Course Title	**ADVANCED DESIGN OF STEEL STRUCTURES**	Semester	II
Course Code	MVJ19CSE21	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/Week	4	**Total**	100
Credits	4	**Exam Duration**	3Hrs

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

- Understand the background to the design provisions for hot-rolled and cold-formed steel structures, including the main differences between them
- Design different types of structures and to detail the structures
- Proficiency in applying the provisions for design of columns, beams, beam-columns
- Design structural sections for adequate fire resistance

Module-1	**L3, L4, L5**	**12Hrs**

Prerequisites: *Knowledge in the fundamentals of Design of Steel Structures*

Laterally Unrestrained Beams: Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams – Design Examples. Concepts of -Shear Center, Warping, Uniform and Non-Uniform torsion.

Laboratory Sessions/ Experimental learning:

- Analysing the failure of restrained beam due to Lateral Torsional Buckling
- Analysing the failure of unrestrained beam due to Lateral Torsional Buckling

Applications:

- Construction of Laterally restrained Beams to act Against Lateral Torsional Buckling
- Better Load withstanding Capability Utilizing Beam by application of load at Shear Centre

Video link / Additional online information:

- https://nptel.ac.in/courses/105105162/

Module-2	**L3, L4, L5**	**12Hrs**

Prerequisites: *Knowledge in the fundamentals of Design of Steel Structures*

Beam- Columns in Frames: Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and

Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 - Examples.

Laboratory Sessions/ Experimental learning:

- Experimental investigation of Long & Short column against axial force, and Biaxial Bending.
- Determining strength of Columns in Sway and Non-sway frames.
- Determining strength of Rigid Jointed Frames.

Applications:

- Developing Long Beam to act against biaxial bending.
- Obtaining the beam of Better strength in rigid jointed Frames.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105105104/pdf/m7l17.pdf
- https://nptel.ac.in/content/storage2/courses/105105104/pdf/m10l27.pdf

Module-3	**L3, L4, L5**	**12Hrs**

Prerequisites: *Knowledge in the fundamentals of Design of Steel Structures*

Steel Beams with Web Openings: Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties, Vierendeel girders (design for given analysis results)

Laboratory Sessions/ Experimental learning:

- Determining the failure pattern of the steel beams with web openings.
- Analysis of Beam with perforated thin and thick webs.

Applications:

- Developing the beams with web openings with better strength.
- Developing the better properties of castelled beams and Vierendeel girders.

Video link / Additional online information:

- http://www2.ku.edu/~iri/publications/sm23a.pdf

Module-4	**L3, L4, L5**	**12Hrs**

Prerequisites: *Knowledge in the fundamentals of Design of Steel Structures*

Cold formed steel sections: Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions- numerical examples, beam design, column design. Cavity walls, walls with piers.

Laboratory Sessions/ Experimental learning:

- Determining the strength of Steel section in Stiffened and Unstiffened Condition
- Determining the Buckling Strength of Steel sections

Applications:

- Utilizing the Stiffened section as better strength criteria compared to unstiffened sections
- Cold Formed Steel sections have wide uses do to its better strength Properties

Video link / Additional online information:

- https://nptel.ac.in/courses/105106113/
- https://nptel.ac.in/content/storage2/courses/105106113/5_cold_form_steel/10_examples.pdf

Module-5	**L3, L4, L5**	**12Hrs**

Prerequisites: *Knowledge in the fundamentals of Design of Steel Structures*

Fire resistance: Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance ratings- Numerical Examples.

Laboratory Sessions/ Experimental learning:

- Determining the strength of Steel section against Fire Resistance.
- Testing different Methods of Fore Resistance.

Applications:

- Using Different Methods of Fire Resistance members to increase the strength.
- Utilizing the steel structures with better fire resistance properties can be obtained.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/downloads_new/105102176/noc18_ce30_ Assignment4.pdf
- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105102176/lec9.pdf

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

CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural Design
CO3	Design and develop analytical skills.
CO4	Summarize the principles of Structural Design and detailing
CO5	Understands the structural performance.

Reference Books:	
1.	N. Subramanian, "Design of Steel Structures", Oxford,IBH, 5th Edition 2015.
2.	Duggal.S.K., Design of Steel structures. 3rd Edition 2017.
3.	Srinath. L.S., Advanced Mechanics of Solids, Tata McGraw-Hill Publishing Co ltd., New Delhi 3. IS 1641, 1642,1643
4.	IS 800: 2007, IS 811
5.	INSDAG Teaching Resource Chapter 11 to 20

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

High-3, Medium-2, Low-1

Course Title	**FINITE ELEMENT METHOD OF ANALYSIS**	Semester	II
Course Code	MVJ19CSE22	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 :20	**SEE**	50
No. of Contact Hours/Week	4	**Total**	100
Credits	4	**Exam Duration**	3Hrs

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

- Make students to learn principles of Analysis of Stress and Strain
- Predict the stress-strain behaviour of continuum
- Evaluate the stress and strain parameters
- Study the inter relations of stress and strain parameters of the continuum

Module-1	**L3**	**12 Hrs**

Basic concepts of elasticity – Kinematic and Static variables for various types of structural problems – approximate method of structural analysis – Rayleigh – Ritz method – Finite difference method – Finite element method. Variation method and minimization of Energy approach of element formulation. Principles of finite element method – advantages & disadvantages – Finite element procedure. Finite elements used for one, two & three dimensional problems – Element aspect ratio – mesh refinement vs. higher order elements – Numbering of nodes to minimize band width.

Laboratory Sessions/ Experimental learning:

- Solve a beam using Rayleigh-Ritz method

Applications:

- Numerical analysis on structures (Beams, Columns and so on)

Video link / Additional online information :

- Rayleigh - Ritz method - https://nptel.ac.in/courses/105/108/105108141/

Module-2	**L3, L4, L5**	**12 Hrs**

Nodal displacement parameters – Convergence criterion – Compatibility requirements – Geometric invariance – Shape function – Polynomial form of displacement function. Generalized and Natural coordinates – Lagrangian interpolation function – shape functions for one, two & three dimensional elements.

Laboratory Sessions/ Experimental learning:

- Derive shape function using all the methods and differentiate the methods.

Applications:

- Numerical analysis of structures (Beams, Columns and so on).

Video link / Additional online information:

- Shape functions - http://www.nptelvideos.in/2012/12/finite-element-method.html

Module-3	**L4, L5**	**12 Hrs**

Isoparametric elements, Internal nodes and higher order elements, Serendipity and Lagrangian family of Finite Elements, Sub-parametric and Super- parametric elements, Condensation of internal nodes, Jacobean transformation Matrix. Development of strain-displacement matrix and stiffness matrix, consistent load vector, numerical integration

Laboratory Sessions/ Experimental learning:

- Do a case study on any two commercial softwares and identify the elements incorporated in it.

Applications:

- Numerical analysis on structures

Video link / Additional online information:

- Isoparametric elements - https://nptel.ac.in/courses/105/105/105105041

Module-4	**L3, L4, L5**	**12 Hrs**

Application of Finite Element Method for the analysis of one & two dimensional problems, Analysis of simple beams and plane trusses, Application to plane stress / strain / axisymmetric problems using CST & Quadrilateral Elements

Laboratory Sessions/ Experimental learning:

- Do a case study on application of FEM in 1D, 2D beams and trusses.

Applications:

- Numerical analysis on structures

Video link / Additional online information:

- Beams and Trusses - https://nptel.ac.in/courses/105/105/105105041

Module-5	**L3, L4, L5**	**12 Hrs**

Application of Finite Element Method for the analysis of two dimensional and three dimensional frame elements, Techniques for Non – linear Analysis.

Laboratory Sessions/ Experimental learning:

- Model making of Plates and Shells for Studying FEM characteristics

Applications:

- Behavior of Plates and Shells using Numerical Analysis

Video link / Additional online information:

- Plates and Shells - https://nptel.ac.in/courses/105/105/105105041

Course outcomes: On completion of the course, students would be able to	
CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of stress-strain behaviour of continuum
CO3	Design and develop analytical skills.
CO4	Describe the state of stress in a continuum
CO5	Understand the concepts of elasticity and plasticity.

Reference Books:	
1.	Krishnamoorthy C S, "Finite Element Analysis"- Tata McGraw Hill 2nd Edition 2015.
2.	Desai C and Abel J F, "Introduction to the Finite Element Method"- East West Press Pvt. Ltd., 1972
3.	Bathe K J, "Finite Element Procedures in Engineering Analysis"- Prentice Hall 3rd Edition 2015.
4.	Rajasekaran. S, "Finite Element Analysis in Engineering Design"-Wheeler Publishing, 4th Edition 2013.
5.	Cook R D, Malkan D S & Plesta M.E, "Concepts and Application of Finite Element Analysis" - 3rd Edition, John Wiley and Sons Inc., 1989
6.	Shames I H and Dym C J, "Energy and Finite Element Methods in Structural Mechanics"- McGraw Hill, New York, 1985

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

High-3, Medium-2, Low-1

Course Title	**EARTHQUAKE RESISTANCE STRUCTURES**	Semester	II
Course Code	MVJ19CSE23	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	4	**Exam. Duration**	3Hrs

Course objective is to:

- The objective of this course is to make students to learn principles of engineering seismology.
- To design the reinforced concrete buildings for earthquake resistance.
- To evaluate the seismic response of the structures

Module-1	**L3**	**12Hrs.**

Introduction: Introduction to engineering seismology, Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behaviour under gravity and seismic loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system, damping devises, base isolation systems.

Applications:

- Epicentral location , seismic zonation

Video link:

- https://nptel.ac.in/courses/105102016/

Module-2	**L3, L4, L5**	**12Hrs.**

The Response history and strong motion characteristics. Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS 1893–2002.

Video link:

- https://nptel.ac.in/courses/105102016/

Module-3	L4, L5	12Hrs.
Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modelling concepts of infill masonry walls. Behaviour of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – codal provisions. Video link: • https://nptel.ac.in/courses/105102016/		
Module-4	**L4, L5**	**12Hrs.**
Design of Reinforced concrete buildings for earthquake resistance-Load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions as per IS 1893–2002. . Structural behaviour, design and ductile detailing of shear walls. Video link: • https://nptel.ac.in/courses/105102016/		
Module-5	**L3, L5**	**12Hrs.**
Seismic response control concepts – Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis, Static Push over analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures. Video link: • https://nptel.ac.in/courses/105102016/		

Course outcomes:	
CO1	Understand the principles of engineering seismology
CO2	Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings.
CO3	To analyse earthquake characteristics and associated effects on structures, including linear responses

CO4	Understand the concepts of earthquake resistance of reinforced concrete buildings.
CO5	Understand the concepts of Seismic response control.

Reference Books:	
1.	Dynamics of Structures – Theory and Application to Earthquake Engineering- 2nd ed. – Anil K. Chopra, Pearson Education, 7th Edition 2018.
2.	Earthquake Resistant Design of Building Structures, Vinod Hosur, WILEY (india), 3rd Edition 2016.
3.	Earthquake Resistant Design of Structures, Duggal, Oxford University Press, 5th Edition 2017.
4	Earthquake resistant design of structures – Pankaj Agarwal, Manish Shrikande – PHI India , 4th Edition 2016.
5	Seismic Design of Reinforced Concrete and Masonry Buildings, T Paulay and M J N Priestley, John Wiley and Sons
6	Codal Provisions IS 1893–2002, IS 4928–1993, IS 13827–1992, IS: 13920–1997, IS: 13935–1993.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**ADVANCED DESIGN OF PRE-STRESSED CONCRETE STRUCTURES**	Semester	II
Course Code	MVJ19CSE241	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**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

- Understand the general mechanical behaviour of prestressed concrete.
- Able to analyze and design for deflection and crack control of prestressed concrete members
- Perform analysis and design of prestressed concrete members
- Be able to analyze transfer and development length as well as prestress losses.

Module-1	**L3, L4**	**12 Hrs**

Losses of Prestress: Loss of prestress in pre-tensioned and posttensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss – Analysis of sections for flexure.

Experimental learning: Compare the effect of various losses in PSC members

Applications:

- Knowledge of losses is important while calculating the jacking forces.

Video link:

- https://www.youtube.com/watch?v=2pfHyPy3R_w

Module-2	**L3, L4**	**12 Hrs**

Design of Section for Flexure: Allowable stresses, Elastic design of simple beams having rectangular and I-section for flexure, kern lines, cable profile and cable layout.

Design of Sections for Shear: Shear and Principal stresses, Improving shear resistance by different prestressing techniques horizontal, sloping and vertical prestressing, Analysis of rectangular and I–beam, Design of shear reinforcement, Indian code provisions

Experimental learning:

- Learn to apply prestressing loads in StaadPro

Applications:

- Useful in calculating flexural and shear stresses in any PSC member.

Video link:

- https://www.youtube.com/watch?v=BIJTWBlguHs

Module-3	**L3, L4**	**12 Hrs**

Deflections of Prestressed Concrete Beams: Short term deflections of uncracked members, Prediction of long-term deflections, load–deflection curve for a PSC beam, IS code requirements for maximum deflections

Laboratory Sessions :

· Practical outlook on construction of **Prestressed Concrete Beams** by field visit (mandatory and marks considered for CIE).

Experimental learning:

- Preparing Excel sheets on load–deflection curve for a PSC beam

Applications:

- To calculate the deflections in various PSC members.

Video link:

- https://www.youtube.com/watch?v=l5RA6XMOtuU

Module-4	**L3, L4**	**12Hrs**

Transfer of Prestress in Pretensioned Members: Transmission of prestressing force by bond, Transmission length, Flexural bond stresses, IS code provisions, Anchorage zone stresses in post tensioned members, stress distribution in End block, Anchorage zone reinforcements.

Experimental learning:

- Learn to apply poststressing loads in StaadPro

Applications:

- To design anchorage blocks in any PSC Member

Video link:

- https://www.youtube.com/watch?v=ztiFxoi-O-Y

Module-5	**L3, L4**	**12 Hrs**

Statically Indeterminate Structures: Advantages and disadvantages of continuous PSC beams, Primary and secondary moments, P and C lines, Linear transformation, concordant and non-concordant cable profiles, Analysis of continuous beams.

Experimental learning:

- Generate excel sheets for analysis of continuous beams.

Applications:

- To analyze various PSC continuous beams.

Video link:

- https://www.youtube.com/watch?v=zYEjDnVnnHs

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

CO1	Calculate losses due to pre-tensioning and post-tensioning in PSC members.
CO2	Design of PSC members for flexure and shear.
CO3	Calculate the short term and long-term deflections in prestressed concrete
CO4	Calculate Transmission length, flexural bond stresses and anchorage zone stresses.
CO5	Analyze various PSC Continuous beams.

Reference Books:

1.	Krishna Raju, "Prestressed concrete", Tata Mc Graw Hill Book – Co, New Delhi, 6th Edition 2018.
2.	T.Y. Lin and Burn, "Design of prestress concrete structures", John Wiley, New York, 3rd Edition 2010
3.	S. Ramamrutham, "Prestressed concrete", Dhanpat Rai & Sons, Delhi,10th Edition 2019.
4.	Prestressed Concrete by N.Rajagopalan, Alpha Science, 2nd Edition 2005.
5.	Prestressed Concrete Structures by P. Dayaratnam, Oxford & Ibh, 6th Edition 2018.
6.	IS :1343 – 2012, "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**STABILITY OF STRUCTURES**	Semester	II
Course Code	MVJ19CSE242	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**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

- The objective of this course is to make students to learn principles of stability of structures.
- To analyse the structural elements for stability. To evaluate the use of strain energy in plate bending and stability.

Module-1	**L3**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials and Structural Analysis*

Beam – column – Differential equation. Beam column subjected to lateral concentrated load, several concentrated loads, Continuous lateral load. Application of trigonometric series, Euler's formulation using fourth order differential equation for pined – pined, fixed – fixed, fixed – free and fixed – pinned column. Imperfection factor.

Laboratory Sessions/ Experimental learning:

- Analysing the Beam due to Several Concentrated load and comparing result with Equation.
- Analysing the Beam due to Different supports and comparing result with Equation.

Applications:

- The Experimental results can be estimated with Differential equation.
- The Beam and Column deflection for different supports can be determined using the equation.

Video link / Additional online information:

- https://nptel.ac.in/courses/105104160/-

Module-2	**L3**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials and Structural Analysis*

Buckling of frames and continuous beams. Elastic Energy method: Approximate calculation of critical loads for a cantilever. Exact critical load for hinged – hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load. Column subjected to non – conservative follower and pulsating forces.

Laboratory Sessions/ Experimental learning:

- Determining the Buckling characteristics of Cantilever due to critical load.

Applications:

- Critical buckling load can be estimated by this method.
- The strength of the beam can be improved by determining the shear force at different cross section.

Video link / Additional online information:

- https://nptel.ac.in/courses/105101085/downloads/lec-25.pdf

Module-3	**L3, L4**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials and Structural Analysis*

Stability analysis by finite element approach – deviation of shape function for a two nodded Bernoulli – Euler beam element (lateral and translation of) – element stiffness and element geometric stiffness matrices – assembled stiffness and geometric stiffness matrices for a discretised column with different boundary condition – calculation of critical loads for a discretised (two elements) column (both ends built in). Buckling of pin jointed frames (maximum of two active DOF) – symmetrical single bay portal frame. Stability analyis of truss.

Laboratory Sessions/ Experimental learning:

- Determining the critical loads for a column using FEM method.
- Determining the Buckling of pin jointed frames using FEM method.

Applications:

- The finite element method represents a powerful alternative approach for stability analysis which is accurate.
- Critical load can be easily determined by FEM method for discretized structure.

Video link / Additional online information:

- https://nptel.ac.in/courses/105105041/

Module-4	**L3**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials and Structural Analysis*

Lateral buckling of beams – differential equation – pure bending – cantilever beam with tip load – simply supported beam of I section subjected to central concentrated load. Pure Torsion of thin – walled bars of open cross section. Non – uniform Torsion of thin – walled bars of open cross section.

Laboratory Sessions/ Experimental learning:

- Determining the loads carrying capacity in I section due to central concentrated load.
- Determining the loads carrying capacity in cantilever beam with tip load

Applications:

- By the approach of equation load acting on the cantilever beam can be determined easily.
- The load value on I-Section can be determined with the help of equations.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105106112/6_beams/6_examples.pdf

Module-5	**L3**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials and Structural Analysis*

Expression for strain energy in plate bending with in plate forces (linear and non – linear). Buckling of simply supported rectangular plate – uniaxial load and biaxial load. Buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides.

Laboratory Sessions/ Experimental learning:

- Experimental investigation on uniaxial and biaxial buckling.
- Determining the Buckling of uniformly compressed rectangular plate simply supported along two opposite sides.

Applications:

- Buckling of the simply supported due to uniaxial and biaxial loading condition can be easily determined by this method.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112106065/lec8.pdf

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

CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of strength and stability
CO3	Design and develop analytical skills.
CO4	Appraise the Stability analysis by finite element approach.
CO5	Understand the concepts of Lateral buckling of beams

Reference Books:

1.	Stephen P.Timoshenko, James M Gere, “Theory of Elastic Stability”-2nd Edition, McGraw –

	Hill, New Delhi, 8th Edition 2013.
2.	T Robert D Cook et.al, "Concepts and Applications of Finite Element Analysis"-3rd Edition, John Wiley and Sons, New York, 7th Edition 2014.
3.	S.Rajashekar, "Computations and Structural Mechanics"-Prentice – Hall, India, 6th Edition 2018.
4.	Ray W Clough and J Penzien, "Dynamics of Structures" - 2nd Edition, McGraw Hill, New Delhi, 5th Edition 2017.
5.	H.Zeiglar, "Principles of Structural Stability"-Blaisdall Publications, 4th Edition 2014.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**DESIGN OF PRECAST & COMPOSITE STRUCTURES**	Semester	II
Course Code	MVJ19CSE243	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**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

- Learn principles of precast materials preparation
- Implement the Design of Precast Concepts.
- Evaluate different methods of Analysis of precast materials.

Module-1	**L3, L4**	**12 Hrs**

Concepts, components, Structural Systems and Design of precast concrete floors: Need and types of precast construction, Modular coordination, Precast elements-Floor, Beams, Columns and walls. Structural Systems and connections.

Design of precast Concrete Floors: Theoretical and Design Examples of Hollow core slabs. Precast Concrete Planks, floor with composite toppings with and without props.

Laboratory Sessions/ Experimental learning:

- Experiments on the Seismic Performance of Hollow-Core Floor Systems in Precast Concrete Buildings.

Applications:

- Understanding the scope of the subject.
- Understanding the design and Construction of precast concrete floors.

Video link / Additional online information:

- https://www.youtube.com/watch?v=Jr43y9WYxkI

Module-2	**L3, L4**	**12 Hrs**

Design of precast reinforced and prestressed Concrete beams: Theoretical and Design Examples of ITB –Full section precast, Semi Precast, propped and un propped conditions. Design of RC Nibs.

Laboratory Sessions/ Experimental learning:

- Testing of precast beams for behaviour of concrete

Applications:

- Understanding the design and construction of precast reinforced and prestressed concrete beams.

Video link / Additional online information:

- https://www.youtube.com/watch?v=pjwrXLWhISE

Module-3	**L3**	**12 Hrs**

Design of precast concrete columns and walls: Design of braced and unbraced columns with corbels subjected to pattern and full loading. Design of Corbels. Design of RC walls subjected to Vertical, Horizontal loads and moments, Design of vertical ties and horizontal joints.

Laboratory Sessions/ Experimental learning:

- Experimental testing of precast concrete panel connections.

Applications:

- Knowledge about the design and Construction of precast concrete columns and walls

Module-4	**L3**	**12 Hrs**

Design of Precast Connections and Structural Integrity: Beam bearing, Socket Connection, Structural integrity, Avoidance of progressive collapse, Design of Structural Ties.

Laboratory Sessions/ Experimental learning:

- Experimental Investigation on Precast Wall Connections

Applications:

- Obtaining the structure with better connection to withstand loads.

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

- https://www.youtube.com/watch?v=uiQzx1YFOBs

Module-5	**L4**	**12 Hrs**

Design of Steel Concrete Composite Floors and Beams Composite Floors: Profiled Sheeting with concrete topping, Design method, Bending and Shear Resistance of Composite Slabs, Serviceability Criteria, Design Example Composite Beams: Elastic Behavior, Ultimate Load behavior of Composite beams, Stresses and deflection in service and vibration, Design Example of Simply Supported beams.

Laboratory Sessions/ Experimental learning:

- Experimental Investigation on Steel Concrete Composite Floor Slab

Applications:

- Knowledge about composite material and construction
- Design of steel concrete composite floors and beams can be done.
- Behavior of precast composite structures against loads.

Video link / Additional online information:

- https://nptel.ac.in/courses/105/108/105108124/

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

CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of precasted elements.
CO3	Design and develop analytical skills.
CO4	Summarize the Probability distributions
CO5	Understand the concepts of prestressed elements.

Reference Books:

1.	Structural Precast Concrete Handbook, CIDB, Singapore, 7th Edition 2017.
2.	INSDAG Teaching Resource Chapter 21 to 24: www.steel-insdag.org
3.	IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete -Code of Practice [CED 51: Planning, Housing and pre-fabricated construction]
4.	IS 1343-2012, IS 456-2000, IS 800-20075.
5.	IS 11384 (1985):Code of Practice for Composite Construction in Structural Steel and Concrete [CED 38: Special Structures]

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**RELIABILITY ANALYSIS OF STRUCTURES**	Semester	II
Course Code	MVJ19CSE244	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**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

- The objective of this course is to make students to learn principles of reliability.
- To implement the Probability Concepts for the Reliability Analysis.
- To evaluate different methods of reliability analysis.

Module-1	**L3, L4**	**12 Hrs**

Preliminary Data Analysis: Graphical representation- Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form y = abx, and parabola, Coefficient of correlation.

Laboratory Sessions/ Experimental learning:

- Prepare excel sheets on preliminary data analysis

Applications:

- Implement probability concepts for Reliability analysis

Module-2	**L3, L4**	**12 Hrs**

Probability Concepts: Random events-Sample space and events, Venn diagram and event space, Measures of probability-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem.

Laboratory Sessions/ Experimental learning:

- Prepare excel sheets on preliminary data analysis

Applications:

- Implement probability concepts for Reliability analysis

Module-3	**L3, L4**	**12 Hrs**

Random variables: Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions- Normal, Log normal distributions.

Laboratory Sessions/ Experimental learning:

- Do a case study on random variables for Probability mass function, probability density function

Applications:

- Implement probability concepts for Reliability analysis

Video link / Additional online information:

- Probability - https://nptel.ac.in/content/syllabus_pdf/114106041.pdf

Module-4	**L3, L4, L5**	**12 Hrs**

Reliability Analysis: Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method).

Laboratory Sessions/ Experimental learning:

- Do a case study on random variables for Probability mass function, probability density function

Applications:

- Reliability analysis for structures

Video link / Additional online information:

- Reliability estimates - https://nptel.ac.in/content/syllabus_pdf/114106041.pdf

Module-5	**L3, L4, L5**	**12 Hrs**

System reliability: Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers- random numbers with standard uniform distribution, continuous random variables, discrete random variables.

Laboratory Sessions/ Experimental learning: • Do a case study on system reliability analysis. Applications: • Reliability analysis for structures Video link / Additional online information: • Reliability - https://nptel.ac.in/content/syllabus_pdf/114106041.pdf

Course outcomes: On completion of the course, students would be able to	
CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of reliability
CO3	Design and develop analytical skills.
CO4	Summarize the Probability distributions
CO5	Understand the concepts of System reliability.

Reference Books:	
1.	Ranganathan, R. (1999). "Structural Reliability Analysis and design"- Jaico publishing house, Mumbai, India, 5nd Edition.
2.	Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planning and design"- Volume –I, John Wiley and sons, Inc, New York, 5th Edition 2015.
3.	Milton, E. Harr (1987). "Reliability based design in civil engineering"- Mc Graw Hill book Co, 3rd Edition.
4.	Nathabdndu, T., Kottegoda, and Renzo Rosso (1998). Statistics, "Probability and reliability for Civil and Environmental Engineers"- Mc Graw Hill international edition, Singapore, 2ndEdition.
5.	Achintya Haldar and Sankaran Mahadevan (2000). "Probability, Reliability and Statistical methods in Engineering design"- John Wiley and Sons. Inc, 4th Edition.
6.	Thoft-christensen, P., and Baker, M., J., (1982), "Structural reliability theory and its applications"- Springer-Verlag, Berlin, NewYork, 4th Edition.

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

High-3, Medium-2, Low-1

Course Title	**ADVANCED STRUCTURAL ANALYSIS**	Semester	II
Course Code	MVJ19CSE251	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**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

- Students will be given provided with the knowledge of mathematics, science, and engineering in the in the analysis of following structural systems curved beams.
- Beams on elastic foundation, shear centre and unsymmetrical bending and buckling of non-prismatic columns and beam column.

Module-1	**L3**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials & Basic Structural analysis*

Curved Beams Curved beams, Introduction, assumptions, derivation of WINKLER BACH equation, Radius to the neutral surface of simple geometric figures, Limitation, Stress distribution in open curved members such as Hooks and chain links, Stress distribution in closed rings and chain links. Deformations of open and closed rings.

Laboratory Sessions/ Experimental learning:

- Experiments on Stress analysis of Curved Beams using strain Guages.
- Determination of geometrical influence of Curved beams due to laoding.

Applications:

- Static and Dynamic analysis of curved beams can be done.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105106049/lecnotes/mainch10.html

Module-2	**L3,L4**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials & Basic Structural analysis*

Beams on Elastic Foundations

Governing differential equation for elastic line, Interpretation of constants, Infinite beam with point load, moment & UDL with problems. Semi-infinite beams with point load and moment UDL with problems over fixed and hinged support conditions.

Laboratory Sessions/ Experimental learning:

- Experiments on influence of foundation mass on Different loading Condition.
- Comparing the equations with experimental result sue to different loading condition on beams.

Applications:

- By the use of equations loads on the foundations can be predicted.
- Critical loading can be avoided hence the foundation can be completely utilized.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105106049/lecnotes/mainch11.html

Module-3	**L3,L4**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials & Basic Structural analysis*

Shear Center

Concept of shear centre in torsion induced bending of beams, expression to the Shear Centre for Symmetrical and Unsymmetrical Sections, Derivation of shear centre for angles, channel, semi-circular and built-up sections with numerical problems

Laboratory Sessions/ Experimental learning:

- Determining the location of Shear Centre by Application of load.

Applications:

- Torsion is critical if not taken care. Hence application of load at shear center reduces torsion.
- The Strength of the structure can be completely utilized by this method.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112101095/lec33.pdf
- https://www.youtube.com/watch?v=3Hg0OWZGUbE

Module-4	**L3, L4**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials & Basic Structural analysis*

Unsymmetrical Bending (Asymmetrical Bending)

Theory behind unsymmetrical bending, Assumptions, obtaining the stresses in beams, simply supported and cantilever unsymmetrical beams subjected to inclined loading, Deflections of unsymmetrical simply supported and cantilever beams with numerical problems.

Laboratory Sessions/ Experimental learning:

- Experiment on Unsymmetrical Bending on simply supported beam due to Inclined Loading.
- Experiment on Unsymmetrical Bending on Cantilever beam due to Inclined Loading

Applications:

- Unsymmetrical bending can be mitigated due to inclined loading by this method.
- Stress analysis on the beam can be determined in simply supported and Cantilever beams.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/114106043/lec23.pdf
- https://www.youtube.com/watch?v=mbJEQHXz5WA

Module-5	**L3, L4**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of Strength of Materials & Basic Structural analysis*

Buckling of Non Prismatic Columns and Beam-Column

Principle behind Euler's theory of buckling, Governing differential equation applied to buckling of columns and evaluation of constants for various boundary conditions, Obtaining the characteristic equation for the buckling load of non-prismatic compound columns, Analysis of Beam-column, conceptual theory of magnification stresses and deformations subjected to axial and different types of lateral loads with numerical problems.

Laboratory Sessions/ Experimental learning:

- Experiment on Buckling of Non-Prismatic columns.
- Analysis of Stresses in Beam –Column Axial load and different Lateral Load.

Applications:

- Torsion is critical if not taken care. Hence application of load at shear center reduces torsion.
- The Strength of the structure can be completely utilized by this method.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105105109/pdf/m1l2.pdf

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

CO1	Apply Winkler Bach and Strain Energy principles to obtain stresses and deformation in curved members.
CO2	Derive the expressions to Foundation pressure, Deflection, Slope, BM and SF of infinite and semi-infinite Beams resting on Elastic Foundation .
CO3	Obtain the equations for the shear centre for symmetrical and unsymmetrical from fundamental.
CO4	Extrapolate the bending theory to calculate the stresses and deformations in unsymmetrical bending.
CO5	Develop the characteristic equation for the buckling load of compound column and stresses and deformations in beam-column.

Reference Books:	
1.	azirani V N and Ratwani M M "Advanced theory of structures and Matrix Method". 5th Edition,2014
2.	HetenyiM."Beams on elastic foundation" 3rd printing, University of Michigan, USA, 1952. 2nd Edition
3.	Alexander Chatjes "Principles of Structural stability theory", Prentice – Hall of India, New Delhi, 2nd Edition,1974.
4.	Sterling Kinney "Indeterminate Structural Analysis", Oxford & IBH publishers, 5th edition,2016

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

High-3, Medium-2, Low-1

Course Title	**DESIGN OF HIGH RISE STRUCTURES**	Semester	II
Course Code	MVJ19CSE252	**CIE**	50
Total No. of Contact Hours	60 L: T: P: 40: 0: 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam Duration**	3Hrs

Course objective is to:

- Learn principles of stability of high rise buildings.
- Design the tall buildings for earthquake and wind resistance.
- Gain knowledge of behaviour of structural systems.
- Evaluate the performance of tall structures for strength and stability.
- Introduce to the code provisions.

Module-1	**L3**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of special concrete.*

Design Criteria: Design philosophy, loading, sequential loading, and materials – high performance concrete, fibre reinforced concrete, lightweight concrete, design mixes. Loading and Movement: Gravity loading- dead and live load, methods of live load reduction, Impact gravity loading, construction loads.

Laboratory Sessions/Experimental learning:

- Development of design mixes for high performance, fibre reinforced and lightweight concrete.
- Testing of concrete blocks with different design mixes.

Applications:

- Understanding of characteristics of concrete materials used for the construction of high-rise structures.
- Importance of each individual loads to be considered on high rise structures.

Video link / Additional online information:

- https://www.sefindia.org/forum/files/design_of_tall_buildings_preliminary_design_124.pdf- Introduction to tall buildings.

- https://www.youtube.com/watch?v=XCun_ewg-I8 (Lecture 1)- An overview of tall buildings
- https://www.youtube.com/watch?v=8iHKKM4enic (Lecture 2)- Design philosophy.
- https://www.youtube.com/watch?v=EqWxCDsr1qU (Lecture 7)- Analysis by gravity loads.

Module-2	**L3, L4 & L5**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of structural dynamics.*

Wind loading: static and dynamic approach, analytical and wind tunnel experimentation method.

Earthquake loading: Equivalent lateral force, modal analysis, combinations of loading, working stress design, Limit state design, Plastic design.

Laboratory Sessions/Experimental learning:

- Experimental investigation on wind load analysis of high-rise structures by wind tunnel experimentation method. (Multidisciplinary learning with Aeronautical Engineering Department)
- Model making to understand the structural behavior of high-rise structures under wind and seismic loading.

Applications:

- Better understanding of wind pressure distribution on high-rise structures with different boundary conditions by wind tunnel experiment.
- Importance of method of analysis under wind and earthquake loading.

Video link / Additional online information:

- https://www.youtube.com/watch?v=rjvM6rR8BZ8 (Lecture 3- Part I & 2)- Design criteria.
- https://www.youtube.com/watch?v=hREd8TjRw_8 (Lecture 8- Part III)- Analysis of lateral loads.

Module-3	**L2, L3**	**12 Hrs**

Behaviour of Various Structural Systems: Factors affecting growth, height and structural form; high rise behaviour, rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, outrigger – braced and hybrid mega system.

Laboratory Sessions/Experimental learning:

- Case study on behavior of various structural systems in high rise structures.
- Analysis and design of high-rise structures with various structural systems.

Applications:

- Understanding the performance of high-rise structures under each structural system.
- Gives better knowledge of optimal structural system that could be employed in a high-rise structure.

Video link / Additional online information: Information on various structural systems.

- https://www.sefindia.org/forum/files/design_of_tall_buildings_preliminary_design_124.pdf
- https://www.youtube.com/watch?v=XCun_ewg-I8 (Lecture 1)

Module-4	**L3, L4 & L5**	**12 Hrs**

Analysis and Design: Modelling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three-dimensional analyses. Structural elements: sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire.

Laboratory Sessions/Experimental learning:

- Analytical investigation of forces, lateral displacement and twisting of members of high-rise structures.
- Software analysis and design to understand seismic performance of high-rise structures along with seismic design aspects.

Applications:

- Knowledge on various analytical procedures in accessing overall structural integrity.
- Understanding various secondary effects in high-rise structures.

Video link / Additional online information: Preliminary design of tall structures

- https://www.youtube.com/watch?v=-86A8kVKzwQ (Lecture 5)

Module-5	**L3 & L4**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of structural dynamics.*

Stability of Tall Buildings: Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation.

Laboratory Sessions/Experimental learning:

- Analyzing the stability of high-rise buildings by buckling and P-Delta effect using structural software.
- Experiencing construction of high-rise structures at site.

Applications:

- Gain knowledge on analytical approaches with respect to stability of the high-rise structures.
- Practical outlook on construction of high-rise structures.

Video link / Additional online information:

- https://www.youtube.com/watch?v=hREd8TjRw_8 (Lecture 8- Part III)- Analysis of lateral loads.

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

CO1	Familiarize with the problems associated with the large heights of structures with respect to different loads and materials.
CO2	Analyse the structure subjected to lateral loads.
CO3	Design and develop analytical skills.
CO4	Summarize the behavior of various structural systems
CO5	Understand the concepts of overall buckling and P-Delta analysis.

Reference Books:

1.	Taranath B.S, "Structural Analysis and Design of Tall Buildings"- McGraw Hill, 3rd Edition 2011.
2.	Wilf gang Schuller, "High rise building structures"- John Wiley, 4th Edition 2012.
3.	Bryan Stafford Smith & Alexcoull, "Tall building structures Analysis and Design"- John Wiley, 2nd Edition 2017.
4.	T. Y Lin & D.Stotes Burry, "Structural concepts and system for Architects and Engineers"- John Wiley, 4h Edition 2015.
5.	Lynn S.Beedle, "Advances in Tall Buildings"- CBS Publishers and Distributors, 6th Edition 2015.
6.	Dr. Y.P. Gupta – Editor, "Proceedings National Seminar on High Rise Structures- Design and Construction practices for middle level cities"- New Age International Limited, 7th Edition 2014.
7.	IS 1893(Part 1):2016 "Criteria for Earthquake Resistant Design of Structures"- (6th revision) BIS, New Delhi.

8.	IS 875(Part 3):2015 "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures - Part 3: Wind Loads (3rd revision) BIS, New Delhi.

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

High-3, Medium-2, Low-1

Course Title	**DESIGN OF INDUSTRIAL STRUCTURES**	Semester	II
Course Code	MVJ19CSE253	**CIE**	50
Total No. of Contact Hours	60 L: T: P: 40: 0: 20	**SEE**	50
No. of Contact Hours/Week	3	**Total**	100
Credits	3	**Exam Duration**	3Hrs

Course objective is to:

- Learn principles of design of industrial building.
- Design different components of industrial structures and detail the structures.
- Design industrial storage structures.
- Design various cold formed light gauge sections.
- Evaluate the performance of the Pre- engineered buildings.

Module-1	**L3, L4 & L5**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of design of steel structures.*

Analysis of industrial building - Gravity and Wind load. Analysis and design of framing components namely, girders, trusses, gable frames.

Laboratory Sessions/Experimental learning:

- Modelling and design of industrial components of buildings under gravity and wind loads.

Applications:

- Understanding of principles of design of industrial building as per the code provisions.
- Find out the response of components of structures under gravity and lateral loads.

Video link / Additional online information:

- https://nptel.ac.in/courses/105106113/- Design of gantry girders and trusses.
- https://www.iare.ac.in/sites/default/files/lecture_notes/lec%20notes%20ASD.pdf- Design of Industrial building (girders, trusses and frames)

Module-2	**L3 & L4**	**12 Hrs**

Prerequisites: *Knowledge in the fundamentals of design of steel structures.*

Analysis and design of gantry column (stepped column / column with bracket), purlins, girts, bracings including all connections.

Laboratory Sessions/Experimental learning:

- Draft the detailing of gantry column, purlins, girts and bracings.

Applications:

- Understanding of behavior of different components of industrial structure.
- Learn to detail various components of an industrial building.

Video link / Additional online information:

- https://nptel.ac.in/courses/105106113/- Design of gantry column.
- https://www.iare.ac.in/sites/default/files/lecture_notes/lec%20notes%20ASD.pdf- Design of bracings with connections.

Module-3	**L4, L5**	**12 Hrs**

Design of silos and bunkers – Design of square bunker – Jansen's and Airy's theories IS Codal provisions, design of side plates, stiffeners, Hooper, longitudinal beams. Design of cylindrical silo – Side plates, ring girder, stiffeners.

Laboratory Sessions/Experimental learning:

- Design of Bunkers from FE based software subjected to wind load.
- Modelling and design of silos under dynamic loads.

Applications:

- Understanding of theoretical and design concepts of bunkers and silos with supporting components.

Video link / Additional online information:

- https://www.iare.ac.in/sites/default/files/lecture_notes/lec%20notes%20ASD.pdf- Design of steel bunkers and silos.

Module-4	**L4**	**12 Hrs**

Forms of light gauge sections, Effective width computation of unstiffened, stiffened, multiple stiffened compression elements of cold formed light gauge sections. Concept of local buckling of thin elements. Limiting width to thickness ratio. Post buckling strength.

Laboratory Sessions/Experimental learning:

- Investigation of numerical and finite element analysis of buckling behavior of light gauge sections under compression.

Applications:

- Gives in depth knowledge of influence of local buckling on the structural behavior of light gauge sections.

Video link / Additional online information:

- https://nptel.ac.in/courses/105106113/- Introduction to light gauge sections, local buckling.

Module-5	**L3 & L4**	**12 Hrs**

Design of compression and tension members of cold formed light gauge sections, Design of flexural members (Laterally restrained / laterally unrestrained), Concept of Pre- engineered buildings.

Laboratory Sessions/Experimental learning:

- Experimental and analytical investigation on different forms of light gauge sections under different loading and boundary conditions.
- Case study on pre-engineered buildings.

Applications:

- Learn design of compression and tension members of cold formed light gauge sections.
- Better knowledge on concepts of pre-engineered buildings.

Video link / Additional online information:

- https://nptel.ac.in/courses/105106113/- Design of tension members, flexural members.

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

CO1	Understand the industrial building and the components.
CO2	Summarize the principles of structural design and detailing.
CO3	Design the silos, bunkers and bins along with supporting structures.
CO4	Design cold formed steel structures as per code provisions.
CO5	Understand the concepts of Pre- engineered buildings.

Reference Books:

1.	Bureau of Indian Standards, IS 800-2007, IS 875-1987, IS-801-1975. Steel Tables, SP 6 (1) – 1984
2.	N Subramanian- "Design of Steel Structure" oxford University Press,4th Edition, (2018).
3.	B.C. Punmia, A.K. Jain "Design of Steel Structures", Laxmi Publications, New Delhi. 2nd revised Edition 2012.
4.	Ramchandra and Virendra Gehlot "Design of Steel Structures "Vol 1 (11th edition, 2012) and

	Vol.2 (9^{th} revised edition,2015), Scientific Publishers, Jodhpur.
5.	Duggal "Limit State Design of Steel Structures" TMH, 3rd Edition 2019.
6.	Reimbert, M. L., &Reimbert, A. M. (1987). Silos. Theory and practice. Vertical silos, horizontal silos (retaining walls) (No. Ed. 2). Lavoisier Publishing.

CO-PO Mapping

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

High-3, Medium-2, Low-1

Course Title	**STRUCTURAL HEALTH MONITORING**	Semester	II
Course Code	MVJ19CSE254	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**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

- Learn the fundamentals of structural health monitoring.
- Examines the use of low-cost, long term monitoring systems to keep civil infrastructure under constant surveillance.
- Ensure the structural integrity.
- Develop the tools and skills the students will learn in this course can be implemented to develop sustainable maintenance and rehabilitation schemes and programs.

Module-1	**L3**	**12 Hrs**

Introduction to Structural Health Monitoring (SHM): Definition & motivation for SHM, SHM - a way for smart materials and structures, SHM and bio mimetic - analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and Active SHM, NDE, SHM and NDECS, basic components of SHM, materials for sensor design.

Laboratory Sessions/ Experimental learning:

- Identify the scope of SHM and various applications on it.

Applications:

- Understanding the basics of SHM
- Knowledge of the scope of the subject

Video link / Additional online information:

- https://nptel.ac.in/courses/114/106/114106046/
- https://nptel.ac.in/courses/112/104/112104160/

Module-2	**L3,L4**	**12 Hrs**

Application of SHM in Civil Engineering: Introduction to capacitive methods, capacitive probe for cover concrete, SHM of a bridge, applications for external post tensioned cables, monitoring historical buildings.

Laboratory Sessions/ Experimental learning:

- Performance assessment of various structures and structural components

Video link / Additional online information:

- https://nptel.ac.in/courses/114/106/114106046/
- https://nptel.ac.in/courses/112/104/112104160/

Module-3	L3	12 Hrs

Non Destructive Testing of Concrete Structures: Introduction to NDT- Situations and contexts, where NDT is needed, classification of NDT procedures, visual Inspection, half-Cell electrical potential methods, Schmidt Rebound Hammer Test, resistivity measurement, electromagnetic methods, radiographic Testing, ultrasonic testing, Infra-Red thermography, ground penetrating radar, radio isotope gauges, other methods.

Laboratory Sessions/ Experimental learning:

- Perform various Nondestructive test on concrete

Applications:

- Strength estimation of concrete
- Corrosion assessment and monitoring
- Detecting defects in concrete structure

Video link / Additional online information:

- https://nptel.ac.in/courses/114/106/114106046/
- https://nptel.ac.in/courses/112/104/112104160/

Module-4	L3, L4	12 Hrs

Condition Survey & NDE of Concrete Structure: Definition and objective of Condition survey, stages of condition survey (Preliminary, Planning, Inspection and Testing stages), possible defects in concrete structures, quality control of concrete structures - Definition and need, Quality control applications in concrete structures, NDT as an option.

Laboratory Sessions/ Experimental learning:

- Collection of data on the structural integrity of structures in the campus(Identification of cracks, various repair techniques, Application of NDT, Retrofitting of structures)

Applications:

- Understanding the defects in concrete structures
- Identify the need of quality control in concrete structures

Video link / Additional online information:

- https://nptel.ac.in/courses/114/106/114106046/
- https://nptel.ac.in/courses/112/104/112104160/

Module-5	L3, L4, L5	12 Hrs

Rehabilitation and Retrofitting of Concrete Structure: Repair rehabilitation & retrofitting of structures, damage assessment of concrete structures, Materials and methods for repairs and rehabilitation, modeling of repaired composite structure, structural analysis and design -Importance of re-analysis, execution of rehabilitation strategy, Case studies.

Laboratory Sessions/ Experimental learning:

- Collection of different case studies as a group work

Applications:

- Better knowledge on various repair techniques.
- Performance enhancement of an existing structures

Video link / Additional online information:

- https://nptel.ac.in/courses/114/106/114106046/
- https://nptel.ac.in/courses/112/104/112104160/

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

CO1	Diagnosis the distress in the structure understanding the causes and factors.
CO2	Assess the health of structure using static field methods.
CO3	Assess the health of structure using dynamic field tests.
CO4	Suggest repairs and rehabilitation measures of the structure
CO5	Understand the concepts of Retrofitting of structure.

Reference Books:

1.	Guide Book on Non-destructive Testing of Concrete Structures", Training course series No. 17, International Atomic Energy Agency, Vienna, 4th Edition 2002.
2.	Daniel Balageas, Claus - Peter FritzenamI Alfredo Guemes, "Structural Health Monitoring", Published by ISTE Ltd., U.K. 5th Edition 2006.
3.	Douglas E Adams "Health Monitoring of Structural Materials and Components-Methods with Applications", John Wiley and Sons, 6th Edition 2007.
4.	Hand book on "Repair and Rehabilitation of RCC Building", Published by Director General, CPWD, Govt. of India, 4th Edition 2002.

5.	J. P. Ou, H. Li and Z. D. Duan, "Structural Health Monitoring and Intelligent Infrastructure", Vol1, Taylor and Francis Group, London, UK, 6th Edition 2006.
6.	Victor Giurglutiu, Academic "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 5th Edition 2007.

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

High-3, Medium-2, Low-1

Course Title	**REMOTE SENSING AND GIS IN ENGINEERING**	Semester	II
Course Code	MVJ19CSE261	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to:

- Understand the basic concepts of remote sensing.
- Analyse satellite imagery and extract the required units.
- Extract the GIS data and prepare the thematic maps
- Use the thematic maps for various applications.

Module-1	**L3 & L4**	**12 Hrs.**

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.

Laboratory Sessions/ Experimental learning:

- Introduction to Working Principles of software
- Arial photograph interpretation

Applications:

- Provides Basic knowledge of Geographical Information Systems

Module-2	**L3 & L4**	**12 Hrs.**

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 - Radargrammetry (SLAR / SAR) - LIDAR -Hyper spectral Remote Sensing: basic concepts

Laboratory Sessions/ Experimental learning:

- Analog to Digital Conversion – Scanning methods
- Digital database creation – Point features, Line features, Polygon features

Applications:

- Teaching knowledge of creation of different shape files

Module-3	L3 & L4	12 Hrs.

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

Laboratory Sessions/ Experimental learning:

- Data Editing-Removal of errors – Overshoot, Undershoot, Snapping
- Data Collection and Integration, Non-spatial data attachment working with tables

Applications:

- Provides knowledge on accesses of Digital image processing

Video link / Additional online information:

- https://nptel.ac.in/courses/105103193/

Module-4	L3 & L4	12 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)

Laboratory Sessions/ Experimental learning:

- Dissolving and Merging
- Clipping, Intersection and Union

Applications:

- Provides knowledge on accesses of Base Map Creation

Module-5	L3 & L4	12 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

Laboratory Sessions/ Experimental learning:

- Point Data collection using GPS with different datum
- Line data collection using GPS and measurements

Applications:

- Gives knowledge of incorporation of GPS and GIS

Video link / Additional online information:

- https://nptel.ac.in/courses/121107009/

Course outcomes:	
CO1	Collect data and delineate various elements from the satellite imagery using their spectral signature
CO2	Analyse different features of ground information to create raster or vector data.
CO3	Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines.
CO4	Perform digital classification and create different thematic maps for solving specific problems
CO5	Make decision based on the GIS analysis on thematic maps.

Reference Books:	
1.	Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
2.	John R. Jensen, "Remote sensing of the environment" , An earth resources perspective – 2nd edition – by Pearson Education 2007
3.	Anji Reddy M., "Remote sensing and Geographical information system", B.S. Publications 2008
4	Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004
5	S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005

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

High-3, Medium-2, Low-1

Course Title	**SUSTAINABILITY CONCEPTS IN ENGINEERING**	Semester	II
Course Code	MVJ19CSE262	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 00 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

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

Module-1	**L3**	**12 Hrs.**

Introduction: 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.

Applications:

- Knowledge of the scope of the subject.
- Knowledge about dynamics of sustainable systems.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

Module-2	**L3**	**14 Hrs.**

Global Environmental Issue: 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 foot print Carbon sequestration – Carbon capture and storage (CCS).

Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.

Laboratory Sessions/ Experimental learning:

- Pollution assessment tests for different areas and give remedies to control it.

Applications:

- Understanding the various environmental pollutions, its effects and how to overcome the global environmental issues.
- Getting an idea to improve urban infrastructure.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

Module-3	**L3**	**12Hrs.**

Sustainable Design:

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.

Laboratory Sessions/ Experimental learning:

- Conduct any sustainability event in the campus (ex: Technical talk, Documentary/film etc)

Applications:

- Knowledge about Sustainable design and green construction.
- Understanding the design of energy efficient building.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

Module-4	**L3 & L4**	**10Hrs.**

Clean Technology and Energy:

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

Laboratory Sessions/ Experimental learning:

- Industrial visit of any of the energy sources and make a report on it.

Applications:

- Understanding the various application of different energy sources

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

Module-5	**L3**	**12 Hrs.**

Green Engineering:

Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

Laboratory Sessions/ Experimental learning:

- Develop a sustainability project for a green campus

Applications:

- Understanding the concept of green engineering and how it is applicable for the sustainability in society.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

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

Reference Books:	
1.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2.	Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage Learning
3.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4.	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication,1998
5.	Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers
6.	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	-	-	-	3	1	1	-	1	-	-	1
CO2	3	-	-	-	1	1	-	-	2	1	1	-
CO3	1	2	3	1	-	1	-	-	-	-	-	1
CO4	3	1	1	1	2	-	-	-	1	-	-	-
CO5	1	1	1	-	-	1	-	-	3	-	-	1

High-3, Medium-2, Low-1

Course Title	**OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT**	Semester	II
Course Code	MVJ19CSE263	**CIE**	50
Total No. of Contact Hours	60 L: T: P: : 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

- To understand the concepts of global scenario of Health & safety.
- Students should be able to analyses and solve basic ergonomical 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	**L3**	**12 Hrs.**

Prerequisites: *Basic knowledge about various types of hazards*

Physical and Chemical Hazards: Recognition, Evaluation and Control of Physical Hazards- Noise and Vibration - Effects and Control

Measures- Thermal Stress - Parameter Control, Radiation - Types - Source - Effect and Control Illumination & Lighting. Recognition, Evaluation and Control of Chemical Hazards- Types - Dust- Fumes -Mist -Vapor-Fog etc., Air Contaminants- Evaluation - Types of Sampling-Air Sampling System-Method Analysis-Control Measures.

Laboratory Sessions/ Experimental learning:

- Measurement of Sound/Noise Level at Various Location and Compare it with Standard Values Permissible for Exposure.
- Determination of SPM and RSPM Present in Working Atmosphere during the Working Period with the help of Respirable Dust Sampler.
- Determination of SPM and Oxides of Sulphur and Nitrogen from the Stack/Chimney using Stack Monitoring kit.
- Determination of pH, TDS, Temperature, DO of water with the help of Multiparameter Monitoring Instrument

Applications:

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

- Documentation of report on SPM and RSPM present in air
- Preparation of water quality analysis report

Video link / Additional online information:

- Hazard terminologies, hazard identification, methods, risk determination, https://www.youtube.com/watch?v=JkTbfVkKGCI#action=share
- Hazard classification and assessment, evaluation, control, https://nptel.ac.in/courses/114106017/
- Hazard analysis necessity, hazard evaluation and control https://www.youtube.com/watch?v=WMPodFzWsSs

Module-2	**L3**	**12 Hrs.**

Prerequisites: *Basic idea about ergonomical issues*

Occupational Health: Concept and Spectrum of Health-Functional Units and Activities of Occupational Health Services-Occupational and Work-related Disease-Levels of Prevention of Diseases - Notifiable Occupational Diseases such as Silicosis- Asbestosis- Pneumoconiosis--Aluminosis and Anthrax. Lead-Nickel, Chromium and Manganese Toxicity-Gas Poisoning (such as CO, Ammonia, Coal Dust etc.,) their effects and Prevention- Cardio Pulmonary Resuscitation-Audiology-Hearing Conservation Programme-Effects of Ultra Violet Radiation and Infrared Radiation on Human Systems Industrial Toxicology-Local and Systemic and Chronic Effects Temporary and Cumulative Effects- Carcinogens Entry into Human System Ergonomics, Personnel Protective Equipment, Personnel Monitoring.

Laboratory Sessions/ Experimental learning:

- A study on analysis of occupational health hazards in a working place
- A study on health monitoring programs out in industries

Applications:

- Preparation of a detailed report on identification of occupational health issues of workers in a working place (manufacturing/service-based industries).
- Preparation of a detailed report on identification of occupational health issues of workers in a corporate sector

Video link / Additional online information**:**

- Occupational health, safety concern, integrity of the system, risk assessment, https://nptel.ac.in/courses/110105094/
- Risk assessment: process, identification, individual and societal,

https://www.youtube.com/watch?v=DxZ2rX0AtcM#action=share

- A manual for primary health care workers, occupational related diseases, disease detection, occupational ergonomics, accident prevention, psychological factors, effects, https://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf

Module-3	**L3**	**12 Hrs.**

Prerequisites: *Basic knowledge about ergonomical issues*

Personal Hygiene and First Aid: Hygiene Concepts-Correct and Clean Dresses-Clean Body - Washing - Good Habits-Oral and Stomach Hygiene-Cleaning - Compressed Air and Degreasing Agents-Long Hair and Nails and Torn and loosely Hanging Clothes-Smoking - Lavatories Maintenance- Living in Unhygienic Areas. First aid concept- -First Aid Boxes-Legal Requirements, Industrial Hygiene, Medical Surveillance, Medical Surveillance Program Development, Recommended Medical Programme, Emergency Treatment, Non-Emergency Treatment, Exposures to Hazardous Materials.

Laboratory Sessions/ Experimental learning:

- Demonstration and training on the usage of personal protective equipments, breathing apparatus, Emergency evacuation drill etc.
- First Aid training and demonstration

Applications:

- Documentation of the report on first aid training and demonstration
- Awareness program on the utilization of the facilities provided to maintain the health of workers in working places

Video link / Additional online information:

- Importance of first aid, injuries, fractures, poisoning, prevention of occupational diseases and accidents, health education, occupational health for women and children https://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf
- Safety assurance and assessment, Health, Safety and Environment (HSE), hazardous waste release procedure, hazard identification plan, organising safety, https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/114106039/lec9.pdf
- Human body health hygiene, safety and first aid, biology reaction, https://www.youtube.com/watch?v=MeQuR6N1YQ4
- Employee welfare, welfare measures inside the working place, workers health services https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/122105020/lec10.pdf

- First aid training, https://www.youtube.com/watch?v=qahukkDYFbk
- First aid - emergency medical services, injuries, first aid kit, https://www.youtube.com/watch?v=Q62UwEPPnrg

Module-4	**L3**	**12 Hrs.**

Prerequisites: *Importance and need of Fire & Safety*

Fire safety: Sources of Ignition- Principles of Fire Extinguishing, Various Classes of Fires, types of Fire Extinguishers, Fire Stoppers, Hydrant Pipes, Hoses, Monitors, Fire Watchers, Maintenance of Fire Trucks, Foam Generators, Escape from Fire, Rescue Operations, Fire Drills, Notice, First Aid for burns

Industrial fire Protection System , Sprinkler-Hydrants -Stand Pipes, Special Fire Suppression Systems (Deluge and Emulsifier), Selection Criteria of the above Installations, Reliability, Maintenance , Evaluation and Standards, Alarm and Detection Systems, Other Suppression Systems (CO2 System - Foam System , Dry Chemical Powder (DCP) System, Halon System), Need For Halon Replacement, Smoke Venting, Portable Extinguishers, Flammable Liquids, Tank Farms, Indices of Inflammability, Fire Fighting Systems

Fire Load, Fire Resistant Material and Fire Testing, Structural Fire Protection, Structural Integrity, Exits and Egress, Fire Certificates, Fire Safety requirements for high-rise Buildings

Laboratory Sessions/ Experimental learning:

- Laying out and Rolling of fire hoses, Priming of water from fire tenders using suction hose, static tank Hydrant fire drills, Site visit.
- Identification rehearsals of Portable extinguishers, Filling of DCP powder in Portable Extinguisher and wearing Protective clothing, Mock drills

Applications:

- A detailed report on classification of fire extinguishers
- Documentation on fire prevention solutions, fire detection systems, emergency lighting, means of escape for both onshore and offshore premises, and detailed individual evacuation plans.

Video link / Additional online information:

- Fire protection: basic concept, fire resistance, introduction of combustion process, https://nptel.ac.in/courses/105102176/
- Fire protection, services and maintenance, management of building, https://www.youtube.com/watch?v=n6HAyxdup_U#action=share

- Fire: Effect of enclosure, fire load, standard fire, fire resistance, https://www.youtube.com/watch?v=krnmHKZ87Wg#action=share
- Fire safety: urban planning, internal planning, occupancy, zoning, https://www.youtube.com/watch?v=eAKTwc3_ixE#action=share
- Fire safety: escape and refuge, planning, exit, https://www.youtube.com/watch?v=O6CYQt9vi_Y#action=share
- Fire safety: Internal planning, detection and suppression, flame spread, http://www.youtube.com/watch?v=e3Orj5XDj2M#action=share

Module-5	**L3**	**12 Hrs.**

Prerequisites: *Basic Knowledge of Industrial Safety*

Safety Policies, OSHAS and Radiation control: Importance of Safety, health and environment. Health safety and environmental policy, fundamentals of safety, classification of accidents, Managements responsibility, objectives of safety management, National safety council, Employees state insurance act 1948, approaches to prevent accidents, principles of safety management, safety organization, safety auditing, maintenance of safety, measurements of safety performance, industrial noise and noise control, Industrial Psychology, Industrial accidents and prevention. Introduction to OSHAS 18001 AND OSHA.

Radiation Shielding - Radiation Dose - Dose Measurements - Units of Exposure- Exposure Limits- Barriers for Control of Radioactivity Release, Control of Radiation Exposure to Plant Personnel, Health Physics Surveillance - Waste Management and Disposal Practices – Environmental, Releases.

Laboratory Sessions/ Experimental learning:

- 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.
- Detailed report on OSHAS certification

Video link / Additional online information:

- OSHAS laboratory safety guidance: Types of hazards, safety hazards, laboratory standards, https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf
- OSHAS 18001: Integrity:- machines, processes, human system, example of an heat metal

transfer, safety and health philosophy of an organization, https://nptel.ac.in/courses/110105094/

- OSHAS 18001: Part I lecture, https://www.youtube.com/watch?v=Rr-xFmErOTk#action=share
- OSHAS 18001: Part II lecture, safety and health philosophy, of an organization, https://www.youtube.com/watch?v=n7oUOUCIblg#action=share
- OSHAS 18001: Part III lecture, case-study of a steel plant, behavioral safety and process safety, https://www.youtube.com/watch?v=8GmIoIlsJ7w#action=share

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

Reference Books:	
1.	Risk assessment- A Practical Guide, 1993, Institution of Occupational Safety and Health, United Kingdom
2.	Hand Book Of Fire Technology By: R.S. Gupta, Orient Longman Publishers, Second Edition, 2005
3.	Hand Book Of Fire And Explosion Protection Engineering By: Dennis P Nolan, Crest Publishing House, First Edition, 2007
4.	Fire Protection And PreventionBy: Brendra Mohan San, Publishers: UBS Publishers & Distributors Pvt Ltd., Edition: First Edition, Year of Publication: 2008
5.	Industrial safety management By: L.M. Deshmukh, Publishers: Tata Megraw Hill ,New Delhi, Year: 2006,First Edition
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

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	**STRUCTURAL SOFTWARE LAB-2**	Semester	II
Course Code	MVJ19CSEL27	**CIE**	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	**SEE**	50
No. of Contact Hours/Week	4	**Total**	100
Credits	2	**Exam Duration**	3Hrs

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

- Learn the application of ETABS in Dynamic Analysis.
- Learn the application of ANSYS in Structural analysis problems
- Learn the application of FEM

SL.NO	**Experiments**	**L4, L5, L6**
1	Conducting Seismic analysis of multi-storied buildings using ETABS.	
2	Demonstration to ANSYS and its application in various analysis problems.	

Video link / Additional online information:

- https://www.youtube.com/watch?v=k2rAFEUNrTc
- https://www.youtube.com/watch?v=LOtuwW9-G68

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

CO1	Understand the general considerations of analysis.
CO2	Achieve Knowledge application of ETABS.
CO3	Understand the principles FEM
CO4	Achieve Knowledge application of ANSYS.

Reference Books:

1. Mukhopadhaya M , "structural dynamics Vibrations" Oxford IBH, 2nd Edition 2014.
2. Mario Paz "Structural Dynamics" CBS publishers,5th Edition 2004
3. Timoshenko S, Van-Nostrand "Vibration Problems in Engineering" C, 5th Edition 2006

CO-PO Mapping

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

High-3, Medium-2, Low-1