elements of Structural Masonry : Elements of Structural Masonry, Masonry materials, requirements of masonry units : characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal- G blocks and Stabilized mud blocks. Manufacture of stabilized blocks.

Structural Masonry Mortars: Mortars, cementitious materials, sand, natural & manufactured, types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar.

<p>Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Strength of Prisms/wallets and walls, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry, Design of masonry compression elements subjected to axial load (Only Theory)</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Presentation regarding different types of mortars <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Knowledge about the behaviour and strength of basic mortars. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105106197/ 		
Module-3	L1 L2	8 Hrs.
<p>Alternate Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from a ground industrial waste, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes.</p> <p>Laboratory Sessions/ Experimental learning (Self Learning):</p> <ul style="list-style-type: none"> • Comparing different Alternate Building Materials <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105102195/ 		
Module-4	L1 L2	8 Hrs.
<p>Alternate Building Technologies: Alternatives for wall constructions, composite masonry, confined masonry, cavity walls, rammed earth, Ferrocement and ferro concrete building components, Materials and specifications, Properties, Construction methods, Applications Top-down construction, Mivan Construction Technique.</p> <p>Alternate Roofing Systems: Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Presentation on advantages of the above alternate building technologies <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105102195/ 		

Module-5		L1 L2	8 Hrs.
<p>Equipment for Production of Alternate Materials: Machines for manufacture of concrete, Equipment's for production of stabilized blocks, Moulds and methods of production of precast elements.</p> <p>Cost concepts in buildings: Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Presentation on precast concrete elements. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/102/105102012/ 			
Course outcomes: On completion of the course, students would be able to			
CO1	Identify the problems of Environmental issues concerned to building materials and cost effective building technologies.		
CO2	Identify appropriate type of masonry unit and mortar for civil engineering constructions		
CO3	Design Structural Masonry Elements under Axial Compression.		
CO4	Analyze different alternative building materials which will be suitable for specific climate and in an environmentally sustainable manner. Also capable of suggesting suitable agro and industrial wastes as a building material.		
CO5	Identify various types of alternative building materials and technologies and design a energy efficient building by considering local climatic condition and building material.		
Scheme of Evaluation:			
		Details	Marks
		Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	30
		Quizzes	2x2 = 4
		Activities / Experimentations related to courses/Assignment	8
		Mini Projects / Case Studies	8
		Semester End Examination	50
		Total	100
Textbooks:			
1.	KS Jagadish, B V Venkatarama Reddy and K S Nanjunda Rao, "Alternative Building Materials and Technologies", New Age International publications.		
2.	Arnold W Hendry, "Structural Masonry", Macmillan Publishers.		

Reference Books:												
1.	RJS Spence and DJ Cook, "Building Materials in Developing Countries", Wiley publications.											
2.	LEED India, Green Building Rating System, IGBC publications.											
3.	IGBC Green Homes Rating System, CII publications.											
CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	1	-	-	-	-	2	1
CO2	2	1	1	1	-	1	-	-	-	-	-	1
CO3	2	1	2	1	1	1	-	-	-	-	1	1
CO4	1	2	1	1	1	1	1	-	-	-	-	1
CO5	1	2	2	1	1	2	1	-	1	1	-	1

High-3, Medium-2, Low-1

Course Title	HIGHWAY ENGINEERING	Semester	V
Course Code	MVJ20CV554	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable the students to

- Brief on different modes of transportation systems, history, development of highways and the organizations associated with research and development of the same in INDIA.
- Explain on Highway planning and development considering the essential criteria's (engineering and financial aspects, regulations and policies, socio economic impact).
- Detail on different aspects of geometric elements and train them to design geometric elements of a highway network.
- Analyze pavement and its components, pavement construction activities and its requirements.
- Evaluate the highway economics by B/C, NPV, IRR methods and also introduce the students to highway financing concepts.

Module-1

L1, L2

8 Hrs.

Principles of Transportation Engineering: Importance of transportation, Different modes of transportation and comparison, Characteristics of road transport Jayakar committee recommendations, and implementation – Central Road Fund, Indian Roads Congress, Central Road Research Institute

Highway Development and Planning: Road types and classification, road patterns, planning surveys, master plan – saturation system of road planning, phasing road development in India, problems on best alignment among alternate proposals Salient Features of 3rd and 4th twenty year road development plans and Policies, Present scenario of road development in India (NHDP & PMGSY) and in Karnataka (KSHIP & KRDC) Road development plan - vision 2021.

Laboratory Sessions/ Experimental learning

- Traffic volume count, Extensive Survey

Camp. Applications

- Selection of centerline for road project

Module-2

L1, L2

8 Hrs.

Highway Alignment and Surveys: Ideal Alignment, Factors affecting the alignment,

Engineering surveys-Map study, Reconnaissance, Preliminary and Final location & detailed survey, Reports and drawings for new and re-aligned projects.		
Highway Geometric Design: Cross sectional elements–width, surface, camber, Sight distances–SSD, OSD, ISD, HSD, Design of horizontal and vertical alignment–curves, super-elevation, widening, gradients, summit and valley curves.		
Laboratory Sessions/ Experimental learning		
<ul style="list-style-type: none"> Traffic volume count, Extensive Survey 		
Camp Applications		
<ul style="list-style-type: none"> DPR preparation, Designing of Highway elements 		
Module-3	L1, L2	8 Hrs.
Pavement Materials: Subgrade soil - desirable properties-HRB soil classification-determination of CBR and modulus of subgrade reaction with Problems Aggregates-Desirable properties and tests, Bituminous materials Explanation on Tar, bitumen, cutback and emulsion-tests on bituminous material		
Pavement Design: Pavement types, component parts of flexible and rigid pavements and their functions, ESWL and its determination (Graphical method only)-Examples		
Laboratory Sessions/ Experimental learning		
<ul style="list-style-type: none"> Highway Material lab. Geo-Technical 		
Lab Applications		
<ul style="list-style-type: none"> Understanding the properties of Highway materials 		
Module-4	L1, L2	8 Hrs.
Pavement Construction: Design of soil aggregate mixes by Rothfuch's method. Uses and properties of bituminous mixes and cement concrete in pavement construction.		
Earthwork; cutting and Filling, Preparation of subgrade, Specification and construction of (i) Granular Sub base, (ii) WBM Base, (iii) WMM base, (iv) Bituminous Macadam, (v) Dense Bituminous Macadam,(vi) Bituminous Concrete, (vii) Dry Lean Concrete sub base and PQC,(viii) concrete roads.		
Laboratory Sessions/ Experimental learning		
<ul style="list-style-type: none"> Understanding the properties of Highway materials Applications 		
<ul style="list-style-type: none"> To understand the pavement construction procedure 		
Module-5	L1, L2	8 Hrs.
Highway Drainage: Significance and requirements, Surface drainage system and design-Examples, sub surface drainage system, design of filter materials, Types of cross drainage structures, their choice and location		

Highway Economics: Highway user benefits, VOC using charts only-Examples, Economic analysis - annual cost method-Benefit Cost Ratio method-NPV-IRR methods- Examples, Highway financing- BOT-BOOT concepts

Laboratory Sessions/ Experimental learning:

- Identification of best suitable subsurface drainage system

Applications:

- Designing the Highway drainage

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

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

CO1	Restate the different modes of transportation, history, organizations. Also understanding of planning, types of roads and highway projects.
CO2	Get insight in to alignment, essential surveys and geometrical elements with specifications as per IRC and design of highway geometric elements
CO3	Understand the pavement and its components and design of the pavement
CO4	Understand pavement and its components, pavement construction activities and its requirements
CO5	Understand pavement and its components, pavement construction activities and its requirements Evaluating the highway economics by B/C, NPV, IRR, methods and also to introduce highway financing concepts.

Text Books:

1.	S K Khanna and C E G Justo, " Highway Engineering", Nem Chand Bros, Roorkee, 1991
2.	L R Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi. 2017

Reference Books:	
1.	R Srinivasa Kumar, "Highway Engineering", University Press. 2001
2.	K.P.subramanium, "Transportation Engineering", SciTech Publications, Chennai. 2000
3.	Relevant IRC Codes
4.	Specifications for Roads and Bridges-MoRT&H, IRC, New Delhi. 2002
5.	C. Jotinkhistry, B. Kent lal, "Transportation Engineering", PHI Learning Pvt. Ltd. New Delhi. 1998.

CO-PO Mapping

CO/P O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12
CO1	2	1	2	-	1	-	-	-	1	-	1	1
CO2	2	1	2	-	1	-	-	-	1	-	1	1
CO3	2	1	2	-	1	-	-	-	1	-	1	1
CO4	2	1	2	-	1	-	-	-	1	-	1	1
CO5	2	1	2	-	1	-	-	-	1	-	1	1

High-3, Medium-2, Low-1

Course Title	COMPUTER AIDED BUILDING PLANNING & DRAWING	Semester	V
Course Code	MVJ20CVL56	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	SEE	50
No. of Contact Hours/Week	4	Total	100
Credits	2	Exam Duration	3Hrs
<p>Course objective is to: This course will enable the students to</p> <ul style="list-style-type: none"> Identify, formulate, and solve engineering problems of RC elements subjected to different kinds of loading. Follow a procedural knowledge in designing various structural RC elements. Impart the culture of following the codes for strength, serviceability, and durability as an ethics. Provide knowledge in analysis and design of RC elements for the success in competitive examinations. 			
Module-1			L3,14
<p>Engineering design principles, interactive design using workstations, and software tools: Usage of all draw tools. Usage of all modify tools. Using Text: Single line text, Multiline text. Special Features: View tools, Layers concept, Dimension tools, Hatching, creating blocks. Customizing toolbars, Working with multiple drawings Introduction to Autocad 3D, basic tools, and commands</p>			
Module-2			L3, L4
<p>Drawing of structural Detailing Elements: Size Stone Masonry Beam Detailing: Simply supported, Cantilever Beam Footing detailing: Isolated, Stepped. Simple Steel Roof Truss with bolted connection. Modeling of staircase and two room residential building using 3D modelling tools.</p>			
Module-3			L3, L4
<p>Building Drawings and generation of design basis Report: Educational Institution Commercial building Residential building Multistorey structure</p> <p>All drawings should be submitted with elevation and cross section with Plan showing sanitary and electrical layout.</p>			

Video link:

- <http://www.nptelvideos.in/2012/12/computer-aided-engineering-design.html>

Scheme of Evaluation:

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

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

CO1	Create drawings through editing and plotting techniques
CO2	Practice the AutoCAD commands for drawing 2D & 3D building drawings required for different Civil Engineering applications
CO3	Plan and draw Civil Engineering Buildings as per aspect and orientation

Reference Books:

1.	SP 34: Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards.
2.	Beginning AutoCAD 2015, by Cheryl R. Shroc.

CO-PO Mapping

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

High-3, Medium-2, Low-

Course Title	HIGHWAY ENGINEERING LABORATORY	Semester	V
Course Code	MVJ20CVL57	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective is to: This course will enable the students to

- Explain the properties of Aggregates and different test pertaining to Aggregates
- Explain procedures of conducting tests on bitumen.
- Demonstrate on properties of bitumen for field condition

Prerequisites: Basic geotechnical engineering, theory of stress & strain

S.NO	Experiments	L3,L4
1	Determination of Crushing strength of aggregates by Compression test.	
2	Determination of Toughness of an aggregate by Impact test.	
3	Determination of Hardness of an aggregate by Abrasion test.	
4	Shape tests on aggregates.	
5	Test on Stripping value of aggregates.	
6	Determination of penetration value of bitumen.	
7	Determination of softening point of bitumen using ring ball apparatus.	
8	Test on viscosity of bitumen.	
9	Test on ductility value of bitumen.	
10	Determination of flash and fire point of bitumen.	
11	Specific gravity test on bitumen.	
12	CBR Test	

Video link / Additional online information: (Self Learning)

- http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Transportation_Engineering_Lab/labs/index.html
- <https://www.digimat.in/nptel/courses/video/105106203/L01.html>

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

CO1	Test the aggregates for Crushing, Hardness and Toughness properties
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CO2	Test neat bitumen for field applications
CO3	Restate the testing procedure on Aggregate and neat Bitumen

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Tota l	50 marks

Reference Books:	
1.	Highway Material Testing – S K Khanna- C.E.G. Justo , and Veera Raghavan A Nemchand Bros- Roorkee, 2010
2.	IS 456-2016, IS:383-1970, IS:2386-1 (1963) and IRC Publications
3.	ASTM Standards for Aggregate and Bitumen Testing

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

High-3, Medium-2, Low-1

Course Title	GEOTECHNICAL ENGINEERING LABORATORY	Semester	V
Course Code	MVJ20CVL58	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective: Students should be able to,

- Examine laboratory tests and to classify the soil as per IS codal procedures
- Identify laboratory tests to determine index properties of soil
- Investigate shear strength and consolidation characteristics of soils

Prerequisites: Basic geotechnical engineering, theory of stress & strain

S.NO	Experiments	L3,L4
1	Determination of Specific Gravity of Soil Solids by Density Bottle Method	
2	Determination of Specific Gravity of Soil Solids by Pycnometer Method	
3	Determination of Water Content of Soil by Oven Drying Method	
4	Determination of Water Content of Soil by infrared moisture method- Demonstration	
5	Determination of Particle size Distribution by Sieve Analysis	
6	Determination of Particle size Distribution by Hydrometer analysis	
7	Determination of Field Density of Soil by Core-cutter Method	
8	Determination of Field Density by Sand Replacement Method	
9	Determination of the Liquid Limit by Casagrande Method	
10	Determination of the Liquid Limit by Cone Penetration Method	
11	Determination of Plastic Limit of the Soil	
12	Determination of Shrinkage Limit	
13	Moisture Content–Dry Density Relationship by Standard Proctor Compaction Test	
14	Moisture Content–Dry Density Relationship by Modified Proctor Compaction Test	
15	Determination of Permeability of a Soil sample by Constant-head Method	

16	Falling Head Permeability test for fine Grained Soils
17	Unconfined Compression Test.
18	Determination of Shear Parameters by Direct Shear Test
19	Determination of Shear Parameters of a given Soil sample of Soil by Triaxial Shear Test
20	One-Dimensional Consolidation Test. -Demonstration
21	Vane Shear Test-Demonstration
22	Demonstration of Miscellaneous Equipments such as Augers, Proctor's needle.
23	Demonstration of Determination of Relative Density of Sands.
Video link / Additional online information: (Self Learning)	
<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/101/105101201/ • https://nptel.ac.in/courses/105/101/105101160/ 	
Course outcomes: On completion of the course, students would be able to	
CO1	Examine physical and index properties of the soil
CO2	Classify based on index properties and field identification
CO3	Identify OMC and MDD, plan and assess field compaction program
CO4	Analyze shear strength and consolidation parameters to assess strength and deformation characteristics.
CO5	Investigate in-situ shear strength characteristics (SPT- Demonstration)

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

Reference Books:	
1.	Punmia B C, Soil Mechanics and Foundation Engineering- (2017), 16th Edition, Laxmi Publications co., New Delhi.
2.	Lambe T.W., "Soil Testing for Engineers", Wiley Eastern Ltd., New Delhi.
3.	Head K.H., "Manual of Soil Laboratory Testing" Vol. I, II, III, Princeton Press

4.	Bowles J.E., "Engineering Properties of Soil and Their Measurements",- McGraw Hill Book Co. New York
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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	1	-	-
CO2	2	1	1	-	1	1	1	-	-	1	-	-
CO3	1	2	2	2	-	-	1	-	1	1	-	-
CO4	1	-	1	2	1	2	1	-	1	1	-	-
CO5	2	1	-	1	-	1	1	-	1	1	-	-

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL STUDIES	Semester	V
Course Code	MVJ20ENV59	CIE	50
Total No. of Contact Hours	15 L: T: P :1 :0 :0	SEE	50
No. of Contact Hours/week	1	Total	100
Credits	1	Exam. Duration	3 Hrs.

Course objective is to: This course will enable the students to

- Relate to interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes; Study drinking water quality standards and to illustrate qualitative analysis of water.
- Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability.

Prerequisites: *Basic Science*

Module-1	L1, L2	3 Hrs
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Introduction to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.
Ecosystems (Structure and Function): Forest, Desert, Rivers, Ocean
Biodiversity: Types, Hot spots; Threats and Conservation of biodiversity, Deforestation.

Video link:

- <https://nptel.ac.in/courses/127/106/127106004/>

Module-2	L1,L2	3 Hrs.
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Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.
Natural Resource Management (Concept and case-study): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Video link:

- <https://nptel.ac.in/courses/121/106/121106014/>

Module-3		L1	3 Hrs.
<p>Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.</p> <p>Waste Management & Public Health Aspects: Bio-medical Waste; Solid waste; Hazardous waste; E-waste.</p> <p>Video link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/122/106/122106030/ • https://nptel.ac.in/courses/105/103/105103205/ • https://nptel.ac.in/courses/120/108/120108005/ • https://nptel.ac.in/courses/105/105/105105160/ 			
Module-4		L1,	3 Hrs.
<p>Global Environmental Concerns (Concept, policies, and case-studies): Global Warming Climate Change; Acid Rain; Ozone Depletion; Fluoride problem in drinking water.</p> <p>Video link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/122/106/122106030/ • https://nptel.ac.in/courses/120108004/ • https://onlinecourses.nptel.ac.in/noc19_ge23/preview 			
Module-5		L1,L2	3 Hrs.
<p>Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO 14001.</p> <p>Video link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/102/105102015/ • https://nptel.ac.in/courses/120/108/120108004/ 			
<p>Course outcomes: On completion of the course, students would be able to</p>			
CO1	Describe the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.		
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.		

CO3	Demonstrate ecology knowledge of a complex relationship between biotic and Abiotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	40
Quizzes / Assignment		10
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	Environmental Studies Benny Joseph Tata Mc Graw – Hill. 2 nd Edition, 2012
2.	Environmental Studies S M Prakash Pristine Publishing House, Mangalore 3 rd Edition, 2018.

Reference Books:

1	Principals of Environmental Science and Engineering, Raman Siva kumar, Cengage learning, Singapur, 2 nd Edition, 2005
2	Environmental Science – working with the Earth G.Tyler Miller Jr. Thomson Brooks /Cole, 11 th Edition, 2006
3	Textbook of Environmental and Ecology, Pratiba Singh, Anoop Singh & Piyush Malaviya , ACME Learning Pvt. Ltd. New Delhi, 1 st Edition.

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

High-3, Medium-2, Low-1

Course Title	UNIVERSAL HUMAN VALUES II - UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT	Semester	V
Course Code	MVJ20UHV510	CIE	50
Total No. of Contact Hours	30 L: T : P : 1 : 2 :0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	2	Exam. Duration	2 Hrs.

<p>Course objective is to: This course will enable the students to</p> <ul style="list-style-type: none"> • Appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. • Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. • Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature. 		
<p>Prerequisites: <i>Universal Human Values I</i></p>		
Module-1	L1,L2	6 Hrs
<p><i>Review on Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario,</i></p> <p>Value Education: Understanding Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, , Method to Fulfill the Basic Human Aspirations,</p> <p>Practical Sessions: Sharing about Oneself (Tutorial 1), Exploring Human Consciousness (Tutorial 2), Exploring Natural Acceptance (Tutorial 3)</p>		
<p>Video link:</p> <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=85XCw8SU084 • https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz 		

<ul style="list-style-type: none"> • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		
Module-2	L1,L2	6 Hrs
<p><i>Review on Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body.</i></p> <p>Harmony in the Human Being: Distinguishing between the Needs of the Self and the Body, Understanding Harmony in the Self, Programme to ensure self-regulation and Health.</p> <p>Practical Sessions: Exploring the difference of Needs of Self and Body (Tutorial 4), Exploring Sources of Imagination in the Self (Tutorial 5), Exploring Harmony of Self with the Body (Tutorial 6).</p> <p>Video link:</p> <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=GpuZo495F24 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		
Module-3	L1,L2	6 Hrs
<p><i>Review on Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.</i></p> <p>Harmony in the Family and Society: 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Vision for the Universal Human Order,</p> <p>Practical Sessions: Exploring the Feeling of Trust (Tutorial 7), Exploring the Feeling of Respect (Tutorial 8), Exploring Systems to fulfill Human Goal (Tutorial 9).</p> <p>Video link:</p> <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=F2KVV4WNnS8 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		
Module-4	L1,L2	6 Hrs
<p>Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.</p> <p>Practical Sessions: Exploring the Four Orders of Nature (Tutorial 10), Exploring Co-existence in Existence (Tutorial 11).</p> <p>Video link:</p> <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=1HR-QB2mCF0 • https://www.youtube.com/watch?v=lfN8q0xUSpw • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 		

Module-5		L1,L2	6 Hrs
<p><i>Review on Natural Acceptance of Human Values, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies.</i></p> <p>Implications of the Holistic Understanding – a Look at Professional Ethics: Definitiveness of (Ethical) Human Conduct, Competence in Professional Ethics, Strategies for Transition towards Value-based Life and Profession</p> <p>Practical Sessions: Exploring Ethical Human Conduct (Tutorial 12), Exploring Humanistic Models in Education (Tutorial 13), Exploring Steps of Transition towards Universal Human Order (Tutorial 14).</p> <p>Video link:</p> <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=BikdYub6RY0 • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw 			
Course outcomes: On completion of the course, students would be able to			
CO1	Explore themselves, get comfortable with each other and with the teacher		
CO2	Enlist their desires and the desires are not vague.		
CO3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking		
CO4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them		
CO5	Present sustainable solutions to the problems in society and nature		

Scheme of Evaluation			
Details			Marks
CIE (Average of three IA each carries 40 Marks)		CIE(50)	40
Activities / Assignment			10
Semester End Examination		SEE (50)	50
Total			100
Text Books:			
1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/AicteSipUHV_download.php		
2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN		

	978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2
Reference Books:	
1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

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

High-3, Medium-2, Low-1

Course Title	HYDROLOGY AND IRRIGATION ENGINEERING	Semester	VI
Course Code	MVJ20CV61	CIE	50
Total No. of Contact Hours	50 L: T: P:: 3: 2: 0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- Explain the concept of hydrology and analyse hydrological data
- Measure the components of hydrological cycle.
- Analyse the flood hydrograph, unit hydrograph and S curve hydrograph.
- Demonstrate the system of irrigation.
- List and explain the Irrigation structures.

Module-1

L1, L2, L3

10 Hrs

Prerequisite: Knowledge on Water in earth, Water cycle, weather & climate

Hydrology: Introduction- Surface and Ground water Hydrology, Importance and Application of Hydrology in Engineering, Hydrologic cycle- Horton's representation, Engineering representation, Descriptive representation. Climate, Weather - Meteorological measurements

Precipitation: Forms and types of precipitation, measurement of precipitation (Simon's gauge & Syphon gauge only), and selection of rain gauge station. Adequacy of rain gauges, methods of computing average rainfall, interpolation of missing data, adjustment of missing data by double mass curve method, Hyetograph and mass curve of rainfall, Frequency analysis.

Laboratory Sessions/ Experimental learning: Determination of the average annual rain fall of the river basin by collecting the data

- Case study on the Precipitation data Analysis

Applications:

- Measuring the rainfall in the field
- Determining the missing rainfall data
- Presenting of rainfall data for Hydrological analysis

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104029/#>

Module-2

L1, L2, L3

10 Hrs

Prerequisite: precipitation and Runoff

Losses from precipitation: Evaporation: Definition, factors affecting, measurement (Class A pan). Estimation using empirical methods (Meyer's and Rohwer's equation),

evaporation control. Evapo-transpiration: Definition, factors affecting, measurement, estimation (Blaney criddle method)

Infiltration: Definition, factors affecting measurement (double ring infiltrometer), infiltration indices, Horton's equation of infiltration.

Runoff –Process, Estimation of runoff and Factor affecting runoff.

Laboratory Sessions/ Experimental learning: Measurement of evaporation rate of a reservoir and identification of evaporation control measures

- Case study on Evaporation control

Applications:

- Evaporation rate measurement the in the reservoir
- Measurement of infiltration rate for the different landscape
- Measuring the runoff in a river

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104029/#>

Module-3

L1, L2, L3

10 Hrs

Prerequisite: Flood & Drought,

Hydrographs: Definition, components of hydrographs, unit hydrograph and its derivation from simple storm hydrograph, base flow separation, Unit Hydrograph, S Hydrograph – Applications and numerical problems **Estimation of flood & flood**

routing: Definition of flood, methods of estimation of flood, Flood routing- Classification and introduction to Flood routing techniques, Flood control and management.

Laboratory Sessions/ Experimental learning:

- Plotting the hydrograph of a river basin by collecting the relevant data.
- Case study on Flood mitigation measures

Applications:

- Analyzation of runoff and Rainfall relationship
- Prediction of Flood
- Proposing the flood mitigation measures

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104029/>

Module-4

L1, L2, L3

10 Hrs

Prerequisite: Irrigation, Crops, and Crops seasons.

Irrigation Engineering: Introduction, need for irrigation, advantages and disadvantages of irrigation, Systems of irrigation: Gravity irrigation, lift irrigation, Flow irrigation, Furrow Irrigation, Strip Irrigation, Border Irrigation, Basin Irrigation, Micro Irrigation-Components- Advantages and disadvantages.

Water Requirement of Crops: Introduction, definitions, crop seasons of India, water requirement of a crop, duty, delta, base period. Consumptive use, Irrigation efficiencies, Assessment of irrigation water.

Laboratory Sessions/ Experimental learning:

- Identifying the suitable irrigation system in the particular field to improve the productivity
- Case study on Selection of irrigation methods

Applications:

- Increasing the water productivity
- Analyzing Effective Irrigation water management techniques
- Design the irrigation system

Video link / Additional online information:

- <https://nptel.ac.in/courses/10512159/>
- <https://nptel.ac.in/courses/105102159/>

Module-5	L1, L2, L3	10 Hrs
<p>Prerequisite: <i>Open channel flow</i></p> <p>Irrigation Structures: Definition, Irrigation water storage and water diversion structures, Dam- Components, types, functions, Tank- Components and Functions, Diversion head works, weir, River training works- Components.</p> <p>Canals: Definition, Types of canals, Alignment of canals, Design of canals by Kennedy's and Lacey's methods- Problems, Canal Fall and its types.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Identification of irrigation structure in a given region • Case study on canal design <p>Applications:</p> <ul style="list-style-type: none"> • Design of water storage structures, Design of canal • Rehabilitation of Irrigation structures <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105103096/ 		

Course Outcome	
CO1	Use the precipitation data for the hydrological research
CO2	Predict the components of Hydrological cycle
CO3	Use the hydrographs of the basin for runoff analysis
CO4	Illustrate the suitable irrigation system by calculating the water requirement of the crop
CO5	Explain the various irrigation structures

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses / Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1	K. Subramanya, "Engineering Hydrology", 4 th Edition Tata McGraw Hill Publishers, New Delhi, 2017
2	Punmia B C and Lal Pandey, "Irrigation and Water Power Engineering" Lakshmi Publishers, 2018

Reference Books:	
1.	Jayarami Reddy, "A Text Book of Hydrology", Lakshmi Publications, New Delhi, 2019
2	Te Chow, V., "Applied hydrology", Tata McGraw-Hill Education, 2010.

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

High-3, Medium-2, Low

Course Title	DESIGN OF RC STRUCTURES	Semester	VI
Course Code	MVJ20CV62	CIE	50
Total No. of Contact Hours	50 L: T: P: 3: 2: 0	SEE	50
No. of Contact Hours/Week	5	Total	100
Credits	4	Exam Duration	3Hrs

Course objective is to:

- Identify, formulate, and solve engineering problems of RC elements subjected to different kinds of loading.
- Illustrate a procedural knowledge in designing various structural RC elements.
- Impart the culture of following the codes for strength, serviceability, and durability as an ethics.
- Provide knowledge in analysis and design of RC elements for the success in competitive examinations.

Module-1	L1,L2,L3	10 Hrs
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Pre requisites: Basic knowledge of Structural Analysis

Introduction to Limit State Design and Serviceability: Introduction to working stress method, Difference between Working stress and Limit State Method of design, Modular Ratio and Factor of Safety. Philosophy and principle of limit state design with assumptions. Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Limiting deflection, short term deflection, long term deflection. Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam. Calculation of deflection and cracking of singly reinforced beam only.

Laboratory Sessions/ Experimental learning: (Self Learning)

- To compare various components designed using older methods and limit state method.
- Comparison of components designed using older methods and limit state method

Applications: (Self Learning)

- To access the importance of strength and serviceability criteria in the design.

Video link:

- <https://nptel.ac.in/courses/105/105/105105105/>

Module-2	L1,L2,L3	10 Hrs
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Limit State Analysis of Beams: Analysis of singly reinforced, doubly reinforced, and flanged beams for flexure and shear.

Laboratory Sessions/ Experimental learning: (Self-Learning) <ul style="list-style-type: none"> • Generate excel sheets for analysis of beams Applications: <ul style="list-style-type: none"> • In analyzing beams of single and multistoried buildings. Video link: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 		
Module-3	L1,L2,L3	10 Hrs
Limit State Design of Beams: Design of singly and doubly reinforced beams, Design of flanged beams for shear, design for combined bending and torsion as per IS-456. Laboratory Sessions/ Experimental learning: (Self-Learning) <ul style="list-style-type: none"> • Generate excel sheets for design of beams/ develop 3D models in software to understand detailing. Applications: <ul style="list-style-type: none"> • In designing beams of single and multistoried buildings. Video link: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 		
Module-4	L1,L2,L3	10 Hrs
Limit State Design of Slabs and Stairs: Introduction to one way and two-way slabs, Design of cantilever, simply supported and one-way continuous slab. Design of two-way slabs for different boundary conditions. Design of dog legged and open well staircases. Importance of bond, anchorage length and lap length. Laboratory Sessions/ Experimental learning: (Self-Learning) <ul style="list-style-type: none"> • Models of beams and slabs/ Site visits to understand the RC detailing of various components. Applications: <ul style="list-style-type: none"> • In designing slabs and stairs for single and multi-storied buildings. Video link: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 		
Module-5	L1,L2,L3	10 Hrs
Limit State Design of Columns and Footings: Analysis and design of short axially loaded RC column. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load and for axial load & moment.		

Laboratory Sessions/ Experimental learning: (Self Learning)	
<ul style="list-style-type: none"> • Generate excel sheets for design / develop 3D models in software to understand detailing. 	
Applications:	
<ul style="list-style-type: none"> • In designing columns and footings for single and multistoried buildings 	
Video link:	
<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105105/ 	
Course outcomes: On completion of the course, students would be able to	
CO1	Restate the design philosophy and principles.
CO2	Solve engineering problems of RC elements subjected to flexure, shear and torsion.
CO3	Illustrate on the procedural knowledge in designs of RC structural elements such as slabs, columns and footings
CO4	Identify the different failure modes of steel tension and compression members and beams and compute their design strengths.
CO5	Design column splices and bases as per the Indian Standards

Text Books:	
1.	Unnikrishnan Pillai and Devdas Menon, "Reinforced Concrete Design", McGraw Hill, New Delhi, 2017
2.	Subramanian, "Design of Concrete Structures", Oxford university Press, 2013

Reference Books:	
1.	H J Sah, "Reinforced Concrete Vol. 1 (Elementary Reinforced Concrete)", Charotar Publishing House Pvt. Ltd. 2014
2.	P C Varghese, "Limit State design of reinforced concrete", PHI, New Delhi, 2013
3.	W H Mosley, R Husle, J H Bungey, "Reinforced Concrete Design", MacMillan Education, Palgrave publishers, 1999
4.	IS: 456-2000, "Indian Standard Code Of Practice For Plain And Reinforced Concrete"
5.	SP 16 (1978): Design Aids for Reinforced Concrete to IS 456:1978

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses / Assignment		8

Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	AIR QUALITY MANAGEMENT	Semester	VI
Course Code	MVJ20CV631	CIE	50
Total No. of Contact Hours	40 L: T:: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective: Students should be able to,

- Classify the sources and effects of air pollution.
- Outline the meteorological factors influencing air pollution.
- Analyse air pollutant dispersion models.
- Illustrate particulate and gaseous pollution control methods.
- Predict vehicular pollution and control methods.

Prerequisites: *Environmental Studies, chemistry, Introduction to Environmental engineering.*

Module-1

L1, L2, L3

08 Hrs

Introduction: Sources and effects of air pollution

Definition, Sources, classification, and characterization of air pollutants.

Effects of air pollution on health, vegetation & materials. photochemical smog and coal induced smog. Global Environmental episodes.

Laboratory Sessions:

- Model making of classifying pollutants.
- Study of recent case study on air pollution episodes.

Applications: (Self Learning)

- Identification of various sources, classification, and characterization of pollutants.
- Effects of air pollutants on human beings and environment.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089>
- <https://nptel.ac.in/courses/105102089/8>

Module-2

L1, L2, L3

08 Hrs

Meteorology:

Temperature lapse rate & stability, Types of inversion wind velocity & turbulence, plume behaviour, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths.

Development of air quality models-Gaussian dispersion model, Applications.

Laboratory Sessions:

- Model making of various types of wind roses.

Applications: (Self Learning)

- Collection of data and development of air quality models.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089/>
- <https://nptel.ac.in/courses/105102089/8>

Module-3

L1, L2, L3

08 Hrs

Sampling and Analysis: Basic Principles of Sampling – Source and ambient sampling, sampling Principles - Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution).

Monitoring and analysis of air pollutants (PM_{2.5}, PM₁₀, SOX, NOX, and CO), preservation techniques.

Laboratory Sessions:

- Sample collection to identify and analyze indoor and ambient pollutants.

Applications: (Self-Learning)

- Sample collection procedures and analysis.
- Preservation techniques for different particulates.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089/8>
- <https://nptel.ac.in/courses/105102089/>

Module-4

L1, L2, L3

08 Hrs

Control Techniques

Control of particulates, Control at Sources, Process Changes, Equipment modifications, Design and operation of control. Equipment's – Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators. Selection criteria for equipment.

Gaseous pollutant control by adsorption & absorption, condensation, combustion – Pollution control for specific major industries.

Laboratory Sessions:

- Model making of particulate control equipment's like scrubber, filter, etc.

Applications: (Self Learning)

- Selection criteria for different equipment's suitable for control of pollutants.

- Understanding the procedures of air pollution control for specific industries.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104099/35>
- <https://nptel.ac.in/courses/105102089/8>
- <https://nptel.ac.in/courses/105102089/>

Module-5

L1, L2, L3

08 Hrs

Air and Noise Pollution:

Air pollution due to automobiles, standards, and control methods.

Noise pollution causes, effects and control, noise standards.

Environmental issues, laws, acts, protocols, Legislation, and enforcement –

Environmental Impact Assessment – Methods.

Laboratory Sessions:

- Poster Presentation on various environmental laws and protocols
- Experimental checking of indoor air quality levels using handy air sampler.

Applications: (Self Learning)

- To understand various environmental laws and protocols.
- To gain knowledge about noise pollution and its effects on human beings.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105102089/8>
- <https://nptel.ac.in/courses/105102089/>
- <https://nptel.ac.in/courses/105104099/35>

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

CO1	Identify the major sources of air pollution and understand their effects on health and environment.
CO2	Analyze the dispersion of air pollutants in the atmosphere and to develop air quality models.
CO3	Examine the sampling techniques for atmospheric and stack pollutants.
CO4	Outline and use the control techniques for particulate and gaseous emissions
CO5	Identify the sources of automobile pollution and understand their effects on health and environment and their control methods.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30		30

Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		10
		0

Text Books:

1.	Rao C.S. (2006) Environmental Pollution Control Engineering, 2nd edition, New Age International, New Delhi.
2	Anjaneyulu Y, "Textbook of Air Pollution and Control Technologies", Allied Publishers

Reference Books:

1.	W.L. Heumann (1997), Industrial Air Pollution Control Systems, McGraw Hill, New York
2	Rao M.N., & Rao H V N. (1996), Air Pollution Control, Tata-McGraw Hill, New Delhi.
3	H. C. Perkins, "Air pollution". Tata McGraw Hill Publication
4	Mackenzie Davis and David Cornwell, "Introduction to Environmental Engineering" McGraw-Hill Co.
5	Noel De Nevers, "Air Pollution Control Engineering", Waveland Pr Inc.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	MUNICIPAL WASTEWATER MANAGEMENT	Semester	VI
Course Code	MVJ20CV632	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective: Students should be able to,

- Describe the concepts about sewerage systems and sewer appurtenances.
- Outline different unit operations and unit process in involved in wastewater treatment process.
- Explain the concept and design of various physicochemical treatment units.
- Illustrate the concept and design of various biological treatment units.
- Examine the concept of tertiary wastewater treatment methods

Prerequisites: *Introduction to Environmental engineering, Basic knowledge of hydraulics is necessary.*

Module-1

L1, L2, L3

8 Hrs

Introduction: Wastewater Engineering

Introduction: need for sanitation, methods of sewage disposal, types of sewerage systems, dry weather flow, wet weather flow, factors effecting dry and wet weather flow on design of sewerage system, estimation of storm flow, time of concentration flow, material of sewers, shape of sewers, laying of sewers, joints and testing of sewers, ventilation of sewers.

Sewer appurtenances, manholes, catch basins, flushing tanks, traps, basic principles of house drainage, typical layout plan showing house drainage connections, maintenance of house drainage.

Laboratory Sessions:

- Model making of different types of sewers.
- Study of various shapes of sewers and its model making.

Applications: (Self – Learning)

- Identifying different sewer material properties.
- Knowledge about various sewer appurtenances and its practical use.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105104102/>
- <https://nptel.ac.in/courses/105105048/>

Module-2	L1, L2, L3	8 Hrs
<p>Design of sewers: Hydraulic formula for velocity, effects of variation on velocity, self-cleansing and non-scouring velocities, regime velocity, design of hydraulic elements for circular sewers for full flow and partial flow conditions. Reaction kinetics (zero order, 1st order, and 2nd order).</p> <p>Disposal of effluents by dilution, self-purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, numerical problems on disposal of effluents, Streeter- Phelps equation.</p> <p>Laboratory Sessions: (Self – Learning)</p> <ul style="list-style-type: none"> • Study of journal papers on hydraulic elements and design of sewers under different flow conditions. • Experimental study of oxygen sag curve. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Knowledge about the hydraulic elements of sewers under different flow conditions. • Behavior of different types of streams due to disposal of effluents. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105104102/ <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105105048/ 		
Module-3	L1, L2, L3	8 Hrs
<p>Wastewater characteristics: Sampling, significance and techniques, physical, chemical, and biological characteristics, CNS cycles, flow diagram for municipal wastewater treatment, unit operations.</p> <p>Theoretical principles and design criteria and design of screens, equalization basin, grit chamber, skimming tanks, primary and secondary settling tanks.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Sampling and testing of wastewater samples to identify various physical, chemical, and biological characteristics of water. (Env.Lab experiments) • Model making of Municipal Wastewater treatment showing various treatment units. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Sample collection procedures and analysis. • Knowledge of BIS standards for various physical, chemical, and biological parameters. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105104102/ 		

<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105105048/ 		
Module-4	L1, L2, L3	8 Hrs
<p>Working principles and design</p> <p>Suspended growth system - conventional activated sludge process and its modifications. Attached growth system – trickling filter, bio-towers and rotating biological contactors. Principles and design of stabilization ponds. Sequential batch reactors, moving bed bio reactors.</p> <p>Sludge Processing: Separation - sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic. Activated sludge process, F/M ratio and modifications of ASP.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Model making of suspended and attached growth systems. • Preparation of flow chart showing various waste treatment processes. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Understand the sludge processing techniques and its behavior in different feeding conditions. • Knowledge on varying F/M ratios and understand its applications for various modifications of ASP. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105104102/ • https://nptel.ac.in/courses/105105048/ 		
Module-5	L1, L2, L3	8 Hrs
<p>Tertiary Wastewater Treatment</p> <p>Anaerobic Sludge digestion, Sludge digestion tanks, Design of Sludge drying beds, Need and technologies used. Nitrification and Denitrification Processes, Phosphorous removal. Advance oxidation Processes (AOPs), Electro coagulation, Numerical Problems.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Experimental determination of coagulation process. • A visit to college STP to make them understand and give practical exposure about the various wastewater treatment procedures. <p>Applications: (Self – Learning)</p> <ul style="list-style-type: none"> • Understand the importance of denitrification and removal of phosphorous from the wastewater. • Behavior of digested sludge on drying and its practical use as a manure. <p>Video link / Additional online information:</p>		

- <https://nptel.ac.in/courses/105104102/>
- <https://nptel.ac.in/courses/105105048/>

Course outcomes: On completion of the course, students would be able to	
CO1	Illustrate to design sewer and Sewerage treatment plant.
CO2	Outline degree of treatment and type of treatment for disposal, reuse and recycle.
CO3	Identify waste streams and design the municipal wastewater treatment plant.
CO4	Predict sewage effluent issues.
CO5	Identify the technologies used in tertiary wastewater treatment.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. \sum (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Text Books:

1.	Metcalf and Eddy, "Wastewater Engineering - Collection, Treatment, Disposal and Reuse", McGraw Hill Pub.Co., 2009.
2	Patwardhan A.D, "Industrial Wastewater Treatment", PHI Learning Private Limited- New Delhi

Reference Books:

1	Nelson Leonard Nemerow, "Industrial Waste Treatment", Butterworth-Heinemann, 2007.
2	Hammer, M.J. and Hammer, M.J., "Water and Wastewater Technology", 7th Ed., Prentice Hall of India
3	Manual on Wastewater Treatment: CPHEEO, Ministry of Urban Development, New Delhi.
4	Fair, Geyer and Okun , "Water and Wastewater Engineering" Vol-II, John Willey Publishers, New York.
5	Howard S Peavy, Donald R Rowe and George Tchobanoglous, "Environmental Engineering", Tata Mcgraw Hill Publishing Co Ltd.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	SOLID WASTE MANAGEMENT	Semester	VI
Course Code	MVJ20CV633	CIE	50
Total No. of Contact Hours	40 L: T: P:: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective is to:

- Restate the different elements of solid waste management from generation of solid waste to disposal.
- Analyze different processing technologies.
- Evaluate landfill site and conversion of municipal solid waste to compost or biogas.
- Identify sources, collection, treatment, and disposal of various types of solid waste.
- Analyze the energy recovery techniques from solid waste.

Prerequisites: Environmental Sciences, Introduction to Environmental Engineering.

Module-1

L1, L2, L3

8 Hrs

Introduction:

Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. functional elements of solid waste management system Generation rate, Numerical Problems.

Collection: Collection of solid waste- services and systems, equipment's.

Transportation: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid waste management 2000 rules with 2016 amendments.

Laboratory Sessions:

- Poster Presentation on composition of Solid waste
- Collection of solid waste generation data of the campus

Applications: (Self Learning)

- Identification of various sources, collection and transportation of solid waste.
- Effects of mishandling of solid waste on human beings and environment.

Video link / Additional online information:

- <https://nptel.ac.in/courses/120/108/120108005/>
- <https://nptel.ac.in/courses/105/103/105103205/>
- <https://nptel.ac.in/courses/105/105/105105160/>
- <https://nptel.ac.in/courses/105/106/105106056/>

Module-2	L1, L2, L3	8 Hrs
<p>Processing techniques: Purpose of processing, Chemical volume reduction (incineration) - Process description, 3T's, principal components in the design of municipal incinerators, Air pollution control, Mechanical volume reduction (compaction), Mechanical size reduction (shredding), component separation (manual and mechanical methods).</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Poster Presentation on Processing of Municipal Solid Waste <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Identification of different processing techniques of Solid waste. • Identification of factors responsible for the design of Incinerators. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/120/108/120108005/ • https://nptel.ac.in/courses/105/103/105103205/ • https://nptel.ac.in/courses/105/105/105105160/ • https://nptel.ac.in/courses/105/106/105106056/ 		
Module-3	L1, L2, L3	8 Hrs
<p>Composting Aerobic and anaerobic method - process description, process microbiology, design consideration, Mechanical composting, Vermicomposting, Numerical Problems.</p> <p>Sanitary Landfilling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Design of sanitary landfill. Numerical Problems.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Poster Presentation on Design of Sanitary Landfills. • Checklist for Composting techniques. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Identification of factors responsible for site selection for a Sanitary Landfill. • Effects of mishandling Sanitary Landfill Site. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/120/108/120108005/ • https://nptel.ac.in/courses/105/103/105103205/ • https://nptel.ac.in/courses/105/105/105105160/ • https://nptel.ac.in/courses/105/106/105106056/ 		
Module-4	L1, L2, L3	8 Hrs
<p>Sources, collection, treatment and disposal of :- Biomedical waste, E-waste, Hazardous waste and Construction and Demolition waste</p>		

Laboratory Sessions:

- Collection of E-waste generation data of the campus.
- Poster Presentation on collection, transport, and processing of Construction waste.

Applications: (Self Learning)

- Segregation of Biomedical waste and its impact on Biomedical waste handling and processing.
- Identification of characteristics of Hazardous waste.

Video link / Additional online information:

- <https://nptel.ac.in/courses/120/108/120108005/>
- <https://nptel.ac.in/courses/105/103/105103205/>
- <https://nptel.ac.in/courses/105/105/105105160/>
- <https://nptel.ac.in/courses/105/106/105106056/>

Module-5

L1, L2, L3

8 Hrs

Waste management rules and its amendments- Plastic Waste, E-waste, Biomedical Waste and Hazardous Waste. Energy recovery technique from solid waste management

Laboratory Sessions:

- Poster Presentation on Energy recovery techniques from solid waste management

Applications: (Self Learning)

- Different energy recovery techniques and their implications.

Video link / Additional online information:

- <https://nptel.ac.in/courses/120/108/120108005/>
- <https://nptel.ac.in/courses/105/103/105103205/>
- <https://nptel.ac.in/courses/105/105/105105160/>
- <https://nptel.ac.in/courses/105/106/105106056/>

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

CO1	Evaluate different elements of solid waste management system
CO2	Design suitable processing system
CO3	Asses the disposal site for solid waste
CO4	Identify sources, collection, treatment, and disposal of various types of solid waste
CO5	Apply the energy recovery techniques utilizing solid waste

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30

Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Text Books:	
1.	George Tchobanoglous, Hilary Theisen , Samuel A Vigil, "Integrated Solid Waste Management: Engineering principles and management issues", M/c Graw hill Education . Indian edition, 1993.
2.	Howard S Peavy, Donald R Rowe and George Tchobanoglous, "Environmental Engineering", Tata Mcgraw Hill Publishing Co ltd, ISBN: 9789351340263, 9789351340263, 2017

Reference Books:	
1.	Municipal Solid Wastes (Management and Handling) Rules, 2000.Ministry of Environment and Forests Notification, New Delhi, the 25th September, 2000. Amendment – 1357(E) – 08-04-2016.
2.	Municipal Solid waste management manual, Part II published under Swachh Bharat Mission, Central Public Health And Environmental Engineering Organization (CPHEEO), 2016, Ministry of Urban Development, Government of India.
3.	Handbook of Solid waste management, second edition, George Tchobanoglous, Frank Kreith, published by M/c Graw hill Education, 2002, ISBN-13 978-0071356237 ISBN -100071356231

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

High-3, Medium-2, Low-1

Course Title	AIR AND WATER QUALITY MODELLING	Semester	VI
Course Code	MVJ20CV634	CIE	50
Total No. of Contact Hours	40 L: T: P: : 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- To facilitate acquiring basic skills of sampling and analytical techniques in air quality monitoring.
- Understanding of the air quality modelling and simulation techniques.
- To facilitate understanding of water quality guidelines, criteria and standards, and water quality index.
- Understanding and implementation of water quality programs.
- to acquire knowledge of the water quality modelling, sampling and analysis; and
- to provide exposure to the conventionally used water quality models

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: Basic knowledge about importance of air quality in Environmental Engineering

Introduction: Overview of current air quality trends and challenges; Basic concepts; applications and importance of air quality Monitoring; Iso-kinetic sampling; Precision and accuracy of monitoring; Air Quality Guidelines and Standards.

Laboratory Sessions/ Experimental learning:

- Documentation on air quality guidelines and standards
- Mini project on air sampling technique

Module-2

L1, L2, L3

8 Hrs.

Prerequisites: Basic knowledge about importance of air quality monitoring

Air Quality Modelling: Basic Components of an Air Quality Simulation Model; Parameters of Air Pollution Meteorology; Steady-state; Non-Steady-state and Grid Meteorological Modelling; Dispersion and Receptor modelling techniques; Gaussian plume model; Pasquill's stability Classification.

Laboratory Sessions/ Experimental learning:

<ul style="list-style-type: none"> • Report on derivation of Gaussian plume model • Documentation on air pollution parameters 		
Module-3	L1, L2, L3	8 Hrs.
<p>Prerequisites: <i>Basic knowledge about importance of air quality monitoring</i></p> <p>Analytical Techniques: Preparation of samples for analysis; Gravimetry; titrimetry; potentiometry (including ion analyzers); Colorimetry (UV-visible spectrometry); Metals and heavy metal detection techniques; Interpretation of Data; Air Quality Assessment and Reporting.</p> <p>Water sampling and analysis techniques; Water quality index and use specific water quality index.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Practice on preparation of samples for analysis • Knowledge about calibration of analyser 		
Module-4	L1, L2, L3	8 Hrs.
<p>Prerequisites: <i>Basic knowledge about importance of water quality monitoring</i></p> <p>Introduction to water quality modelling; Modelling of Lakes and reservoirs; Rivers and streams; and Groundwater modelling; Modelling for common water quality parameters: DO; temperature; suspended solids; algae; nutrients; coliforms and toxics; Calibration; validation and use of water quality models (DO-BOD models; solute transport models; nutrients and eutrophication models; and toxic substances and sediments models).</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Documentation work on water quality and its monitoring • Mini project on eutrophication models 		
Module-5	L1, L2, L3	8 Hrs.
<p>Prerequisites: <i>: Basic knowledge about importance of water quality modelling</i></p> <p>Softwares</p> <p>Air Modelling softwares; Validation of Models; Applications of Modelling; Air Pollution Forecast Models.</p> <p>Air quality Model -ARMOD, CALPUFF. – UNAMAP- BLP-RAM-ISCMPTER-CRSTER-Surface water quality models -HSPF, QUAL2K,</p> <p>Conventional Water Quality Models: QUAL2E – QUAL2K; BASINS and WASP7.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Practice on usage of various software's related to modelling <p>Applications:</p> <ul style="list-style-type: none"> • SO_x analysis by West and Geake method; 		

- NOx analysis by Jacobs and Hochheiser method;
- Stack monitoring; Tail pipe emissions monitoring;
- Preparation and analysis of samples in AAS and IC;
- Measurement of indoor air quality;
- Noise monitoring; Air modelling softwares - ISCST3; AERMOD, CALROADS, CALPUFF, etc

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

CO1	Learning of the techniques employed in the monitoring of particulates and gaseous pollutants in ambient air and stack gas
CO2	Gaining knowledge about modelling of air quality through the use of different softwares.
CO3	To be able to use the knowledge of water quality guidelines, criteria and standards, and water quality index
CO4	To be able to use water sampling and analysis techniques, water quality data analysis and WQI calculations
CO5	To be able to understand of water quality modelling and exposure to some of the conventionally used water quality models.

Scheme of Evaluation

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Text Books:

1.	Borrego C and Ana IM, Air Pollution Modelling and its Application; Springer (2008).
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2.	Khare M, Air Pollution – Monitoring; Modelling; Health and Control; InTech Publishers (2012)
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Reference Books:	
1.	Tiwary A and Colls J, Air Pollution: Measurement; Modelling and Mitigation; Spon Press (2002).
2.	Zannetti P, Air Quality Modelling - Theories; Methodologies; Computational Techniques; and Available Databases and Software: Volume IV - Advances and Updates; EnviroComp Institute (2010).
3.	Bartram J (Ed.), Water quality monitoring: A practical guide to the design and implementation of freshwater quality studies and monitoring programs, Taylor & Francis (2012).
4	Manivanan R, Water quality modelling: rivers, streams and estuaries, New India Publishing Agency (2008).
5.	Chapra SC, Surface water quality modelling, Waveland press (2008).
6.	Thomann RV and Mueller JA, Principles of surface water quality modelling and control, Harper & Row (1987).

Web Link and Video Lectures:	
1.	https://nptel.ac.in/courses/105/104/105104099/
2.	https://nptel.ac.in/content/storage2/courses/105101010/downloads/Lecture29.pdf

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

High-3, Medium-2, Low-1

Course Title	HIGHWAY GEOMETRIC DESIGN	Semester	VI
Course Code	MVJ20CV641	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- State the size and shape of various elements of roads are designed according to standards prescribed by IRC.
- Explain on how horizontal and vertical curves are designed to meet the design speed on the various types of roads.
- Illustrate on how the roads are designed to achieve optimum speed with maximum safety economically.
- Describe on how the roads are designed to achieve safe speed and maximum safety in the region of valley and summit curves.
- Brief on intersections and its suitability for safe traffic movement and to provide drainage elements for sustainable road.

Module-1

L1, L2, L3

8 Hrs

Prerequisites: Knowledge of roads and its components.

Introduction:

Geometric Control factors like Topography – design speed – design vehicle – Traffic – Capacity – volume – environment and other factors as per IRC and AASHTO standards and specifications- PCU concept – factors controlling PCU for different design purpose

Cross sectional elements: Pavement surface characteristics – friction – skid resistance – pavement unevenness - light reflecting characteristics – camber – objectives – types of camber – methods of providing cambers in the field – problems.

Laboratory Sessions/ Experimental learning:

- Visit to the nearest road and exploring the things

Applications:

- Able to get a practical knowledge on road elements provides.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105101087/>

Module-2	L1, L2, L3	8 Hrs
<p><i>Prerequisites: Knowledge of pedestrian facilities and driver visibility.</i></p> <p>Cross sectional elements and Sight Distance:</p> <p>Cross sectional elements: Carriage way – kerb – median – shoulder – foot path – parking lanes – service roads – cycle tracks – Driveways – Right of way – Factors influencing right of way – Design of Road humps as per latest IRC provisions.</p> <p>Sight distance: Important, types, Sight distance at uncontrolled intersection, derivation, factors affecting sight distance, IRC, AASHTO standards, problems on above.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Visit to the nearest road and exploring the things <p>Applications:</p> <ul style="list-style-type: none"> • Able to get a practical knowledge on road elements provides. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105101087/ 		
Module-3	L1, L2, L3	8 Hrs
<p><i>Prerequisites: Knowledge of change in alignment in horizontal direction</i></p> <p>Horizontal alignment:</p> <p>Definition, Checking the stability of vehicle, while moving on horizontal curve, Super elevation, Ruling minimum and maximum radius, Assumptions – problems – method of providing super elevation for different curves – Extra widening of pavement on curves – objectives – Mechanical widening – psychological widening – Transition curve – objectives – Ideal requirements – Types of transition curve – Method of evaluating length of transition curve – Setting the transition curve in the field, set back distance on horizontal curve and problems on above.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Designing a horizontal curve and marking in the field. <p>Applications:</p> <ul style="list-style-type: none"> • The knowledge on transferring design to field will be achieved. 		
Module-4	L1, L2, L3	8 Hr
<p><i>Prerequisites: Knowledge on change in ground profile.</i></p> <p>Vertical Alignment and Intersection design:</p> <p>Vertical alignment: Gradient – Types of gradients – Design criteria of summit and valley curve – Design of vertical curves based on SSD – OSD – Night visibility considerations – Design standards for hilly roads – problems on the above.</p>		

Intersection design: Principle – At grade and Grade separated junctions – Types – channelization – Features of channelizing Island – median opening – Gap in median at junction.

Laboratory Sessions/ Experimental learning: Model making on intersections and channelization

Applications: Knowledge on intersections and its vehicular behavior

Module-5	L1, L2, L3	8 Hr
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Prerequisites: Knowledge on round about intersection and highway drainages

Rotary intersection and Highway drainage:

Elements – Advantages – Disadvantages – Design guidelines – problem on the above – Grade separated intersection – Three legged inter section – Diamond inter change – Half clover leaf – clover leaf- Advantages- Disadvantages only

Highway drainage: Importance – sub surface drainage –surface drainage – Design of roadside drives – Hydrological – Hydraulically considerations and design of filter media, problems on above.

Laboratory Sessions/ Experimental learning: Identifying and chart making on different drainage types.

Applications: Knowledge on importance of drainage and patterns of drainage.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

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

CO1	Find importance and design geometric elements.
CO2	Predict sight distances and the components of horizontal curves.
CO3	Illustrate components of vertical curves and to design.
CO4	Solve the design of intersections in a roadway.
CO5	Examine IRC recommendations for highway.

Text Books:	
1.	Principle and practice of Highway Engineering- L R KADIYALI & N B LAL: Khanna publications, 2009
2.	Highway Engineering – Khanna S K & Justo, Nemchand & Bros. 2001
Reference Books:	
1	Highway Engineering by Srinivas Kumar, 2002
2	Relevant IRC Publications
3	Transportation Engineering and Planning- Papa Coastas and Prevendors PHI, New Delhi.

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

High-3, Medium-2, Low-1

Course Title	PAVEMENT MATERIALS	Semester	VI
Course Code	MVJ20CV642	CIE	50
Total No. of Contact Hours	40 L: T: P:: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- Explain the different types, properties and tests on soil sub grade.
- Explain the properties of aggregates and different test procedures and specifications.
- Explain the origin, properties, constituents and preparation of bitumen, tar, cutback bitumen and emulsions.
- Illustrate the bituminous mix design method.
- Explain in detail about HMA, WMA, CMA Explain types of cement, tests on cement, types of concrete, fillers, and sealers.

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: Knowledge on basics of Soil Mechanics

Soil Characterization:

Properties of sub grade layers; different types of soils, Soil Classification; Index and other basic properties of soil; A critical look at the different laboratory and in - situ procedures for evaluating the mechanical properties of soils viz. SPT, CPT, CBR, Plate Load test, Field compaction and control.

Laboratory Sessions:

- Basic tests on soil.
- Soil Stability Test.

Applications:

- To find out the Physical requirements of Aggregates with respect to IRC specifications.
- To find out the Optimum Binder Content for Bituminous Mixes.

Video link / Additional online information:

- <https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-26.pdf>
- <https://www.youtube.com/watch?v=fqYK4JGIVJY>
- <https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-24.pdf>

Module-2	L3	8 Hrs.
<p><i>Prerequisites: Knowledge on basic Highway Engineering materials.</i></p> <p>Bitumen: Bitumen and Tar: Origin, preparation, properties and chemical constitution of bituminous road binders; requirements, Grades of bitumen i.e. Penetration Grade, Viscosity Grade, bitumen structure, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, Bituminous Emulsions and Cutbacks, Preparation, characteristics, uses and tests, Adhesion of Bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion, Modified binders.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Basic tests on bitumen. <p>Applications:</p> <ul style="list-style-type: none"> • To find out the Physical requirements of Bitumen with respect to IRC specifications. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105106053/lec31.pdf • https://nptel.ac.in/courses/105105107/ 		
Module-3	L3	8 Hrs.
<p><i>Prerequisites: Knowledge on basic Highway Engineering materials.</i></p> <p>Bituminous Mixes: Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation Parameters and other Properties. Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short-term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFOT and PAV. Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall's specifications, Hubbard Field method of mix design, Hveem's method of mix design; Introduction to super pave mix design procedure, HMA, WMA, CMA.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Rutting test and Fatigue test • Marshall Mix Design <p>Applications:</p> <ul style="list-style-type: none"> • To determine the stability of the mix • To Prepare the stable bituminous mix for the road construction 		
Module-4	L3	8 Hrs.
<p>Pre requisites: Types of equipment</p>		

Pavement construction.
 Road construction equipment – different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice, productivity calculation. Problem on equipment usage charges Investment on equipment, depreciation. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction.

Laboratory Sessions/ Experimental learning:

- Refer standard contract forms and identify important clauses.

Application:

- Equipment selection.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105103093/>,
- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104161/lec12.pdf,
- <https://syedsohailuddin.files.wordpress.com/2018/07/is-1200-17.pdf>

Module-5	L3	8 Hrs.
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Prerequisites: Knowledge on basic Highway Engineering materials.

Quality control
 Sub grade: Preparation of sub grade- construction of embankments and cuts for roads; Quality control tests. Flexible Pavements: Specifications of materials, construction method and field control check for of flexible pavement layers –BM- DBM and BC Cement Concrete Pavements: – PQC-FRCC- Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints.

Laboratory Sessions/ Experimental learning:

- Compaction Test(density)
- Quality tests of aggregate.
- Quality test on the Bituminous and cement concrete during the construction

Video link / Additional online information (related to module if any):

- <https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-19.pdf>

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8

Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

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

CO1	Gain knowledge about aggregates, properties and tests.
CO2	Capable of doing mix design for different layers of pavement.
CO3	Gain the Knowledge Bituminous Mixes and its Properties.
CO4	Assess quality of materials.
CO5	Inspect and estimate the work of equipment

Text Books:

1.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., 'Highway Engineering', Nem Chand and Bros, Roorkee, 2014.
2.	Partha Chakroborty and Animesh Das, 'Principles of Transportation Engineering', Prentice Hall (India), New Delhi, 2011.

Reference Books:

1	Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, Prentice–Hall, 2002.
2	Freddy L Roberts, Prithvi S Kandhaletal, "Hot Mix Asphalt Materials, mixture design and construction" -(2ndEdition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA, 2009.
3.	Peurifoy.R.L., 'Construction Planning, Equipment and Methods', McGraw Hill Publishers, New York,2000.
4	S.C.Sharma, 'Construction Equipment and its Management', Khanna Publishers, New Delhi, 1988.
5.	IRC:16-2008, IRC: SP:20-2002, IRC:SP:72-2007, IRC: SP:62-2004, MoRTH and AASHTO Publications

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	RAILWAYS, HARBOURS, TUNNELING AND AIRPORTS	Semester	VI
Course Code	MVJ20CV643	CIE	50
Total No. of Contact Hours	40 L: T: P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students should be able to,

- Illustrate the basic knowledge in railways
- Explain the basic concepts of the construction and management of railways
- Predict the development of Harbour and tunnelling
- Outline the design concepts of berthing structures
- State the basic knowledge of airport planning and design

Pre requisites: Elements of Transportation Engineering, Transportation modes, traffic engineering

Module-1	L1, L2, L3	8 Hrs.
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Railways: Introduction to rail transportation and its limitation, merits and demerits, (Online Mode)

Railway track, concept of gauge, Advantages of uniform gauge and loading gauge, Components of permanent way and its ideal requirement, Wheel and Axles, Coning of Wheels, Components of permanent way and its ideal requirement, Rail ,various type of rail cross section, length of rail, defects in rail and remedies to reduce the defects, Measure to reduce the wear of rails, Characteristics of an ideal rail joints ,Rail fastening and fixtures Purpose of welding of rail joints, Type, function and requirement of an ideal sleeper, Merits and demerits of various sleepers, Coning of wheels and its purposes(Online Mode) Stresses in Components of Track.

Laboratory Sessions/ Experimental learning: (Self Learning)

- HEADS Rail software (Alignment design for Railways, Metro Rail Tunnels, Mono Rails, MRT, LRT)
- Poster preparation on components of rails

Applications: (Self Learning)

- Case study - Railway Reservation (<https://www.oreilly.com/library/view/introduction-to-database/9788131731925/xhtml/casestudy002.xhtml>)
- Dynamic Effects of a Long-span Railway Continuous Beam Bridge

Module-2	L1, L2	8 Hrs.
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Railway Construction and Maintenance: Earthwork – Stabilization of track on poor soil, Calculation

of Materials required for track laying – Construction and maintenance of tracks
Modern methods of construction & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways (Online Mode).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Ansys software introduction
- Kenpave software introduction

Applications: (Self Learning)

- ABS on the Rails
- Signal crossing prevention system

Module-3	L1, L2, L3	8 Hrs.
<p>Harbour Engineering: Definition of Basic Terms: Planning and Design of Harbours: Requirements, Classification, Location (Online Mode).and Design Principles – Harbour Layout and Terminal Facilities, Coastal Structures, Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works.</p> <p>Tunneling: Introduction, size and shape of the tunnel, tunneling methods in soils, tunnel lining, tunnel drainage and ventilation. (Online Mode).</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Design load application in Numerical Modelling for Coastal Structures • Subsurface soil exploration tests <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Risk levels in coastal and river engineering Environmental impact of harbor activities 		
Module-4	L1, L2, L3	8 Hrs.
<p>Berthing structure: General aspects of selection and design for berthing structures, Piers, Wharf, Quay wall, Jetty, Dolphins, trestle, Moles and mooring accessories, Design and construction of Dock wall, classification of Break water and construction method of Break water wall, Necessity for Fenders, types of fenders and Mooring system, Importance of Navigation Aids, Type of Navigation, Requirements of Signals, Light house, Beacons, Beacon light, Floating Navigation aids, Range light and Radar Reflectors. Types of dredger, Necessary of dredging (Online Mode).</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Model making of berthing structures <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Navigational aids in harbors and port approaches 		

Module-5		L1, L2, L3	8 Hrs.
Airport Design: Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting			
Laboratory Sessions/ Experimental learning: (Self Learning) <ul style="list-style-type: none"> Virtual Aerodrome Laboratory introduction AVN 370 Airport Management and Finance 			
Applications: (Self Learning) <ul style="list-style-type: none"> Sustainable Approach to Airport Design and Operations Final Airport Eco Design 			
Scheme of Evaluation:			
Details			Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3		CIE(50)	30
Quizzes			2x2 = 4
Activities / Experimentations related to courses/Assignment			8
Mini Projects / Case Studies			8
Semester End Examination		SEE (50)	50
Total			100
Course outcomes: On completion of the course, students would be able to			
CO1	Predict the capability of choosing alignment and also design geometric aspects of railway system, runway and taxiway		
CO2	Compare and estimate the material quantity required for laying a railway track and also will be able to determine the hauling capacity of a locomotive		
CO3	Restate the layout plan of airport, harbor, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same		
CO4	Apply the knowledge gained to conduct surveying, understand the tunneling activities		
CO5	Analyze the Change tunnels, harbors, dock and necessary navigational aids and various methods of tunneling and tunnel accessories		

Text Books:	
1.	Oza.H.P. and Oza.G.H., A course in Docks & Harbour Engineering. Charotar Publishing Co.2016
2.	C Venkatramaiah, Transportation Engineering, Volume II: Railways, Airports, Docks and Harbours, Bridges and Tunnels, Universities Press, 2016

Reference books:	
1	Mundrey J.S. A course in Railway Track Engineering. Tata McGraw Hill, 2009
2	Srinivasan R. Harbour, Dock and Tunnel Engineering , 26th Edition 2013
3	Khanna S K, Arora M G and Jain S S, Airport Planning and Design, Nemchand and Brothers, Roorkee, 1994

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

High-3, Medium-2, Low-1

Course Title	ROAD SAFETY AND MANAGEMENT	Semester	VI
Course Code	MVJ20CV644	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objective: Students will be able to,

- Explain different parameters responsible for providing road safety in the construction of new roads.
- Describe road reconstruction principle and improvement of road considering the different components of road and intersections.
- Discuss road safety and maintenance measures for road in operation considering pedestrian, cyclists, and road furniture.
- Define road safety audit principle and procedure, various traffic management techniques and their effectiveness.

Module-1

L3

8 Hrs.

Prerequisites: Road accidents

Road accidents, Causes, Scientific Investigations and Data Collection: Accident Analysis considering different scenarios, Analysis of Individual accidents to arrive at Real Causes, Statistical Methods of Analysis of Accident Data.

Laboratory Sessions/ Experimental learning:

- Analyzing any accident at a nearby junction

Applications:

- Accident analysis and finding the speed of vehicles involved in the accident.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_42.pdf

Module-2

L3

8 Hrs.

Prerequisites: Road safety and design

Ensuring Traffic Safety in Designing New Roads: Ways of Ensuring Traffic Safety in Road Design considering the Features of Vehicle Fleet, Psychological Features of Drivers, Natural and Meteorological Conditions, Structure of Traffic Streams, Orientation of a Driver on the Direction of a Road beyond the Limits of Actual Visibility and Roadway Cross Section and Objects on the Right-of-Way.

Laboratory Sessions/ Experimental learning:

- Surveying newly constructed road with respect to safety parameters stated in the module.

Applications:

- Understanding how different conditions affect safety on New roads.

Module-3

L3

8 Hrs.

Prerequisites: Road reconstruction.

Ensuring Traffic Safety in Road Reconstruction: Road Reconstruction and Traffic Safety, Reconstruction Principles, Plotting of Speed Diagram for Working out Reconstruction Projects, Use of Accident Data in Planning Reconstruction of Roads.

Applications:

- Analyzing the accident data for reconstruction of roads.

Module-4

L3

8 Hrs.

Prerequisites: Road safety ensuring

Ensuring Traffic Safety in Road Operation: Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines and Guideposts, Guardrails and Barriers and Road Lighting.

Laboratory Sessions/ Experimental learning:

- Conducting a pedestrian safety survey at Hope form junction and analyzing the results.

Module-5

L3

8 Hrs.

Prerequisites: Road safety management

Road Safety Audit and Traffic Management Techniques: Principles- Procedures and Practice, Code of Good Practice and Checklists. Road safety issues and engineering, education, enforcement measures for improving road safety. Local area management. Low-cost measures, area traffic control.

Laboratory Sessions/ Experimental learning:

- Analyzing the safety of road with respect to engineering parameters on a stretch of road nearby.

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

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

CO1	Recognize the factors affecting the construction of new roads
CO2	Illustrate the factors affecting the reconstruction of existing roads
CO3	Summarize the factors affecting the operation condition of road
CO4	Remember and illustrate the process of road safety audit and the measures of improving road safety.
CO5	Recognize the factors affecting the construction of new roads

Text Books:

1.	Kadiyali, L.R., 'Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009.
2.	Jotin Kishty and B. Kent Lall, 'Transportation Engineering-An Introduction', Third Edition, Prentice Hall of India Private Limited, New Delhi, 2006

Reference Books:

1.	Babkov, V.F. 'Road conditions and Traffic Safety', MIR publications, Moscow - 1975.
2.	K.W. Ogden, 'Safer Roads – A Guide to Road Safety Engg.' Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
3.	IRC SP 88-2010, RC:11-2015 IRC:103-2012

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	SUSTAINABILITY CONCEPTS IN ENGINEERING	Semester	V
Course Code	MVJ20CV651	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objective: Students will be able to,

- Describe about the principles, indicators, and general concept of sustainability.
- Apprehend the local, regional, and global impacts of unsustainable designs, products and processes.
- Student shall be able to apply the sustainability concepts in engineering
- Know built environment frameworks and their use.
- Analyse how building and design is judged and valued by clients and stakeholders and how to implement sustainability.

Module-1

L1, L2, L3

8 Hr

Introduction:

Prerequisites: Knowledge on sustainable approach in engineering

Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.

Experimental learning:

- In-situ investigation of high strength sustainability materials

Applications:

- In construction of building

Video link:

- <https://nptel.ac.in/courses/127/105/127105018/>

Module-2

L1, L2, L3

8 Hr.

Global Environmental Issue:

Prerequisites: Knowledge on environmental impacts of modern engineering tool

Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste – sources, impacts of solid waste, Zero waste concept. Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon footprint Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking

Experimental learning:

- In-situ determination of air pollution, water pollution and solid waste management.

Applications:

- In maintaining the good environment.

Video link:

- <https://nptel.ac.in/courses/110/105/110105073/>

Module-3

L1, L2, L3

8 Hrs.

Sustainable Design:

Prerequisites: Knowledge on sustainable building materials for civil engineering

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.

Experimental learning:

- laboratory strength determination of the green building materials

Applications:

- In application of green technology in the sustainability will reduce the pollution to the environment

Video link:

- <https://nptel.ac.in/courses/105/105/105105157/>

Module-4

L1, L2, L3

8 Hrs.

Clean Technology and Energy:

Prerequisites: Knowledge on using modern tool in engineering

Energy sources: Basic Concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.

Experimental learning:

- laboratory investigation of energy sources

Applications: <ul style="list-style-type: none"> In utilizing the sustainability approaches will save the environment pollution Video link: <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/102/105102195/ 		
Module-5	L1, L2, L3	8 Hrs.
Green Engineering: Prerequisites: Knowledge on using eco-friendly materials Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis. Experimental learning: <ul style="list-style-type: none"> In-situ evaluation of properties for different building materials and pollution control devices Applications: <ul style="list-style-type: none"> In utilizing the sustainability approaches will save the environment pollution Video link: <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/102/105102195/ 		

Course outcomes: On completion of the course, students would be able to	
CO1	Learn the sustainability concepts, understand the role and responsibility of engineers in sustainable development
CO2	Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits
CO3	Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines
CO4	Application of engineering knowledge in utilization of natural resources for the production materials.
CO5	Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. (Marks Obtained in each test) / 3		30
		CIE (50)

Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Text Books:

1.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2	Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional

Reference Books:

1	Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage Learning
2	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication
3	Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers
4	Daniel A. Vallero and Chris Brasier, "Sustainable Design: The Science of Sustainability and Green Engineering", Wiley-Blackwell

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	RESOURCE ALLOCATION AND MANAGEMENT	Semester	VI
Course Code	MVJ20CV652	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objectives: This course will enable students to

- State the different types of resources and planning
- Illustrate on characteristics of resources and labour Management
- Represent materials and equipment's required for construction activities
- Apply the time management strategies on effective planning
- Detail on Resource allocation and levelling

Prerequisites: Basic idea of Management and financial resources

Module-1

L1, L2, L3

8 Hr

Resource Planning: Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Develop the check list for Resource planning for construction activities

Applications: (Self Learning)

- Resource Planning for Residential Building

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106149/>

Module-2

L1, L2, L3

8 Hr.

Labour Management: Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, Optimum use Labour.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Develop the check list for Classes of Labour for construction activities

Applications: (Self Learning)

- Labour Arrangement for Construction of slab for a residential building

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106149/>

Module-3	L1, L2, L3	8 Hrs.
<p>Materials and Equipment: Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution. Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Selection of Equipment for the Shutting materials preparation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Preparation of column shuttering Material using cutting machine <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106149/ 		
Module-4	L1, L2, L3	8 Hr
<p>Time Management: Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control..</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Planning for Time management of Footing Layout marking, shuttering and concreting <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Item of work and its cash flow control measures <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106149/ 		
Module-5	L1, L2, L3	8 Hr
<p>Resource Allocation and Levelling: Time-cost trade off, Computer application – Resource leveling, resource list, resource allocation, Resource loading, Cumulative cost – Value Management.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Development of resource planning by MS Project <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Value management for an Apartment building (G+10) <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106149/ 		

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

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

CO1	Restate the different types of resource planning for a construction activities
CO2	Illustrate the required characteristics of resources and labour for the item of work
CO3	Explain the materials and equipment's required for a particular construction activity
CO4	Create the checklist for effective planning through time management
CO5	Explain on Resource allocation and leveling for a construction activities

Text Books:

- Andrew,D., Szilagg, "Hand Book of Engineering Management", 2002.
- Harvey, A., Levine, "Project Management using Micro Computers", Osborne -McGraw Hill
C.A.Publishing Co., Inc. 2005. Industry, Granda Publishing Ltd.,

Reference Books:

- James.A., Adrain, "Quantitative Methods in Construction Management", American Elsevier
Publishing Co., Inc., 2002
- Oxley Rand Poslcit, "Management Techniques applied to the Construction",2000

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT	Semester	VI
Course Code	MVJ20CV653	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- To understand the concepts of global scenario of Health & safety.
- Students should be able to analyse and solve basic agronomical issues.
- To be efficient in the operation of industrial hygiene equipment.
- To illustrate the importance and need of Fire & Safety.
- Students should be able to know the basics of fire and its classification.

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: Basic knowledge about various types of hazards

Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation.

Laboratory Sessions/ Experimental learning:

- Measurement of Sound/Noise Level at Various Location and Compare it with Standard Values

Applications:

- Documentation of the report on noise level in the working environment

Video link / Additional online information:

- <https://nptel.ac.in/courses/114106017/>

Module-2

L1, L2, L3

8 Hrs.

Ergonomics at Workplace: Ergonomics Task analysis, Preventing Ergonomic Hazards, Workspace Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations.

Laboratory Sessions/ Experimental learning:

- A study on analysis of occupational health hazards in a working place

Video link / Additional online information: <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110105094/ 		
Module-3	L1, L2, L3	8 Hrs.
<p><i>Prerequisites:</i> Basic knowledge about agronomical issues</p> <p>Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. Electrical Safety, Product Safety: Technical Requirements of Product safety.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Demonstration and training on the usage of personal protective equipments, breathing apparatus, Emergency evacuation drill etc. <p>Applications:</p> <ul style="list-style-type: none"> • Awareness program on the utilization of the facilities provided to maintain the health of workers in working places <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf 		
Module-4	L1, L2, L3	8 Hrs.
<p><i>Prerequisites:</i> Importance and need of Fire & Safety</p> <p>Health Considerations at Workplace: types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Identification rehearsals of Portable extinguishers, Filling of DCP powder in Portable Extinguisher and wearing Protective clothing, Mock drills <p>Applications:</p> <ul style="list-style-type: none"> • A detailed report on classification of fire extinguishers <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • Fire protection: basic concept, fire resistance, introduction of combustion process, https://nptel.ac.in/courses/105102176/ 		
Module-5	L1, L2, L3	8 Hrs.
<p><i>Prerequisites:</i> Basic Knowledge of Industrial Safety</p> <p>Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Roles and responsibilities of workers, managers, and supervisors.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • A performance study on responsibility of management for safety in industries, safe guarding the workers • A study on OSHAS by considering a case-study 		

Applications:

- Documentation on an effective safety management in a manufacturing industry from workers health point of view.

Video link / Additional online information:

- <https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf>
- <https://nptel.ac.in/courses/110105094/>

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

CO1	Gains the knowledge about the various types of hazards and their control measures
CO2	Gains the knowledge about the occupational health issues
CO3	Able to analyse and solve occupational health issues
CO4	Able to know the basics of fire and its precautions, active and passive fire protection system in building or other industries/ premises.
CO5	To render the concept of safety analysis and confined space

Scheme of Evaluation

Detail s		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Test Books:

1.	Fire Protection and Prevention By: Birendra Mohan San, Publishers: UBS Publishers & Distributors Pvt Ltd., Edition: First Edition, Year of Publication: 2008
2.	Industrial safety management By: L.M. Deshmukh, Publishers: Tata Megraw Hill, New Delhi, Year: 2006,First Edition

Reference Books:	
1.	Risk assessment- A Practical Guide, 1993, Institution of Occupational Safety and Health, United Kingdom
2.	Handbook Of Fire Technology By: R.S. Gupta, Orient Longman Publishers, Second Edition, 2005
3.	Handbook Of Fire And Explosion Protection Engineering By: Dennis P Nolan, Crest Publishing House, First Edition, 2007
6.	Industrial safety health and environment Management system By: R.K. Jain & Sunil S. Rao, Publishers: Khanna Publishers, Year: 2008, Edition: Second
7.	A Handbook on health, Safety and Environment, SC Bhatia
8.	S Rao, H L Saluja- Electrical Safety, Fire Safety Engineering and Safety Management

Web Link and Video Lectures:	
1.	https://nptel.ac.in/courses/120108004/
2.	https://nptel.ac.in/courses/114106017/
3.	https://nptel.ac.in/courses/103/106/103106162/
4.	https://nptel.ac.in/courses/103/106/103106162/
5.	https://nptel.ac.in/courses/114106039/

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

High-3, Medium-2, Low-1

Course Title	INDUSTRIAL SAFETY	Semester	VI
Course Code	MVJ20CV654	CIE	50
Total No. of Contact Hours	40 L: T: P: 3: 0: 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hr

Course objectives: This course will enable students to

- State the importance and necessity of Safety measures in Industry
- Illustrate on significance of Sign Boards on Fire safety
- Apply the Safety programs in Industry Activities
- Detail on Safety precautions against shocks
- Construct the procedure for checking on chemical safety.

Pre Requisites: Basic idea of Safety

Module-1	L1, L2	8 Hr.
<p>Introduction to Safety: Terms used: accident, safety, hazard, safe, safety devices, safety guard, security, precaution, caution, appliance, slip, trip, fall. Ladders and scaffolding. Unsafe acts, reason for accidents, MSDS (material safety data sheet), OSHA, WHO. Lockout and tag out procedures, Safe material handling and storage.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Preparation of Safety manual for a hazardous Construction activity <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Material handling in Library <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-2	L1, L2	8 Hr.
<p>Fire Safety: Introduction, Class A, B, C, D and E fire. Fire triangle, Fire extinguishers, Fire hazard and analysis, prevention of fire. Fire protection and loss prevention, steps after occurrence of fire. Portable fire extinguishers. Fire detection, fire alarm and firefighting systems. Safety sign boards, instruction on portable fire extinguishers.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Collection of Fire safety Industries in India and compare with the specifications <p>Applications: (Self Learning)</p>		

<ul style="list-style-type: none"> • Fire Safety Equipment and Management in Industry like New Age Fire Protection Industries Private Limited, Usha Fire Safety Equipments (P) Ltd etc., <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-3	L1, L2	8 Hr.

<p>Safety Programs: Human Factors in Construction Safety, Problem Areas in Construction Safety, Elements of an Effective Safety Programs, Job-Site Safety Assessment, Safety Meetings, Safety Incentives.</p> <p>Safety while handling Material, compressed gas cylinders, corrosive substance, waste drum and containers.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Assessment and report on Bhopal gas tragedy in 1984 <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • National Occupational Health and Safety <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-4	L1, L2	8 Hr.

<p>Electrical Safety: Introduction to electrical safety, Electric hazards, effect of electric current on human body, causes of electrical accidents, prevention of electric accidents, PPE used. Electric shock. Primary and secondary electric shocks, AC and DC current shocks. Safety precautions against shocks. Safety precautions in small and residential building installations. Safety procedures in electric plant.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Collection of Electrical Testers manufacturers <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Honeywell – Protect your workforce against electrical hazards <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/110/105/110105094/ • https://nptel.ac.in/courses/105/102/105102206/ 		
Module-5	L1, L2	8 Hr.

<p>Chemical Safety and other Safety Checks: Introduction to Chemical safety, Labeling of chemicals, acid hoods. Handling of acids, eye washers and showers. Safety thinking, accident</p>		
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investigation, safety policy of the company, safety, loss prevention and control, check list for LPG installations, safety precautions using CNG, fire prevention and safety audit, confined space entry, risk assessment.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Prepare the check list to maintain the Chemical safety (pre and post assessment)

Applications: (Self Learning)

- Different ways to stay safe in Chemical Industry

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/110/105/110105094/>
- <https://nptel.ac.in/courses/105/102/105102206/>

Scheme of Evaluation

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

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

CO1	Identify the hazards around the work environment and industries
CO2	Use the safety measures while performing work in and around the work area of the available Laboratories
CO3	Write the case studies by sharing experience of the employees working in housekeeping, laboratories like workshops, electrical labs, machine shops, electronics and computer laboratories.
CO4	Recognize the sign boards and its application.
CO5	Apply the necessary precautions while using chemicals and other hazardous materials

Text Books:	
1.	Electrical Safety, fire safety and safety management by S.Rao, R K Jain and Saluja. Khanna Publishers, 1997
2.	Chemical process Industrial safety by K S N Raju by McGraw Hill Education (India) private Limited, 2014

Reference Books:	
1.	Jimmy W. Hinze, "Construction Safety", Prentice Hall Inc., 2000
2.	Industrial Safety and Management by L M Deshmukh by McGraw Hill Education (India) private Limited, 2005
3.	Environmental engineering by Gerard Kiely by McGraw Hill Education (India) private Limited, 2006

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

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL ENGINEERING LABORATORY	Semester	VI
Course Code	MVJ20CVL66	CIE	50
Total No. of Contact Hours	L : T : P :: 0: 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hr
Course objective is to: This course will enable students to <ul style="list-style-type: none"> • Examine different methods of water & wastewater quality • Recommend the degree and type of treatment • Explain the environmental significance and application in environmental engineering practice 			
Prerequisites: Water supply and Treatment Engineering			
S.NO	Experiments	L3, L4	
1	Determination of pH, Conductivity, TDS and Turbidity.		
2	Determination of Acidity and Alkalinity.		
3	Determination of Calcium, Magnesium and Total Hardness.		
4	Determination of Dissolved Oxygen		
5	Determination of BOD.		
6	Determination of Chlorides		
7	Determination of percentage of % of available chlorine in bleaching powder sample and Residual Chlorine.		
8	Determination of Solids in Sewage: i) Total Solids, ii) Suspended Solids, iii) Dissolved Solids, iv) Volatile Solids, Fixed Solids v) Settleable Solids.		
9	Determination of optimum coagulant dosage using Jar test apparatus.		
10	Determination of Sulphates by spectrophotometer		
11	Determination Nitrates and Iron by spectrophotometer.		
12	Determination of Sodium and Potassium by flame photometer.		
13	Determination of COD(Demonstration)		
14	Air Quality Monitoring (Demonstration)		
Video link / Additional online information: (Self-Learning)			

- http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/index.html
- http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_2/index.html
- <https://jecassam.ac.in/engineering/civil/laboratories/environmental-engineering-laboratory/>

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

CO 1	Acquire capability to conduct experiments and estimate the concentration of different parameters.
CO 2	Compare the result with standards and discuss based on the purpose of analysis.
CO 3	Identify type of treatment, degree of treatment for water and wastewater.
CO 4	Identify the parameter to be analysed for the student project work in environmental stream.

Scheme of Evaluation

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

Test Books:

1.	AWWA, WEF, APHA, 1998, Standard Methods for the Examination of Water and Wastewater (Method: 5210B,5-day BOD).
2.	Sawyer, C.N., McCarty, P.L., and Parkin, G.F. 2000. Chemistry for Environmental Engineering 4th Edition. Tata McGraw-Hill Publishing Company Limited.

Reference Books:

1.	IS 3025 (Part 44)-1993: Method of Sampling and Test (Physical and Chemical) for Water and Wastewater, Biochemical Oxygen Demand, First Revision.
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CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	SOFTWARE APPLICATION LABORATORY	Semester	VI
Course Code	MVJ20CVL67	CIE	50
Total No. of Contact Hours	L : T : P :: 0: 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs

Course objective: Students will be able to,

- Use industry standard software in a professional set up.
- Understanding the elements of finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design.
- Develop customized automation tools.
- Effectively communicate the mechanical properties of materials.

Module -1

L3

Prerequisites: Theory of stress & strain

Use of Software: ETags, STAAD pro or any other related software.

1. Analysis of plane trusses, continuous beams, portal frames. (ANALYSIS OF STRUCTURES_ MVJ19CV42_ Module 3 & 4)
2. 3D analysis of multi storied frame structures.

Module – 2

L3

Prerequisites: Basics of Project management, Geodetic Information

Project Management- Exercise on Project planning and scheduling of a building project using any project management software:

1. Understanding basic features of Project management software
2. Constructing Project: create WBS, Activities, and tasks and Computation Time using Excel spread sheet and transferring the same to Project management software.
3. Identification of Predecessor and Successor activities with constrain
4. Constructing Network diagram (AON Diagram) and analyzing for Critical path, Critical activities and Other non-Critical paths, Project duration, Floats.
5. Study on various View options available
6. Basic understanding about Resource Creation and allocation
7. Understanding about Splitting the activity, linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project

GIS applications using open-source software:

1. To create shape files for point, line, and polygon features with a map as reference.

2. To create decision maps for specific purpose.

Module-3		L3
Prerequisites: Design of RC Structures, Curve Setting. Use of EXCEL spread sheets:		
<ol style="list-style-type: none"> 1. Design of singly reinforced and doubly reinforced rectangular beam.(DESIGN OF RC STRUCTURES_ MVJ19CV62_Module 2) 2. Design of one way and two-way slabs, computation of earthwork, (DESIGN OF RC STRUCTURES_ MVJ19CV62_Module 3) 3. Design of horizontal curve by offset method, Design of super elevation. (GEODETIC INFORMATION_ MVJ19CV34_Module 4) 		
Course outcomes: On completion of the course, students would be able to		
CO1	Compute the stresses developed due to different loading conditions on plane trusses, continuous beams and portal frame.	
CO2	Use of software skills in a professional set up to automate the work and thereby reduce cycle time for completion of the work	
CO3	Design Beams, Slabs in RC Structures, Setting out curve in highway.	

Text Books:

1.	Chang,K , "Introduction to Geographic Information Systems", Tata McGraw-Hill Publishing Co. Ltd, 2008
2	R K Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications, 2010
3	Unnikrishnan Pillai and Devdas Menon, " Reinforced Concrete Design" , McGraw Hill, New Delhi
4.	B.C. Punmia, "Surveying Vol.1 & 2", Laxmi Publications pvt. Ltd., New Delhi –2009.

Reference Books:

1	George Joseph, "Fundamentals of Remote Sensing", University Press, 2003
2	Training manuals and User manuals and Relevant course reference books

Scheme of Evaluation

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

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

High-3, Medium-2, Low-1

Course Title	Mini-Project	Semester	VI
Course Code	MVJ20CVP68	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 0 : 6	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	3	Exam. Duration	-

Course Objective:

- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.

Mini-project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project: (i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department. **(ii) Interdisciplinary:** Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.

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

CO1	Describe the project and be able to defend it. Develop critical thinking and problem solving skills.
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CO2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.

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

Course Title	DESIGN OF STEEL STRUCTURES	Semester	VII
Course Code	MVJ20CV71	CIE	50
Total No. of Contact Hours	50 L: T: P: 3 : 2 : 0	SEE	50
No. of Contact Hours/Week	5	Total	100
Credits	4	Exam Duration	3Hrs
<p>Course objective is to: This course will enable students to</p> <ul style="list-style-type: none"> • Introduce steel structures and its basic components • Introduce structural steel fasteners like welding and bolting • Design tension members, compression members, beams and beam-column • Design column splices and bases 			
Module-1		L1,L2,L3	10 Hrs.
<p>Introduction: Advantages and Disadvantages of Steel structures, Loads and Load combinations, Design considerations, Limit State Method (LSM) of design, Failure criteria for steel, Codes, Specifications, and section classification.</p> <p>Plastic Behavior of Structural Steel: Introduction, Plastic theory, Plastic hinge concept, Plastic collapse load, conditions of plastic analysis, Theorem of Plastic collapse, Methods of Plastic analysis, Plastic analysis of continuous beams</p> <p>Experimental learning:</p> <ul style="list-style-type: none"> • Developing animated videos to understand formation of plastic hinges <p>Applications:</p> <ul style="list-style-type: none"> • To select the type of member and to understand the plastic behavior of steel structures. <p>Video link:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105162/ 			
Module-2		L1,L2,L3	10Hrs
<p>Bolted Connections: Introduction, Behavior of Bolted joints, Design strength of ordinary Black Bolts, Design strength of High Strength Friction Grip bolts (HSFG), Pin Connections, Simple Connections, Moment resistant connections, Beam to Beam connections, Beam and Column splices, Semi rigid connections.</p> <p>Welded Connections: Introduction, Welding process, Welding electrodes, Advantages of Welding, Types and Properties of Welds, Types of joints, Weld symbols, Weld specifications, Effective areas of welds, Design of welds, Simple joints, Moment resistant connections, Continuous Beam to Column connections, Continuous Beam to Beam connections, Beam Column splices, Tubular connections.</p> <p>Experimental learning:</p>			

<ul style="list-style-type: none"> Develop 3D models using any modelling software to understand various connections. <p>Applications:</p> <ul style="list-style-type: none"> In developing connections between various elements of a steel structure. <p>Video link:</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/105/105105162/ 		
Module-3	L1,L2,L3	10Hrs
<p>Design of Tension Members: Introduction, Types of tension members, Slenderness ratio, Behavior of tension members, Modes of failure, Factors affecting the strength of tension members, Angles under tension, Other sections, Design of tension member, Lug angles, Splices, Gussets. Design of splices and gussets</p> <p>Experimental learning:</p> <ul style="list-style-type: none"> Field visit to understand various tension members. <p>Applications:</p> <ul style="list-style-type: none"> In designing trusses, purlins and beams of multistoreyed buildings. <p>Video link: https://nptel.ac.in/courses/105/105/105105162/</p>		
Module-4	L1,L2,L3	10Hrs.
<p>Design of Compression Members: Introduction, Failure modes, Behavior of compression members, Elastic buckling of slender compression members, Sections used for compression members, Effective length of compression members, Design of compression members, Built up compression members.</p> <p>Experimental learning:</p> <ul style="list-style-type: none"> Field visit to understand various compression members <p>Applications:</p> <ul style="list-style-type: none"> In designing trusses and columns of multistoried buildings. <p>Video link: <ul style="list-style-type: none"> https://nptel.ac.in/courses/105/105/105105162/ </p>		
Module-5	L1,L2,L3	10Hrs
<p>Design of Column Bases and Beams: Design of simple slab base and gusseted base. Introduction, Beam types, Lateral stability of beams, factors affecting lateral stability, Behavior of simple and built-up beams in bending(without vertical stiffeners), Design strength of laterally supported beams in Bending, Design strength of laterally unsupported beams, Shear strength of steel beams, Maximum deflection, Design of beams and purlins.</p>		

Experimental learning:

- Develop 3D models using any modelling software to understand behavior of beams.

Applications:

- In designing columns and footings for multistoried buildings

Video link:

- <https://nptel.ac.in/courses/105/105/105105162/>

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

CO1	Restate the basic elements of a steel structure
CO2	Illustrate the fundamentals of structural steel fasteners
CO3	Design basic elements of steel structure like tension members, compression members, beams and beam-columns
CO4	Identify the different failure modes of steel tension and compression members and beams and compute their design strengths.
CO5	Design column splices and bases.

Scheme of Evaluation

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	Subramanian, -Design of Steel Structures , Oxford University Press, New Delhi, 2013.
2.	Gambhir. M.L., -Fundamentals of Structural Steel Design , McGraw Hill Education India Pvt.Ltd., 2013

Reference Books:

1.	Shiyekar. M.R., -Limit State Design in Structural Steel , Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013.
2.	Duggal. S.K., -Limit State Design of Steel Structures , Tata McGraw Hill Publishing Company, 2005.
3.	Shah.V.L. and Veena Gore, -Limit State Design of Steel Structures , IS 800–2007 Structures Publications, 2009.

4.	IS 800:2007 GENERAL CONSTRUCTION IN STEEL – CODE OF PRACTICE
5.	SP 6-1: ISI Handbook for Structural Engineers -Part- 1 Structural Steel Sections by Bureau of Indian Standards

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	DESIGN OF PRE-STRESSED CONCRETE ELEMENTS	Semester	VII
Course Code	MVJ20CV72	CIE	50
Total No. of Contact Hours	50 L: T: P: 3 : 2 : 0	SEE	50
No. of Contact Hours/week	5	Total	100
Credits	4	Exam. Duration	3 Hrs.

Course objective is to: This course will enable students to

- Use the basics of prestressing to concrete elements.
- Restate the basic principle of prestressing including losses.
- Interpret the deflections in a prestressed concrete member.
- Analyze the section for flexure, shear under limit state of serviceability and design the pre- stressed beam under permissible stress condition.
- Describe the design of anchorage zones.

Module-1

L2

10 Hrs.

Prerequisites: Concept of stress-strain characteristics of steel and concrete.

Introduction- High strength concrete and steel, stress-strain characteristics and properties, fundamentals, load balancing concept, stress concept, center of thrust. Pre-tensioning and post-tensioning systems, tensioning methods, and end anchorages (Online mode).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Experimental investigation to verify the efficiency and strength of post-tensioning systems.
- Industrial visit to witness pre-tensioning and post-tensioning methods and different types of end anchorages.

Applications: (Self Learning)

- Understanding of principles of prestressing concept.
- Find out the mechanism of the working of tensioning systems and various tools available to prestress the structures.

Video link / Additional online information: (Self Learning)

(Introduction to PSC, high strength concrete and steel, stress-strain characteristics and properties, pre-tensioning and post-tensioning systems, tensioning methods and end anchorages.)

<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106117/ 		
Module-2	L3	10 Hrs.
<p>Losses of Prestress: Stresses in concrete due to prestress and loads, stresses in steel due to loads, cable profiles, various losses encountered in pre-tensioning and post tensioning methods (Online Mode), determination of jacking force.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Calculation of losses in a prestressed concrete beam. • FE software analysis to study the effect of cable profiles in determining the stress distribution in post-tensioned member. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Estimating various losses of prestressing. • Find out the behaviour of prestressed concrete beam under different cable profiles. <p>Video link / Additional online information: (Self Learning) (Various losses encountered in pre-tensioning and post tensioning methods, determination of jacking force.)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106117/ 		
Module-3	L3	10 Hrs.
<p>Deflection of a pre-stressed member – Short term and long-term deflections, Elastic deflections under transfer loads and due to different cable profiles. Deflection limits as per IS 1343. Effect of creep on deflection, load verses deflection curve, methods of reducing deflection.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • FE software analysis to study the effect of cable profiles in determining the deflections in post- tensioned member. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Knowledge of deflection behavior of post-tensioned member under the loads and tendon profiles. • Understanding of long-term deformations due to creep in PSC. <p>Video link / Additional online information: (Self Learning) (Short term and long-term deflections, elastic deflections under transfer loads and due to different cable profiles. Deflection limits as per IS 1343).</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106117/ 		
Module-4	L3 & L4	10 Hrs.
<p>Prerequisites: Knowledge of Limit State of Strength & Serviceability.</p> <p>Flexure -Types of flexural failure, IS Code recommendations (Online Mode). Ultimate flexural strength of sections. Shear - IS Code recommendations (Online Mode), shear</p>		

resistance of sections, shear reinforcement. Limit state of serviceability – control of deflections and cracking.

Design of Beams: Design of pre-tensioned and post-tensioned symmetrical and asymmetrical sections.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Analysis and design of simple prestressed concrete beams, encompassing bending and shear performance.
- Comparative analysis of behavior of PSC and RCC sections under flexure and shear.

Applications: (Self Learning)

- Gives in depth knowledge of performance of PSC beams under flexure and shear.

Video link / Additional online information: (Self Learning)

(Types of flexural failure, IS code recommendations, ultimate flexural strength of sections, IS Code recommendations, shear resistance of sections, shear reinforcement, control of deflections and cracking. Design of Beams.)

- <https://nptel.ac.in/courses/105/106/105106117/>

Module-5	L3 & L4	10 Hrs.
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Design of End block: Transmission of Prestress in pretension members, transmission length, Anchorage stress in post-tensioned members (Online Mode). Bearing stress and bursting tensile force stresses in end blocks- Methods, I.S. code provision for the design of end block reinforcement. **Laboratory Sessions/ Experimental learning: (Self Learning)**

- Software analysis of stress in anchorage zone in post-tensioned members.
- Case study on the effect of reinforcement on anchorage zone cracks in prestressed concrete members.

Applications: (Self Learning)

- Learn design of end zone reinforcement to check the bursting effect of the tensile stresses.

Video link / Additional online information: (Self Learning)

(Transmission of Prestress, Bearing stress and design of end block reinforcement).

- <https://nptel.ac.in/courses/105/106/105106117/>

Course outcomes: On completion of the course, students would be able to	
CO1	Restate the basic concept of pre-stressing and understand the requirement of PSC members for present scenario.
CO2	Examine the stresses encountered in PSC element during transfer and at working.
CO3	Interpret the effectiveness of the design of PSC after studying losses.
CO4	Investigating the PSC element and finding its efficiency and design PSC beam for different requirements.
CO5	Design the end blocks in PSC using codal provisions.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	Prestressed Concrete- N. Krishna Raju - Tata McGraw Hill Publishers- Sixth Edition, 2018.
2.	Fundamentals of Prestressed Concrete- Dr. N C Sinha & Dr. S K Roy- S Chand Publishing-Third Edition- 2011.

Reference Books:	
1.	Prestressed Concrete- Problems and Solutions- N. Krishna Raju- CBS Publishers & Distributors Pvt Ltd – Third Edition, 2018.
2.	Pre-stressed Concrete- N. Rajagopalan- Narosa Publishing House- Second Edition, 2015.
3.	Pre-stressed Concrete structures- P. Dayaratnam- Medtech Publishers- Seventh Edition, 2017.
4.	K U Muthu - "Prestressed Concrete"- PHI Learning, 2016.
5.	Design of Prestressed Concrete Structures- T.Y. Lin and Ned H. Burns - Wiley India Pvt Ltd- Third edition, 2010.
6.	Leonhardt Fritz- "Prestressed Concrete-Design and Construction", Berlin, W. Ernst, 1964.
7.	IS: 1343 - Indian Standard code for practice for prestressed concrete, BIS, New

Delhi.

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

High-3, Medium-2, Low-1

Course Title	DESIGN AND DRAWING OF HYDRAULIC STRUCTURES	Semester	VII
Course Code	MVJ20CV731	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable students to

- State and explain the reservoir classifications and planning
- Explain the types of earth dams, gravity dams and their components and safety
- List and explain the types of spillways and energy dissipators in spillways
- Demonstrate different irrigation structures and their design criteria
- Demonstrate pipe network design and stormwater network design

Prerequisites: Knowledge on Water cycle in earth, different components and measurements of hydrological variables, hydrostatics, kinematics, and dynamics, and open channel flow.

Module-1

L1, L2, L3

8 Hrs

Prerequisites: Knowledge on Water cycle in earth, different components and measurements of hydrological variables, hydrostatics, Darcy law.

Reservoir Planning: Introduction, classification of Reservoirs, Storage zones of a reservoir, Mass curve, fixing capacity of a reservoir, safe yield, Numerical problems on storage capacity of reservoirs, density currents, Trap efficiency, Reservoir sedimentation, life of a reservoir, economic height of a dam and problems, environmental effects of reservoirs.

Earth Dams: Introduction, types of Earth dams, construction methods, Design criteria for Earth dams, causes of failure of earth dams, section of dam, preliminary design criteria, problems, control of seepage through earth dams, Safety measures.

Laboratory Sessions: (Self Learning)

- Determination of reservoir storage by collecting data

Applications: (Self Learning)

- Reservoir planning
- Fixing the capacity of the reservoirs
- Determination of sediment load and different storage volumes of reservoir
- Design of Earth dams

Video link / Additional online information: (Self Learning)		
<ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/108/105108130/ 		
Module-2	L1, L2, L3	8 Hrs
<p><i>Prerequisites: Basics of concrete technology</i></p> <p>Gravity Dams: Introduction, forces on a gravity dam, Numerical problems on stress analysis, combination of forces for design. Elementary & practical profiles of a gravity dam, stability analysis (without earthquake forces), problems, galleries in gravity dams.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> • Analyzing the forces acting on an existing gravity dam <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Dam safety analysis of different failures • Design of gravity dam storage and different forces <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105108130/ 		
Module-3	L1, L2, L3	8 Hrs
<p><i>Prerequisites: Notches, weirs, and hydraulic jump</i></p> <p>Spillways: Introduction, essentials of a spillway, spillway components, factors affecting types & design of spillways, Types of spillways, Ogee spillway, Numerical problems on Ogee spillway, Energy dissipation below spillways (hydraulic jump- No design), Numerical problems based on conjugate depth, Froude number and energy dissipation, Spillway crest gates, Outlet works.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> • Hydraulic jump experiment on energy dissipation using conjugate depths. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Design of Ogee spillway <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/126/105/126105012/ 		
Module-4	L1, L2, L3	8 Hrs
<p><i>Prerequisites: Notches, weirs, and basics of irrigation engineering</i></p> <p>Diversion Head Works: Components of diversion headworks, Design of impervious floors, Bligh's creep theory and limitations.</p> <p>Irrigation: Design of Surplus Weir, Canal gate sluice without tower head, Notch type canal fall, Cross drainage works, Canal cross regulator, Simple Aqueduct of Type III.</p> <p>Laboratory Sessions: (Self Learning)</p>		

- Measurement of discharge of flow over a weir

Applications: (Self Learning)

- Design of canal cross regulator

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/126/105/126105012/>

Module-5	L1, L2, L3	8 Hrs
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Hydraulic design in water supply: Losses in pipes, Moody diagram, Equivalent length of pipes in parallel and series, Water distribution network design, Numerical problems on Hardy-Cross method, Introduction to EPANET and demo.

Hydraulic design in stormwater management: Manning’s equation, Hazen-Williams equation, Darcy-Weisbach equation, Introduction to SWMM for a simple storm water network and demo.

Laboratory Sessions: (Self Learning)

- Design of pipe network for a simple distribution network

Applications: (Self Learning)

- Design of pipe network
- Design of storm water network

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106119/>

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

CO1	Identify reservoir types and apply of reservoir storage capacity estimation methods
CO2	Develop of Earth dams and Gravity dams designs and stability analysis
CO3	Make use of design methods of Ogee spillway and selection of spillway type
CO4	Select cross drainage works and design
CO5	Model water distribution network and stormwater drainage network

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8

Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	Punmia, B. C., et al. "Irrigation and Waterpower Engineering". Laxmi Publications, Ltd., 2009.
2.	Garg, S. K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2006.

Reference Books:	
1.	Murthy, C.S., "Water resources engineering: principles and practice". New Age International, 2002.
2.	Sen, D., "Water Resources Engineering", NPTEL Website, https://nptel.ac.in/courses/105/105/105105110/# , 2009, December 31.

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

High-3, Medium-2, Low-1

Course Title	WATER RESOURCE MANAGEMENT	Semester	VII
Course Code	MVJ20CV732	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective is to: This course will enable students to

- Judge surface and ground water resources.
- Address the issues of water resources management.
- Explain the principles of integrated water resources management.
- Apply the legal framework of water policy.
- Suggest the different methods of water harvesting.

Module-1

L1, L2

8 Hrs

Prerequisites: Knowledge on Water cycle in earth, form of water available in earth

Water Resources: Hydrologic Cycle, Global water resources and Indian Water resources, Water Balance, Available Renewable Water Resources, Surface Water Resources, Groundwater Resources- Types of Aquifers, and Groundwater as a Storage Medium.

Water resources management: The Water Balance as a Result of Human Interference, Storm water management, Flood water management, Fresh water management, Ground water management, Wastewater management, Urban water management, Water pollution and water quality management. Water table- Factors affecting water table, Water Scarcity

Laboratory Sessions/ Experimental learning:

- Identification of water management system available in a region

Applications:

- Water quantity estimation
- Water quantity management
- Quantifying the water scarcity.

Video link / Additional online information:

- <https://nptel.ac.in/courses/114105044/>
- <https://nptel.ac.in/courses/114105044/>
- <https://nptel.ac.in/courses/114105044/>

Module-2

L1, L2

8 Hrs

Water Resources Planning and Management: Necessity, Planning and management issues, System components, planning scales, Approaches. Planning and management

aspects, Analysis, Models for impact prediction and evaluation, Adaptive Integrated Policies, Post Planning and management Issues. Meeting the Planning and Management Challenges.

Laboratory Sessions/ Experimental learning:

- Analyzing the alternate solutions for water quality problem in a given region

Applications:

- Preparing analytical framework of management system
- Model analysis for selecting the optimum solution
- Management of Water quality issues through system approach

Video link / Additional online information:

- <https://nptel.ac.in/courses/105108130/>

Module-3

L1, L2

8 Hrs

Prerequisites: Role of women in water management, Cost, and value of water

Integrated Water Resources Management: Definition of IWRM- Natural and human integration system, Principles- Water as a finite and vulnerable resource, Participatory approach, The important role of women in water management, Water as an economic good, Implementation of IWRM, Legislative and Organizational Framework.

Private sector Involvement: Types and Forms of Private Sector Involvement, Benefits of IWRM in different sector- Environmental sector, Food and agriculture sector, water supply and sanitation.

Laboratory Sessions/ Experimental learning:

- Identification of private sector participation in water supply for a given

Applications:

- Decision making for water quantity problems based on IWRM Concept
- Evaluation of value of water
- Monitoring Private sector involvement in water management

Video link / Additional online information:

- <http://www.digimat.in/nptel/courses/video/105101010/L08.html>
- <https://nptel.ac.in/courses/114105044/>

Module-4

L1, L2

8 Hrs

Water Governance: Definition, Necessity of water governance, Principles of effective governance- Approaches, performance and operation water governance challenges, water governance cycle **National Water Policy:** National water resource council, 1987 & 2002 Nation water policy Irrigation Management Transfer Policies and Activities , Legal Registration of ,WUAs , Legal Changes in Water Allocation, – Role of Local

Institutions – Community Based Organizations .

Laboratory Sessions/ Experimental learning:

- Verification of implementation of water policies in a given region. Applications: (Self Learning)
- Justification on water allocation
- Highlighting the water policies during the decision-making process in water management
- Evaluation of effective participation of WUA

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/114105044/>

Module-5

L1, L2

8 Hrs

Prerequisites: Rainwater Harvesting, Evaporation, Water conservation

Water conservation: Definition, Goals, Water conservation techniques- Conservation by surface water storage, Conservation of rain water, Ground water conservation (Online mode), Catchment area protection (CAP) - Inter-basin transfer of water- Adoption of drip sprinkler irrigation, Management of growing pattern of crops, Reducing evapotranspiration, Reducing evaporation from various water bodies- Recycling of water , Measures of water conservation, simple water saving methods.

Water Harvesting: Water Harvesting Techniques, Micro-catchments, Design of Small Water Harvesting Structures, Farm Ponds, Percolation Tanks, Yield from a Catchment, Rain water Harvesting-various techniques related to Rural and Urban area(Online mode).

Laboratory Sessions/ Experimental learning:

- Design Rainwater harvesting structure in a given region to conserve water.

Applications:

- Design of Rainwater harvesting system
- Evaluation of effective conservation of water.
- Implementation of micro irrigation system

Video link / Additional online information:

- <https://nptel.ac.in/courses/105101010/>

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

CO1	Discuss the potential of groundwater and surface water resources.
CO2	Illustrate the issues related to planning and management of water resources
CO3	Outline IWRM in different regions.
CO4	List out the legal issues of water policy
CO5	Predict the method for water harvesting based on the area.

Scheme of Evaluation (Theory)		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	K. Subramanya, "Engineering Hydrology", Tata McGraw Hill Publishers, New Delhi, 2017
2.	H.M. Raghunath, "Ground Water", Wiley Eastern Publication, New Delhi. ,2016
Reference Books:	
1.	Mollinga, P. et al, "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
2.	Daniel P. Loucks and Eelco van Beek, "Water Resources Systems Planning and Management", UNESCO Publication,2005
3.	Water Resources Engineering, D A Chin (Indian Edition), Pearson Publications
4.	Water Resources Engineering, L W Mays (Indian Edition), Wiley Publications

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

High-3, Medium-2, Low-1

Course Title	GROUND WATER HYDRAULICS	Semester	VII
Course Code	MVJ20CV733	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective is to: This course will enable students to

- State the properties of aquifer with its influence on groundwater storage
- Analyze the steady and unsteady groundwater flow conditions
- Apply the model approach for groundwater management system
- Estimate the groundwater quality
- Propose the suitable remedial measures for the groundwater development system

Prerequisites: *Environmental Studies, chemistry, Introduction to Environmental engineering.*

Module-1

L1, L2, L3

8 Hrs

Introduction – Water bearing Properties of Rock – Type of aquifers – Aquifer properties – permeability, specific yield, transmissivity, and storage coefficient – Methods of Estimation– Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms, Global distribution of water, Role of groundwater in water resources system and their management.

Laboratory Sessions:

- Poster Presentation on types of aquifers.
- Study of various properties of Rock

Applications: (Self Learning)

- Groundwater table fluctuation.
- Understanding the scope of the subject.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/105/105105042/>
- <https://nptel.ac.in/courses/105/103/105103026/>

Module-2

L1, L2,L3

8 Hrs

Objectives of Groundwater hydraulics – Darcy's Law – Groundwater equation – steady state flow – Dupuit Forchheimer assumption – heterogeneity & anisotropy, Ground water flow rates & flow directions, general flow equations through porous media. Unsteady state flow – Theis method – Jacob method -Slug tests – Image well theory – Partial penetrations of wells.

Laboratory Sessions:

- Poster Presentation on Image well theory and Partial penetrations of wells.
- Study of slug test by preparing the charts

Applications: (Self Learning)

- Understanding the groundwater equation.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/105/105105042/>
- <https://nptel.ac.in/courses/105/103/105103026/>

Module-3

L1, L2, L3

8 Hrs

Need for Management Model, Database for groundwater management, groundwater balance study, Introduction to Mathematical model, Conjunctive use, Collector well, Infiltration gallery and introduction to MODFLOW.

Laboratory Sessions:

- Case Study on Groundwater balance study by using Mathematical model.
- Poster Presentation on Infiltration Gallery

Applications: (Self Learning)

- Study of Mathematical modelling.

Video link / Additional online information:

- https://nptel.ac.in/courses/105/105/105105042
/
- https://nptel.ac.in/courses/105/103/105103026
/

Module-4

L1,L2,L3

8 Hrs

Ground water chemistry – Origin, movement, and quality – Water quality standards – Health and aesthetic aspects of water quality – Saline intrusion.

Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh & saline water interface, fresh-saline water relations on oceanic islands, Karst terrains.

Laboratory Sessions:

- Model making of self -purification of groundwater.
- Poster Presentation on Saline Intrusion.

Applications: (Self Learning)

- Understanding of impact of saline intrusion.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/105/105105042/>
- <https://nptel.ac.in/courses/105/103/105103026/>

Module-5	L1, L2, L3	8 Hrs
<p>Ground water conservation: Artificial recharge techniques, Ground water management studies, Protection zone delineation, Contamination source inventory, Ground water Pollution and legislation, Remediation measures for quality and quantity improvement, Remediation of Saline intrusion.</p> <p>Laboratory Sessions:</p> <ul style="list-style-type: none"> • Poster Presentation on Groundwater Pollution and legislation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Understanding of groundwater management studies. <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105042/ • https://nptel.ac.in/courses/105/103/105103026/ 		

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

CO1	Asses the properties of aquifer with its influence on groundwater storage
CO2	Identify the steady and unsteady groundwater flow conditions
CO3	Apply the model approach for groundwater management system
CO4	Estimate the groundwater quality
CO5	Suggest the suitable remedial measures for the groundwater development system

Scheme of Evaluation (Theory)

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE (50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2.	Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.

Reference Books:	
1.	Todd D.K and Mays L.W, "Ground Water Hydrology", 3 rd Edition, John Wiley and Sons, New York, 2004.
2.	Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2013.

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

High-3, Medium-2, Low-1

Course Title	COMPUTATIONAL FLUID DYNAMICS	Semester	VII
Course Code	MVJ20CV734	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable students to

- State the governing equations of fluid dynamics
- Formulate and solve Euler's equation of motion
- Represent the skills related to Functions on Computer
- Apply the finite difference method on linear stability analysis
- Solve computational problems related to fluid flows by finite volume method

Module-1

L3

8 Hrs.

Introduction to CFD and Governing Equations: Need of CFD as tool, role in R&D, continuum, material or substantial derivative or total derivative, gradient, divergence and curl operators, Linearity, Principle of Superposition. Derivation of Navier-Stokes equations in control volume (integral form) and partial differential form, Euler equations (governing inviscid equations). Mathematical classification of PDE (Hyperbolic, Parabolic, Elliptic). Method of characteristics, Introduction to Riemann Problem and Solution Techniques.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Surface mesh formation by boundary element method

Applications: (Self Learning)

- Solve transport equations for the Reynolds stresses

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/112/105/112105045/>
- <https://nptel.ac.in/courses/103/106/103106119/>

Module-2

L3

8 Hrs.

One-dimensional Euler's equation: Conservative, Non-conservative form and primitive variable forms of Governing equations. Systematic way to diagonalise Eigenvalues and Eigenvectors of Flux Jacobian. Decoupling of Governing equations, introduction of characteristic variables. Relation between the two non- conservative forms. Conditions for genuinely nonlinear characteristics of the flux Jacobian.

Introduction to Turbulence Modeling: Derivation of RANS equations and k-epsilon model.

Laboratory Sessions/ Experimental learning: (Self Learning) <ul style="list-style-type: none"> Determination of Eigenvalues and Eigenvectors for matrix data Applications: (Self Learning) <ul style="list-style-type: none"> Identify the pressure at the upper surface of an airfoil Video link / Additional online information: (Self Learning) <ul style="list-style-type: none"> https://nptel.ac.in/courses/112/105/112105045/ https://nptel.ac.in/courses/103/106/103106119/ 		
Module-3	L3	8 Hrs.
Representation of Functions on Computer: Need for representation of functions, Box Function, Hat Function, Representation of $\sin x$ using hat functions- Aliasing, high frequency, low frequency. Representation error as a global error. Derivatives of hat functions, Haar functions, Machine Epsilon. Using Taylor series for representation of Derivatives. Laboratory Sessions/ Experimental learning: (Self Learning) <ul style="list-style-type: none"> Taylor's formula to find the power series expansion of $\sin x$ Applications: (Self Learning) <ul style="list-style-type: none"> Study the Global errors propagated in the numerical integration Video link / Additional online information: (Self Learning) <ul style="list-style-type: none"> https://nptel.ac.in/courses/112/105/112105045/ https://nptel.ac.in/courses/103/106/103106119/ 		
Module-4	L3	8 Hrs.
Finite Difference Method : Applied to Linear Convection equation, Laplace Equations, Convection Diffusion equations, Burgers equations, modified equations, Explicit methods and Implicit methods as applied to linear convection equation, Laplace equations, convection diffusion equation. FTCS, FTFS, FTBS, CTCS. Jacobi Method, Gauss-Siedel, Successive Over Relaxation Method, TDMA. Von-Neumann stability (linear stability) analysis. Upwind Method in Finite Difference method. Laboratory Sessions/ Experimental learning: (Self Learning) <ul style="list-style-type: none"> Predict the condition of Pandemic situation by Gauss-Siedel method Applications: (Self Learning) <ul style="list-style-type: none"> Propagation in a Gaseous Medium Video link / Additional online information: (Self Learning) <ul style="list-style-type: none"> https://nptel.ac.in/courses/112/105/112105045/ https://nptel.ac.in/courses/103/106/103106119/ 		
Module-5	L3	8 Hrs.
Finite Volume Method: Finite volume method. Finding the flux at interface. Central schemes		

- Lax- Friedrichs Method, Lax-Wendroff Method, Two-Step Lax-Wendroff Method and Mac Cormack Method Upwind Method in Finite Volume methods - Flux Splitting Method Steger and Warming, van Leer, Roe's Method and finding Roe's Averages.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Determination of solution of hyperbolic partial differential equations

Applications: (Self Learning)

- Gravity wave-model equations

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/112/105/112105045/>
- <https://nptel.ac.in/courses/103/106/103106119/>

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

CO1	Restate the mathematical characteristics of partial differential equations.
CO2	Explain how to classify and computationally solve Euler and Navier-Stokes equations.
CO3	Make use of the concepts like accuracy, stability, consistency of numerical methods for the governing equations.
CO4	Identify and implement numerical techniques for space and time integration of partial differential equations.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	Pletcher, r. H., Tannehill, j. C., Anderson, d., Computational fluid mechanics and heat transfer, 3 rd ed., Crc press, 2011.
2.	Moin, p., Fundamentals of engineering numerical analysis, 2nd ed., Cambridge university press, 2010.

Reference Books:	
1.	Ferziger, j. H., Numerical methods for engineering application, 2nd ed., Wiley, 1998.
2.	Ferziger, j. H., Peric, m., Computational methods for fluid dynamics, 3rd ed., Springer, 2002.
3.	Leveque, r., Numerical methods for conservation laws, lectures in mathematics, eth Zurich, birkhauser,1999.
4.	Riemann Solvers and Numerical methods for Fluid Dynamics – A Practical Introduction- Eleuterio F Toro, Springer Publications, 1997.

CO-PO Mapping												
CO/PO	PO1	PO2	PO13	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	-	2	-	1	-	1	-	1	1
CO2	1	2	1	-	2	-	1	-	1	-	1	1
CO3	1	2	1	-	2	-	1	-	1	-	1	1
CO4	1	2	1	-	2	-	1	-	1	-	1	1
CO5	1	2	1	-	2	-	1	-	1	-	1	1
High-3, Medium-2, Low-1												

Course Title	EARTH AND EARTH RETAINING STRUCTURES	Semester	VII
Course Code	MVJ20CV741	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable students to

- To recall lateral earth pressure theories and pressure theories and design of retaining walls.
- To analyze anchored bulkheads by different methods.
- To explain pressure envelopes and design of various components in braced cuts and cofferdams.
- To impart knowledge about different types of dams and their basic design requirements.

Module-1

L3

8 Hrs.

Prerequisites: Effective stress, Total stress, and Pore water pressure

Lateral Pressure: Basic concepts, Rankine and Coulomb earth pressure theories, graphical methods. Determining active and passive pressures: Culmann's, Rebhan's, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earthquake, wave effect, stratification, type of backfill, wall friction and adhesion. Retaining walls: Uses, types, stability, and design principles of retaining walls, backfill drainage, settlement and tilting.

Video link / Additional online information: (Self Learning)

- <https://www.digimat.in/nptel/courses/video/105105185/L55.html>
- <https://nptel.ac.in/courses/105/105/105105168/>

Module-2

L3

8 Hrs.

Prerequisites: Effective stress, Total stress, and Pore water pressure

Anchored bulkheads: Classification of anchored bulkheads, free and fixed earth support methods. Rowe's theory for free earth supports and equivalent beam methods for fixed earth supports. Design of anchored rods and dead man Braced cuts and Cofferdams: Braced excavations and stability of vertical cuts, lateral pressures in sand and clay, Braced and cellular cofferdams uses, types, components, stability, piping and heaving. Stability of cellular cofferdams, cellular cofferdams in rock and in deep soils.

Video link / Additional online information: (Self Learning)		
<ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105105185/L55.html • https://nptel.ac.in/courses/105/105/105105168/ 		
Module-3	L3	8 Hrs.
<p>Prerequisites: Slope stability</p> <p>Earth dams- Stability analysis: Classification, seepage control in embankments and foundations, seepage analysis, stability analysis: upstream and downstream for steady seepage, rapid draw down, end of construction, method of slices and Bishop's method.</p> <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105101201/L22.html • https://nptel.ac.in/courses/105/105/105105168/ 		
Module-4	L3	8 Hrs.
<p>Prerequisites: soil stabilization</p> <p>Earth dams -Protection & Construction: Slope protection, filters, embankment construction materials and construction, quality control, grouting techniques. Instrumentation and performance observations in earth dams.</p> <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://www.digimat.in/nptel/courses/video/105105185/L55.html • https://nptel.ac.in/courses/105/105/105105168/ 		
Module-5	L3	8 Hrs.
<p>Prerequisites: stability analysis</p> <p>Rigid Retaining Structures: Rigid Retaining Structures, Types, Empirical methods and Stability analysis. Flexible Retaining Structures: Flexible Retaining Structures, Types, Material, Cantilever sheet piles, Anchored bulkheads, free earth method, fixed earth method, moment reduction factors, anchorage, Braced Excavation Types, Construction methods, Pressure distribution in sands and clays.</p> <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/105/105105168/ 		
Course outcomes: On completion of the course, students would be able to		
CO1	Examine earth pressures on retaining structures,	
CO2	Design of braced excavation for deep cuts and excavation in ground.	
CO3	Analyze retaining walls, anchored bulkheads, braced cuts, coffer dams and	

	earth dams.
CO4	Outline different types of dams, their basic design requirements and loads imposed.
CO5	Design retaining structures considering both external and internal stability aspects

Scheme of Evaluation

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1. Basic & Applied soil mechanics – Gopal Ranjan & ASR Rao, New Age International Publishers, 2011
2. Engineering for Embankment Dams by B. Singh & R. S. Varshney, A A Balkema Publishers, 1995

Reference Books:

1. Embankment Dams by Sharma Hd, Publisher: India Book House (IBH) Limited, 1991
2. Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955.
3. Earth and Rock-Fill Dams: General Design and Construction Considerations by United States Army Corps of Engineers, University Press of the Pacific, 2004

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	MATRIX METHODS OF STRUCTURAL ANALYSIS	Semester	VII
Course Code	MVJ20CV742	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable the students to

- Use principles of structural analysis.
- Solve for forces and moments of indeterminate structures using principle of matrix method.
- Investigate the internal forces of various types of beams, frames & trusses.
- Examine the force and displacement parameters of the structures.

Module-1

L2,L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Strain Energy & Energy Concepts

Fundamental concepts: Static and Kinematic indeterminacy, Concepts of stiffness and flexibility. Energy concepts. Principle of minimum potential energy and minimum complementary energy. Development of element flexibility and element stiffness matrices for truss, beam and grid elements.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

Applications: (Self Learning)

- Calculations of Forces & Moments due to external and unit load application
- To check the behavior of Beams, Trusses & Frames

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/content/storage2/courses/112108092/module4/lec27.pdf>
- <https://nptel.ac.in/courses/105/105/105105180/>

Module-2

L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Strain Energy & Energy Concepts

Analysis using Flexibility method: Force transformation matrix using Flexibility method, Development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6x6flexibility matrix)

Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method (having not more than 3 coordinates – 3x3 flexibility matrix).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

Applications: (Self Learning)

- Development of global flexibility matrix for different structural elements
- Analyzing the behavior of Beams, Trusses & Frames using flexibility method

Video link / Additional online information: (Self Learning)

- <https://web.iitd.ac.in/~sbhalla/flexibility.pdf>
- <https://nptel.ac.in/content/storage2/courses/105105109/pdf/m2l7.pdf>

Module-3

L2,L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Strain Energy & Energy Concepts

Analysis using Stiffness Method: Displacement transformation matrix using Stiffness Method, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6x6 stiffness matrix) Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (having not more than 3 coordinates – 3x3 stiffness matrix)

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

Applications: (Self Learning)

- Development of global stiffness matrix for different structural elements
- Analyzing the behavior of Beams, Trusses & Frames using stiffness method

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/content/storage2/courses/105105109/pdf/m4l30.pdf>

Module-4

L3

8 Hrs.

Prerequisites: Concepts of Analysis of Structures, SFD & BMD, Temperature Stresses
Effects of temperature change and lack of fit: Related numerical problems by flexibility and stiffness method as in Module 2 and 3.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Computation of Forces & Displacements using structural software
- Computation of Forces & Displacements using EXCEL Sheet

Applications: (Self Learning)		
<ul style="list-style-type: none"> Analyzing the behavior of structural elements subjected to temperature stresses Analyzing the behavior of Trusses due to Lack of fit 		
Video link / Additional online information: (Self Learning)		
<ul style="list-style-type: none"> https://nptel.ac.in/courses/105/105/105105180/ 		
Module-5	L3	8 Hrs.
<i>Prerequisites: Matrix methods, Redundant Forces, Static & Kinematic Indeterminacies</i>		
<p>Solution techniques: Solution techniques including numerical problems for simultaneous equations, Gauss elimination and Cholesky method. Bandwidth consideration.</p>		
<i>Laboratory Sessions/ Experimental learning: (Self Learning)</i>		
<ul style="list-style-type: none"> Computation of Forces & Displacements using structural software Computation of Forces & Displacements using EXCEL Sheet 		
Applications: (Self Learning)		
<ul style="list-style-type: none"> Calculation of Forces & Displacements using matrix methods 		
Video link / Additional online information: (Self Learning)		
<ul style="list-style-type: none"> https://www.stat.cmu.edu/~ryantibs/convexopt-S15/scribes/09-num-lin-alg-scribed.pdf https://atozmath.com/example/CONM/GaussEli.aspx?he=e&q=CD2 		
Course outcomes: On completion of the course, students would be able to		
CO1	Illustrate problem solving skills	
CO2	Examine the principles of Structural Analysis	
CO3	Use analytical skills	
CO4	Write the Solution techniques	
CO5	Investigate the behavior of structure.	

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3		30
Quizzes	CIE(50)	2x2 =4
Activities / Experimentations related to courses/Assignment/Assignment		8
Mini Projects / Case Studies		8

Semester End Examination	SEE (50)	50
		Total 100

Textbooks:	
1.	Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001
2.	Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998.

Reference Books:	
1.	Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New York, 1986.
2.	W.Weaver and J.H.Gere, "Matrix Analysis of Framed Structures", Van Nastran, 1980.
3.	A.K.Jain "Advanced Structural Analysis with Computer Application" Nemchand and Brothers, Roorkee, India.
4.	M.F.Rubinstein "Matrix Computer Methods of Structural Analysis "Prentice – Hall.

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

High-3, Medium-2, Low-1

Course Title	ADVANCED FOUNDATION ENGINEERING	Semester	VII
Course Code	MVJ20CV743	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3hrs

Course objective is to: This course will enable students to

- Discuss the knowledge in calculating the bearing capacity and settlement of soils
- Examine the advanced topics of foundation design and analyses, supplementing their comprehensive knowledge acquired in basic foundation engineering course
- Illustrate profound understanding of shallow and deep foundation analyses
- Classify the choice of foundation design parameters
- Relate the cause and effect of dynamic loads on foundation

Module-1

L1, L2 & L3

8Hrs.

Prerequisites: basic geotechnical engineering, advanced geotechnical engineering, soil mechanics General bearing capacity equation-Terzaghi's, Brinch Hansen's and Meyerhof's analyses, bearing capacity of footings according to BIS, eccentrically loaded footing, footing on layered soil, Settlement of shallow Foundations: Immediate, consolidation, & differential settlements. (Online mode) Principles of design of footing, Proportioning of footings for equal settlement.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Standard penetration test
- Dynamic cone penetration test
- Vane shear test

Applications: (Self Learning)

- Model making of footings
- Case study of settlement of foundation

Module-2

L1, L2 & L3

8Hrs.

Design of combined footings by Rigid method, Combined footings (rectangular & trapezoidal), strap footings. Types of rafts, bearing capacity & settlements of raft foundation (online mode), Design of raft foundation-Conventional rigid method, Elastic methods, Coefficient of sub-grade reaction, IS code (IS- 2950) procedure.

Laboratory Sessions/ Experimental learning: (Self Learning)

<ul style="list-style-type: none"> • Design of raft foundation using software Applications: (Self Learning) <ul style="list-style-type: none"> • Introduction to Ansys software 		
Module-3	L1, L2 & L3	8 Hrs.
<p>Introduction Necessity of pile foundations, Classification, Load bearing capacity of single pile by Static formula, Dynamic formula, Pile load test and Penetration tests. Introduction, Pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, laterally loaded piles and under reamed piles. (Online mode),</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Model making of pile foundation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Case studies related to pile foundation in clay and sand 		
Module-4	L1, L2 & L3	8 Hrs.
<p>Well Foundations: Introduction, Different shapes, and characteristics of wells. Components of well foundation (online mode), Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. Drilled Piers & Caissons: Introduction, construction, advantages and disadvantages of drilled piers. Design of open, pneumatic, and floating caissons. Advantages and disadvantages of floating caissons. (Online mode),</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Poster preparation of well foundation and caissons <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Case studies related mitigation to sinking of well foundation 		
Module-5	L1, L2 & L3	8 Hrs.
<p>Machine Foundations: Introduction, free and forced vibrations, Types of Machine foundations, degrees of freedom of a block foundation, (online mode), general criteria for design of machine foundation, vibration analysis of a machine foundation, determination of natural frequency, vibration isolation and control.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Poster preparation of machine foundation • vibration analysis of a machine foundation <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Case studies related to vibration isolation and control . 		

Course outcomes: On completion of the course, students would be able to	
CO1	Find the settlement and bearing capacity of soil
CO2	Describe the size of isolated and combined foundations to satisfy bearing capacity and settlement criteria.
CO3	Identify the load carrying capacity and settlement of single piles and pile groups including laterally loaded piles
CO4	Recall the basics of analysis and design principles of well foundation, drilled piers and caissons
CO5	Use the design principles of machine foundations program

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE (50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1	Punmia B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Co., India
2	Murthy V.N.S., Advanced Foundation Engineering, CBS PUBLISHERS

Reference Books:	
1.	Donald P. Coduto, Geotechnical Engineering Principles & Practices, Prenticehall of India Ltd, India
2.	Bowles J.E., Foundation Analysis and Design, McGraw Hill Pub. Co. New York
3.	Swami Saran, Analysis and Design of Substructures, Oxford & IBH Pub. Co. Pvt. Ltd., India
4.	Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955.

CO-PO Mapping												
CO/PO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	2	3	1	-	-	1	-	-	1	-	-	-
CO2	2	3	1	-	-	1	-	-	1	-	-	1
CO3	2	3	1	-	-	1	-	-	1	-	-	1
CO4	2	3	1	-	-	1	-	-	1	-	-	1
CO5	2	3	1	-	-	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	FINITE ELEMENT METHOD	Semester	VII
Course Code	MVJ20CV744	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

<p>Course objective: Students will be able to,</p> <ul style="list-style-type: none"> • Outline Energy concepts in FEM problems • Outline the concept of discretization in FEM and Various Co-ordinate system in FEM • Predict shape function for higher order elements • Examine the need of Iso, sub and super parametric elements in FEM. • Use some of the software in FEM 		
Module-1	L1, L2, L3	08 Hr.
<p><i>Pre-requisites: Basic Concepts of Strength of Materials, Mechanics of Deformable bodies, Equilibrium Concepts, Analysis of trusses.</i></p> <p>Introduction to Finite Element method: Various Numerical methods, Difference between Finite element and Finite difference method. Advantages and Disadvantages of FEM. Theory of elasticity concepts, Energy principles, Rayleigh - Ritz Method, Galerkin method, Steps in finite element analysis, displacement approach, stiffness matrix for a Bar, Beam and Truss element. Problems on Bar element only.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Application of Energy principles to different structural elements. <p>Applications(Self learning)</p> <ul style="list-style-type: none"> • Solution to problems from Numerical methods. Video link / Additional online information: • https://nptel.ac.in/courses/105105108/ • https://nptel.ac.in/courses/105/102/105102090/ 		
Module-2	L1, L2, L3	08 Hr.
<p>Discretization and Coordinate System: Finite representation of infinite bodies and discretization of very large bodies, Different types of Coordinate system in FEM, Shape functions, Polynomial, LaGrange and Serendipity , one dimensional formulation; Analysis of Beams and Trusses with numerical examples.</p> <p>Laboratory Sessions/ Experimental learning:</p>		

<ul style="list-style-type: none"> Development of Shape function for Serendipity elements by Inspection. <p>Application:(Self learning)</p> <ul style="list-style-type: none"> Verification of Suitability of Shape function using Serendipity concepts. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ 		
Module-3	L1,L2L3	08 Hrs.
<p>Shape functions: Convergence of Shape functions, Constant Strain Triangle, Linear Strain Triangle, 4 and 8 noded quadrilateral elements, Numerical Evaluation of Element Stiffness -Computation of Stresses, Static Condensation of nodes, Degradation technique, Axi symmetric Elements</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> Experimental study on Static Condensation of Nodes. <p>Application:(Self learning)</p> <ul style="list-style-type: none"> Solution to Axi-symmetric problems using FEM Techniques. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ 		
Module-4	L1,L2L3	08 Hrs.
<p>Isoparametric Elements: Iso parametric, Sub parametric and Super parametric elements, Jacobian transformation matrix, Stiffness Matrix of Iso parametric Elements, Numerical integration by Gaussian quadrature rule for one-, two- and three-dimensional problems</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> Practical application of Quadrature rule for one-, two- and three-dimensional problems <p>Application: (Self Learning)</p> <ul style="list-style-type: none"> Numerical integration techniques in FEM. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ 		

Module-5	L1, L2L3	08 Hrs.
<p>Application of FEM in Civil Engineering: Analysis of Trusses, Frames, Beams & Bars, Determination of stresses in Soil, dams, Stresses in different layers of a flexible pavement due to loading. Exposure to FEM software's.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> Hands on exposure to Use of Ansys Software. <p>Application :</p> <ul style="list-style-type: none"> Solution to various structural engineering problems using FEM. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/105105108/ https://nptel.ac.in/courses/105/102/105102090/ 		

Scheme of Evaluation:

Details	Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	30
Quizzes	2x2 = 4
Activities / Experimentations related to courses/Assignment	8
Mini Projects / Case Studies	8
Semester End Examination	SEE (50) 50
Total	100

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

CO1	Use the basic Knowledge of Energy concepts in FEM method.
CO2	Compose Shape functions for Different types of Elements
CO3	Solve the Basic Structural Engineering problems using FEM analysis
CO4	Design the concept of developing Shape functions for Higher order elements.
CO5	Use the various FEM Software's.

Textbooks:

1.	Krishnamoorthy C.S., "Finite Element analysis" -Tata McGraw Hill,1900
2.	Desai C & Abel J F., " Introduction to Finite element Method" , East West Press Pvt. Ltd.,1972

Reference Books:	
1.	Cook R D et.al., "Concepts and applications of Finite Element analysis ", John Wiley,1995
2.	S.S.Bhavikatti,"Finite Element Analysis, New age International Publishers, 2005.
3.	Bathe K J - " Finite Element Procedures in Engineering analysis "- Prentice Hall,2003
4.	A First Course in the Finite Element Method D L Logan (Indian Edition) CL Engineering

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

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL PROTECTION AND MANAGEMENT	Semester	VII
Course Code	MVJ20CV751	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable students to

- Use the facts of environmental pollution and conservation of natural resources.
- Discuss the elements of corporate environmental management systems complying with international standards.
- Outline the issues of environmental assessment team and implement waste minimization options.
- Use the application of environmental management systems audit for various organizations.

Module-1

L1, L2, L3

8 Hrs.

Prerequisites: *Environmental Studies, Environmental management principles*

Introduction: Importance of Environmental protection and need for Environmental management

Environmental Management Standards: Unique Characteristics of Environmental Problems - Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts

-Business Charter for Sustainable Production and Consumption – Tools, Business strategy drivers and Barriers

- Evolution of Environmental Stewardship. Environmental Management Principles – National policies on environment, abatement of pollution and conservation of resources - Charter on Corporate responsibility for Environmental protection.

Laboratory Sessions/ Experimental learning:

- A study on prediction and assessment of Environmental impacts inclusive of air, water, land and noisy environment.
- Model making of impacts on environment (air, water, land, noise) due to a proposed project.

Applications:

- Assignment on fundamentals and relevance of Environmental standards and laws for water, air and land quality by Pollution Control board.
- Documentation of EIA reports for various industries such as textiles, thermal power plants, mining industries etc.

Video link / Additional online information:

<ul style="list-style-type: none"> Principles of Environmental management, environmental concern, EIA process, https://nptel.ac.in/content/storage2/courses/120108004/module1/lecture1.pdf Fundamentals of environmental pollution and control, EIA, EMP, water pollutant, wastewater, https://nptel.ac.in/courses/123105001/ 		
Module-2	L1, L2, L3	8 Hrs.
<p>Prerequisites: Environmental pollution and standards.</p> <p>Environmental quality: Objectives, Rationale of Environmental standards, Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards, environmental performance evaluation: Indicators, benchmarking.</p> <p>Pollution control Vs Pollution Prevention - Opportunities and Barriers – Cleaner production and clean technology, closing the loops, zero discharge technologies</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> Sampling and analysis of various parameters with respect to water, waste water, air and noise A study clean technology by considering a case study <p>Applications:</p> <ul style="list-style-type: none"> Awareness training program to motivate the students in maintaining and improving the quality of the environment and preventing and abating environment pollution. Performance study of an effluent treatment plant <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> Policy and legal aspects of EMS, Environmental management system standards, EIA documentation and process, https://nptel.ac.in/courses/120108004/ 		
Module-3	L1, L2, L3	8 Hrs.
<p>Prerequisites: Environmental impact and management</p> <p>Environmental Management System: EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention – environmental policy – initial environmental review – environmental aspect and impact analysis – legal and other requirements- objectives and targets.</p> <p>Environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> A study on the structure of environmental management programs by considering a case study 		

- Preparation of a flowchart related to structure of EMS

Applications:

- Equip students with necessary engineering skills such as solving engineering problems in pollution control methodologies in process.
- Documentation of a detailed report on EMS

Video link / Additional online information:

- Environmental management system standards as per the requirement, Policy and legal aspects of EMS, <https://nptel.ac.in/courses/120108004/>
- Environmental management system as per requirement, techniques, <https://nptel.ac.in/courses/123105001/>

Module-4

L1, L2, L3

8 Hrs.

Prerequisites: Environmental management system audit

Environmental Audit: Environmental management system audits as per ISO 19011 – Roles and qualifications of auditors.

Environmental performance indicators and their evaluation – Non-conformance – Corrective and preventive actions – compliance audits – waste audits and waste minimization planning – Environmental statement (form - Due diligence audit

Laboratory Sessions/ Experimental learning:

- A detailed study on EMS audits in corporate sectors
- A detailed study on EMS audits in manufacturing/service industries

Applications:

- Documentation and submission of EMS audit report related to corporate sectors
- Documentation and submission of EMS audit report related to manufacturing/service industries

Video link / Additional online information:

- Environmental management system auditing, EMS techniques, Introduction to waste and safety audit, <https://nptel.ac.in/courses/120108004/>
- Effluent quality assurance program, waste audit and assessment, <https://nptel.ac.in/content/storage2/courses/116104045/lecture9.pdf>
- Objectives and scope of environmental auditing, structure, procedure, <https://pdfslide.net/documents/unit-5-environmental-auditing-answers-to-learning-nptelacincourses120108004module5.html>

Module-5		L1, L2, L3	8 Hrs.
<p>Prerequisites: <i>Environmental management system (EMS) audits for industries</i></p> <p>Applications: Applications of EMS, Waste Audits and Pollution Prevention opportunities in Textile, Sugar, Pulp & Paper, Electroplating, Tanning industry, Dairy, Cement, Chemical industries, etc. Trans boundary movement, disposal, procedures, of hazardous wastes.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • A detailed study on EMS audit system implemented in E-waste recycling unit • A detailed study on EMS audit system pollution prevention technology in any one service-based industry <p>Applications:</p> <ul style="list-style-type: none"> • A mini project on safety audit • Preparation of a report on waste audit in E-waste recycling unit <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • Environmental management system auditing, EMS techniques implementation in various industries, https://nptel.ac.in/courses/120108004/ • Effluent quality assurance program, waste audit and assessment, https://nptel.ac.in/content/storage2/courses/116104045/lecture9.pdf • Objectives and scope of environmental auditing, structure, procedure, Implementation in industries, https://pdfslide.net/documents/unit-5-environmental-auditing-answers-to-learning-nptelacincourses120108004module5.html • EMS: ISO 14001, sustainability, policy, https://www.youtube.com/watch?v=spjwQX-acnA 			
Course outcomes: On completion of the course, students would be able to			
CO1	Discuss the knowledge about environmental issues and an approach to corporate environmental management systems for conservation of resources and environmental protection.		
CO2	Use appropriately the elements of Corporate Environmental Management systems complying to international environmental management system standards		
CO3	Examine pollution prevention assessment team and implement waste minimization options		
CO4	Explain the knowledge about environmental management system audits		
CO5	Compare, Develop, Implement, maintain and Audit Environmental Management systems for industries		

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Reference Books:	
1.	ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002
2.	Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems – astep by step guide" Earthscan Publications Ltd, London, 1999.
3.	Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001.

Text Books:	
1.	ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organization for Standardization, 2004
2.	Paul L Bishop „Pollution Prevention: Fundamentals and Practice“, McGraw- Hill International, Boston,2000.

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

High-3, Medium-2, Low-1

Course Title	CONSTRUCTION METHODS, PLANNING & MANAGEMENT	Semester	VII
Course Code	MVJ20CV752	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs.

Course objective is to: This course will enable students to

- Discuss project preparation, Planning and Analysis with its types, measures & tools for assessment.
- Illustrate various management techniques for successful completion of construction projects.
- Classify various types of equipment's used in construction projects.
- Explain the various safety concepts and requirements applied to construction projects.
- Examine materials management technique in construction

Module-1	L1,L2,L3	08 Hrs.
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Prerequisites: *Building materials, Construction management*

Project Planning: Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. (Online mode). Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, estimating durations, sequence of activities, activity utility data. Application of MS-Project and Primavera for planning

Laboratory Sessions/ Experimental learning: (Self Learning)

- Scheduling a residential building with G+1 project using MS-Project
- Scheduling a residential building with G+1 project using Primavera Software

Applications: (Self Learning)

- Knowledge about MS-Project and Primavera software
- Able to access the real time project scheduling and planning

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/106/105106149/>
- <https://nptel.ac.in/courses/105/103/105103093/>

Module-2	L1,L2, L3	08 Hrs.
<p>Scheduling Procedures- Construction Scheduling, activity cost and time estimation in CPM, PERT, RPM (Repetitive Project Modeling) techniques. LOB technique, Mass haul diagrams.</p> <p>Project Controlling- Monitoring and Control, Crashing (Online mode), Resource Leveling, Updating.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Resource allocation and management using Primavera Software <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Knowledge about the network analysis • Identifying different methods of scheduling a project <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/102/105102199/ 		
Module-3	L1,L2,L3	08 Hrs.
<p>Construction Equipment's and Management- Identification, Planning of equipment, Selection of Equipment, Equipment Management in Projects, Maintenance Management,(Online Mode). Equipment cost, Operating cost, Cost Control of Equipment, Depreciation Analysis, Replacement of Equipment, Replacement Analysis , Safety Management</p> <p>Equipment for Earthwork- Fundamentals of Earth Work Operations, Earth Moving Operations, Types of Earth Work Equipment- Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment (Online Mode)</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Case study on selection of construction equipment <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Behavior of different types of equipment used in construction • Knowledge about planning and selection of equipment in construction projects <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103206/ 		
Module-4	L1,L2,L3	08 Hrs.
<p>Construction Quality, Safety and Human Values- Quality and Safety Concerns in Construction - Construction quality process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management (Online Mode).</p> <p>HSE- Introduction to concepts of HSE as applicable to Construction. Importance of safety in</p>		

construction , Safety measures to be taken during Excavation , Explosives , drilling and blasting , hot bituminous works , scaffolds / platforms /ladder , form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurances.

Ethics- Morals, values and ethics, need of engineering ethics. (Online Mode).

Laboratory Sessions/ Experimental learning: (Self Learning)

- Case study on construction safety
- Poster preparation on construction safety

Applications: (Self Learning)

- Understanding the quality and safety concerns in construction
- Knowledge about total quality management measures taken in construction

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/110/105/110105094/>

Module-5	L1,L2,L3	08 Hrs.
<p>Labor and Material Utilization- Historical Perspective, class of labour, Wages & statutory requirement, (Online Mode). Labor Productivity, Factors Affecting Job-Site Productivity, Labour Relations in Construction, Problems in Collective Bargaining,</p> <p>Materials Management - Material Procurement and Delivery, Inventory Control, Trade-offs of Costs in Materials Management</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Sample preparation of checklist for material procurement <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Knowledge in latest skills for managing supply chain, logistics, delivery, storage of materials and impart training for improving output <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/106/105106206 		

Course outcomes: On completion of the course, students would be able to	
CO1	Use relevant software packages for planning, scheduling, executing and controlling of construction projects.
CO2	Predict the total time required to complete the job without delay and delay in the project
CO3	Classify the type and capacity of construction equipment used in construction site.
CO4	Illustrate safety manuals and practice safety in construction operations
CO5	Examine the modern trends in project management

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
	Total	100

Textbooks:	
1.	Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2.	Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.

Reference Books:	
1.	Jimmy W. Hinze, "Construction Safety", Prentice Hall Inc., 1997
2.	Calin M. Popescu, Chotchai Charoenngam, "Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications", Wiley, New York, 1995.

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

High-3, Medium-2, Low-1

Course Title	REMOTE SENSING AND GIS	Semester	VII
Course Code	MVJ20CV753	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to: This course will enable students to

- State the basic concepts of Remote Sensing.
- Identify the various Remote Sensing Platforms and its limitations
- Illustrate various international space programmes
- Brief various Geographical Information System (GIS) method
- Solve real time problem by the application of RS & GIS

Module-1

L1 & L2

8 Hrs.

Introduction to Remote Sensing:

Introduction: Introduction to Remote Sensing: Definition - History & Concepts - Electromagnetic Radiation (Source, Mode of Energy transfer, Radiation Principles, Black body radiation); Electro Magnetic Radiation (EMR): EMR Spectrum - EMR Interaction with Atmosphere (Absorption, Scattering & Atmospheric windows) - EMR Interaction with Earth surface (Absorption & reflection) - Spectral Response pattern - Energy budgeting in Remote Sensing.

Module-2

L1 & L2

8 Hrs.

Sensor and its characteristics:

Sensors and Platforms: Resolutions (Spectral, Spatial, Temporal, Radiometric) –Platforms Sensors - Scanning & Orbiting Mechanism of Satellites and Data Acquisition. Optical Remote Sensing: Basic concepts -Optical sensors and scanners.

Thermal & Microwave Remote Sensing: Thermal Remote Sensing: Basic concepts-Thermal sensors & scanners - Thermal Inertia. Microwave Remote Sensing: Basic concepts Microwave sensors and Radiometers - Geometric characters – Radar grammetry (SLAR/SAR)- LIDAR - Hyper spectral Remote Sensing: basic concepts.

Module-3

L1, L2

8 Hrs.

Remote Sensing Satellite Programme:

Remote Sensing Satellites: LANDSAT Series - IRS Series - IRS-P series -Cartosat - Spot Series - ASTER, MODIS - IKONOS - QUICKBIRD - ORBVIEW -ERS - Meteorological Satellites -Shuttle Mission - Developments of Remote Sensing in India - Future Remote Sensing Missions

Module-4

L1, L2

8 Hrs.

Introduction to Geographical Information System (GIS): Definition - Usefulness of GIS - Components of GIS - Computer Hardware, Software Modules and Organizational Context of GIS. Data Structure: Data Structure in GIS - Types of Data (Points, Lines and Polygons) - Data Base Structures (Raster Data Structures and Vector data Structures) - Data Conversion (Vector to Raster and Raster to Vector)		
Module-5		L1, L2
8 Hrs.		
Integrated Applications of Remote sensing and GIS: Applications in Land use Land cover analysis, change detection, Water Resources, Urban Planning, Environmental Planning, Natural Resource Management and Traffic Management. Location Based Services and its Applications		
Course outcomes: On completion of the course, students would be able to		
CO1	Collect data and delineate various elements from the satellite imagery using their spectral signature	
CO2	Identified various Remote Sensing Platforms and its limitations	
CO3	Restate and apply sustainability concepts in various space programmes	
CO4	Analyze different features of ground information to create raster or vector data.	
CO5	Perform digital classification and create different thematic maps for solving specific problems & Make decision based on the GIS analysis on thematic maps.	

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1	Anji Reddy M., "Remote sensing and Geographical information system", B.S. Publications 2008
2	S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005

Reference Books:

1	Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
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2	John R. Jensen, "Remote sensing of the environment" , An earth resources perspective – 2 nd edition – by Pearson Education 2007
3	Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004

CO-PO Mapping

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

High-3, Medium-2, Low-1

Title	INTRODUCTION TO RESEARCH AND TECHNICAL WRITING	Semester	VII
Course Code	MVJ20CV754	CIE	50
Total No. of Contact Hours	40 L : T : P :: 3 : 0 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 hrs

Course objective is to: This course will enable students to

- Contrast engineering research, research methodology and types of research
- Demonstrate the process of literature survey and measures of research impact
- Explain research plans and design for outcomes
- Illustrate survey research method and selection of survey method and respondents
- Construct research presentations and demonstrate different presentations

Prerequisites: *Basic knowledge of respective Engineering disciplines.*

Module-1

L1, L2

8 Hrs

Introduction to Engineering Research: Research definition, Next step research, research questions, engineering ethics, identifying proofs, Need for taking research projects

Research Methodology: Research Methods/Scientific methods vs Research Methodology, Research Process. Types of research, Research approaches, Research Problem, Defining the problem, Illustration.

Laboratory Sessions: (Self Learning)

- Read an Environmental Impact Assessment Report and make interpretations.

Applications: (Self Learning)

- Learning of purpose of research and different types of research

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/121/106/121106007/>

Module-2

L1, L2, L3

8 Hrs

Literature Search and Review: Archival literature, why should engineers be ethical? Types of Publications, Journal articles, Conference papers, Books, Standards, Patents, Theses, Trade magazines, Newspaper articles, Infomercials, Advertisements.

Measures of research impact: H-index, I-index, Scopus, Web of science (SCI index), Google scholar, Literature review process, Referencing styles, Keywords, Publication

<p>cost, Plagiarism, retractions of journal articles.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> Find the plagiarism percentage of any report using online plagiarism checker (Turnitin) <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Understanding the purpose of literature review <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/121/106/121106007/ 		
Module-3	L1, L2, L3	8Hrs
<p>Research Plan: Research proposals, Finding a suitable research question, Elements of a research proposal, Project title, Research team, Project summary, Project outline, Budget, Research contracts, Conflict of interest.</p> <p>Design for outcomes: One-dimensional data, Two-dimensional data, N-dimensional data, Research tools, Experimental measurements, Numerical modelling, Theoretical derivations and calculations, Curve fitting.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> Practice curve fitting for sample experimental data. <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Understanding elements of research proposals and data analysis. <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/121/106/121106007/ 		
Module-4	L1, L2	8Hrs
<p>Survey Research Methods: Purpose of a survey (Why undertake a survey?), Ergonomics and human factors, Ethics approval, Survey statements, Survey delivery, Respondent selection, Survey timeline, Statistical analysis, Reporting.</p> <p>Laboratory Sessions: (Self Learning)</p> <ul style="list-style-type: none"> Prepare a questionnaire for survey of a water supply project <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> Discover the survey method, questionnaire and respondents for a research study <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> https://nptel.ac.in/courses/109/103/109103153/ 		
Module-5	L1, L2, L3	8Hrs

Research Presentation: Introduction, Standard terms, Paper title and keywords, Writing an abstract, Practicing abstract writing, Paper presentation and review, Conference presentations, Poster presentations.

Laboratory Sessions: (Self Learning)

- Prepare and present a poster from a research topic.

Applications: (Self Learning)

- Distinguish different formats of research presentation and choose appropriate one for the research work

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/110/105/110105091/>

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

CO1	Identify different research types and research methodologies
CO2	Discover and prepare literature survey and identify literature metrics needed for evaluation research impact
CO3	Construct research plans for their projects and identify data analysis methods
CO4	Identify different survey methods and design survey for research
CO5	Prepare different research presentations

Scheme of Evaluation		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	Kothari, C. R., "Research Methodology: Methods and Techniques", New Age International,

	Fourth edition, 2018.
2.	Kumar, R., "Research methodology: A step-by-step guide for beginners", Sage Publishers, 2018.

Reference Books:	
1.	Thiel, D.V., "Research methods for engineers", Cambridge University Press, 2014.
2.	Research Methodology and Scientific Writing, Thomas, C. G. (2e), Indian Print, Anne Books Ane Books Pvt. Ltd.

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

High-3, Medium-2, Low-1

Course Title	QUANTITY SURVEYING AND CONTRACTS MANAGEMENT	Semester	VII
Course Code	MVJ20CV76	CIE	50
Total No. of Contact Hours	30 L : T : P :: 1 : 2 : 0	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	2	Exam. Duration	3 Hrs.

Course objective is to: This course will enable students to

- Find the quantities of work, develop the bill of quantities, and arrive at the Cost of civil engineering Project
- Use the concept of Valuation for Properties
- Outline the Tender process and Contract document.

Module-1

L3

6 Hrs.

Prerequisites: Reading Drawings, Concept of measurements, Reinforcement details.

Quantity Estimation for Building: Study of various drawing attached with estimates, important terms, and units of measurements, abstract, Types of estimates - Approximate, detailed, supplementary and revised. Estimation of building - short wall and long wall method - center line method.

Estimate of R.C.C structures: Slab, beam, column, footings, with bar bending schedule.

Laboratory Sessions/ Experimental learning: (Self Learning)

- Case Study - Incorporating Pre-construction Cost Estimating in Construction Engineering and Management Programs
- Computation of quantities and cost estimating using EXCEL Sheet

Applications: (Self Learning)

- Quantity Estimation of different buildings
- Estimation of cost for different buildings
- Use of different software's for quantity estimation

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/103/105103093/>

Module-2	L3	6 Hrs.
<p><i>Prerequisites: Reading Drawings, Concept of measurements, Areas & Volume Calculations.</i></p> <p>Estimate of Roof, Sanitary & Water Supply Works: Steel truss, manhole and septic tanks.</p> <p>Quantity Estimation for Roads: Road estimation, earthwork fully in banking, cutting, partly cutting and partly Filling.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Computation of Quantities using Excel Sheet • Plotting of Earthwork for Roads using Excel Sheet <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Quantity Estimation of different structures • Estimation of cost for different structures • Use of different software for quantity estimation <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103093/ 		
Module-3	L2	6 Hrs.
<p><i>Prerequisites: Understanding class of labors, Concept of measurements, Construction stages & Rates of Materials & Labors as per current market.</i></p> <p>Specification for Civil Engineering Works: Objective of writing specifications essentials in specifications, general and detail specifications of different items of works in buildings.</p> <p>Analysis of Rates: Factors Affecting Cost of Civil Works , Concept of Direct Cost , Indirect Cost and Project Cost Rate analysis and preparation of bills, Data analysis of rates for various items of Works, Sub-structure components, Rate analysis for R.C.C. slabs, columns and beams.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Learning current rates and analyzing for different construction works. • Specifications of different constructional activities using different relevant software <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Handling projects for various construction activities • Computing the cost of materials, labours and any taxes applicable using Excel sheets <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103093/ 		

Module-4	L2	6 Hrs.
<p><i>Prerequisites: Planning & Scheduling of Construction Works</i></p> <p>Contract Management-Tender and its Process: Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process. Contract Formulation: covering Award of contract, letter of intent, letter of acceptance and notice to proceed. Features / elements of standard Tender document (source: PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC). Law of Contract as per Indian Contract act 1872 , Types of Contract, Entire contract, Lump sum contract, Item rate, % rate, Cost plus with Target, Labour, EPC and BOT, Sub Contracting. Contract Forms : FIDIC contract Forms , CPWD , NHAI , NTPC , NHEPC.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Law of Contract as per Indian Contract act 1872 • PWD / CPWD / International Competitive Bidding – NHAI / NHEPC / NPC <p>Applications: (Self Learning)</p> <ul style="list-style-type: none"> • Bidding Process • Contract for public and private department works <p>Video link / Additional online information: (Self Learning)</p> <ul style="list-style-type: none"> • https://nptel.ac.in/courses/105/103/105103093/ 		
Module-5	L2	6 Hrs.
<p><i>Prerequisites: Land & Rental demands, Contracts & Laws</i></p> <p>Contract Management-Post award: Basic understanding on definitions, Performance security, Mobilization and equipment advances, Secured Advance, Suspension of work, Time limit for completion, Liquidated damages and bonus, measurement and payment, additions and alterations or variations and deviations, breach of contract, Escalation, settlement of account or final payment, claims, Delay's and Compensation, Disputes & its resolution mechanism, Contract management and administration</p> <p>Valuation: Definitions of terms used in valuation process, Cost, Estimate, Value and its relationship, Capitalized value. Concept of supply and demand in respect to properties (land , building , facilities'), freehold and lease hold , sinking fund, depreciation–methods of estimating depreciation, Outgoings, Process, and methods of valuation : Rent fixation, valuation for mortgage, valuation of land.</p> <p>Laboratory Sessions/ Experimental learning: (Self Learning)</p> <ul style="list-style-type: none"> • Case Study – Multiple Valuation Approaches of Projects For Different Construction Designs & Techniques • Develop Valuation report for buildings using Excel Sheet 		

Applications: (Self Learning)

- Valuation of different property
- Managing the contracts and any disputes

Video link / Additional online information: (Self Learning)

- <https://nptel.ac.in/courses/105/103/105103093/>

Course outcomes: On completion of the course, students would be able to	
CO1	Solve for detailed estimate and abstract of Quantities for buildings.
CO2	Solve for detailed and abstract estimates for roads, roofs, water supply & sanitary works.
CO3	Outline specifications & analyzing rates for different construction works.
CO4	Discuss Contract documents of domestic and international construction works.
CO5	Solve for valuation reports of buildings.

Scheme of Evaluation:		
Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE (50)	30
Quizzes		2x2 = 4
Activities / Experimentations related to courses/Assignment		8
Mini Projects / Case Studies		8
Semester End Examination	SEE (50)	50
Total		100

Textbooks:	
1.	Datta B.N., "Estimating and costing", UBSPD Publishing House, New Delhi
2.	B.S. Patil, " Civil Engineering Contracts and Estimates", Universities Press

Reference Books:	
1	M. Chakraborti; "Estimation, Costing and Specifications", Laxmi Publications
2	Duncan Cartlidge , "Quantity Surveyor's Pocket Book", Routledge Publishers, 2012.
3	Robert L Peurifoy , Garold D. Oberlender , " Estimating Construction Costs" – 5ed , Tata McGraw-Hill , New Delhi
4	David Pratt , " Fundamentals of Construction Estimating" – 3ed
5	PWD Data Book, CPWD Schedule of Rates (SoR). and NH SoR – Karnataka MORTH Specification for Roads and Bridge Works – IRC New Delhi

CO-PO Mapping

CO/PO	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1	1	1	1	-	-	-	-	1	-	-	1	2
CO2	2	2	2	-	1	1	1	2	-	-	2	2
CO3	1	1	2	-	-	1	1	2	1	-	2	2
CO4	1	-	2	-	-	2	1	1	1	-	1	1
CO5	1	-	2	-	-	2	1	2	1	-	1	1

High-3, Medium-2, Low-1

Course Title	COMPUTER AIDED DETAILING OF STRUCTURES	Semester	VII
Course Code	MVJ20CVL77	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 2 : 2	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	2	Exam. Duration	3 Hrs.

Course objective is to: This course will enable students to

- Acquaint with graphic primitives and transformations.
- Be versed of the scale factors, sections of drawings.
- Draft the detailing of RC and Steel structural member.

Prerequisites: Knowledge on Design of RCC structures, SP-34- Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards.

S.NO	Module-1-Detailing of RCC Structures	L3
The following drawings, detailing is to be prepared for the data given, using AUTOCAD.		
1	Footing-Combined- Prepare the plan, cross-sectional elevation, and side view.	
2	Beams – Fixed and Continuous- Prepare the cross-sectional elevation and side view.	
3	Slab –One-way continuous- Prepare the plan, cross-sectional elevation, and side view.	
4	Staircase – Doglegged- Prepare the plan and cross-sectional elevation of all flights.	
5	Cantilever Retaining wall- Prepare the cross-sectional elevation and side view.	
6	Counter Fort Retaining wall- Prepare the plan and cross-sectional elevation.	
7	Circular Water Tank, Rectangular Water Tank- Prepare the plan, cross-sectional elevation front and side view.	
	Module-2-Detailing of Steel Structures	L3
<i>Prerequisites: Knowledge on Design of Steel structures.</i>		
The following drawings, detailing is to be prepared for the data given, using AUTOCAD.		
8	Connections – Beam to beam, Beam to Column by Bolted and Welded Connections Prepare the front and side views.	
9	Built-up columns with lacings and battens- Prepare the plan and elevation.	

10	Column bases and Gusseted bases with bolted and welded connections- Prepare the plan and cross-sectional elevation and side view.
11	Roof Truss – Welded and Bolted- Prepare the elevation and enlarged view of joints and support.
12	Welded Plate girder- Prepare the plan, front and side views.
13	Gantry Girder- Prepare the plan, front and side views.

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

CO1	Utilize the drafting software.
CO2	Prepare detailed working drawings.
CO3	Discuss the drawings of prepared structures.
CO4	Explain through documentation.

Scheme of Evaluation:

Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

Reference Books:

1.	N Krishna Raju, "Structural Design and Drawing of Reinforced Concrete and Steel", University Press-2019.
2.	D Krishna Murthy, "Structural Design and Drawing, Volume-II – Concrete Structures", CBS Publishers, New Delhi-1 st Edition-2018.
3.	SP 34: Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards.
4.	IS 13920, Ductile Design And Detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice, Bureau of Indian Standards.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	3	-	-	-	1	-	-	3
CO2	1	-	-	1	3	-	-	-	1	-	-	3
CO3	1	-	-	-	-	-	-	-	1	-	2	3
CO4	1	-	-	-	-	-	-	-	-	3	1	1

High-3, Medium-2, Low-1

Course Title	PROJECT PHASE – 1	Semester	VII
Course Code	MVJ20CVP78	CIE	100
Total No. of Contact Hours	L : T : P :: 0 : 0 : 4	SEE	-
No. of Contact Hours/week	-	Total	100
Credits	2	Exam. Duration	-

Course Objective: <ul style="list-style-type: none"> • To support independent learning. • To develop interactive, communication, organization, time management, and presentation skills. • To impart flexibility and adaptability. • To expand intellectual capacity, credibility, judgment, intuition. • To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas. 	
Project Work Phase - I: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.	
Course outcomes: At the end of the course the student will be able to:	
CO1	Describe the project and be able to defend it.
CO2	Learn to use modern tools and techniques.
CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.
Scheme of Evaluation : Internal Marks: The Internal marks (100 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.	

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

High-3, Medium-2, Low-1

Course Title	PROJECT PHASE – 2	Semester	VIII
Course Code	MVJ20CVP81	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 0 : 14	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	7	Exam. Duration	3 Hrs

<p>Course Objective:</p> <ul style="list-style-type: none"> • To support independent learning. • To develop interactive, communication, organization, time management, and presentation skills. • To impart flexibility and adaptability. • To inspire independent and team working. • To expand intellectual capacity, credibility, judgment, intuition. • To adhere to punctuality, setting and meeting deadlines. • To instill responsibilities to oneself and others. • To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas. 	
<p>Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.</p>	
<p>Course outcomes: At the end of the course the student will be able to:</p>	
CO1	Describe the project and be able to defend it. Develop critical thinking and problem solving skills.
CO2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.
<p>Scheme of Evaluation :</p> <p>Internal Marks: The Internal marks (50 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the</p>	

actual/model/prototype of the project.

Semester End Examination: SEE marks for the project (50 marks) shall be based on Project report, Presentation and Demonstration of the actual/model/prototype of the project, as per the norms by the examiners appointed

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

High-3, Medium-2, Low-1

Course Title	INTERNSHIP	Semester	VIII
Course Code	MVJ20CVI82	CIE	50
Total No. of Contact Hours	Industrial Oriented	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	3	Exam. Duration	3 Hrs

Course Objective:

- To get the field exposure and experience
- To apply the theoretical concept in field application
- To prepare the comparison statement of difference activities

Internship: This shall be carried out by students in industry set-up related to the construction/ materials testing laboratories/research organizations/project management consulting firms/QS and QA organizations/ planning and design offices/Professional organizations and other avenues related to the civil engineering domain in consultation and approval of internship guide/HOD /internship committees of the institutions.

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

CO1	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation :

Internal Marks: The Internal marks (50 marks) evaluation shall be based on midterm and final presentation of the activities undertaken during the internship, to a panel comprising internship guide, a senior faculty from the department and head of the department. Each student should submit the internship report at the end of semester with internship certificate.

Semester End Examination: Viva-Voce examination shall be conducted by a panel of examiners consisting of internship supervisor, a senior faculty from the department and head of the department.

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

High-3, Medium-2, Low-1

Course Title	SEMINAR	Semester	VIII
Course Code	MVJ20CVS83	CIE	50
Total No. of Contact Hours	L : T : P :: 0 : 0 : 2	SEE	50
No. of Contact Hours/week	2	Total	100
Credits	1	Exam. Duration	3 Hrs

Course Objective:	
<ul style="list-style-type: none"> To inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas. 	
<p>Seminar: Each student, under the guidance of a Faculty, is required to choose, preferably, a recent topic of his/her interest relevant to the course of specialization. Carryout literature survey; organize the Course topics in a systematic order.</p> <ul style="list-style-type: none"> Conduct literature survey in the domain area to find appropriate topic. Prepare the synopsis report with own sentences in a standard format. Learn to use MS word, MS power point, MS equation and Drawing tools or any such facilities in the preparation of report and presentation. Present the seminar topic orally and/or through power point slides. Communicate effectively to answer the queries and involve in debate/discussion. The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident. 	
Course outcomes: At the end of the course the student will be able to:	
CO1	Develop knowledge in the field of Civil Engineering and other disciplines through independent learning and collaborative study.
CO2	Identify and discuss the current, real-time issues and challenges in engineering & technology. Develop written and oral communication skills.
CO3	Explore concepts in larger diverse social and academic contexts.
CO4	Apply principles of ethics and respect in interaction with others.
CO5	Develop the skills to enable life-long learning.
Scheme of Evaluation :	
<p>Internal Marks: The Internal marks (50 marks) evaluation shall be based on midterm and final presentation, to a panel comprising seminar guide, a senior faculty from the department and head of the department. Each student should submit the Seminar report at the end of semester Semester End Examination: Viva-Voce examination shall be conducted by a panel of examiners consisting of seminar supervisor, a senior faculty</p>	

from the department and head of the department.

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

High-3, Medium-2, Low-1

Course Title	CERTIFICATION	Semester	VIII
Course Code	MVJ20CVC84	CIE	-
Total No. of Contact Hours	-	SEE	-
No. of Contact Hours/week	-	Total	-
Credits	2	Exam. Duration	-

Course Objective:	
<ul style="list-style-type: none"> To inculcate self-learning, enhance the skill in different field of Engineering 	
Certification: Each student, under the guidance of a Faculty, is required to undergo online certification course minimum of 30 hours (number of courses is not limited) preferably, a recent topic of his/her interest. Each student should submit the Course details and Qualification Certificates at the end of semester.	
Course outcomes: At the end of the course the student will be able to:	
CO1	Develop knowledge in different fields of Engineering
CO2	Develop the skills to enable life-long learning.